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Community inhabitants' values and benefits in dynamic tropical forest landscapes

Participation and spatial analysis in landscape knowledge integration

by
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Contents

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1. Introduction

Global land cover estimates show an overall decline and degradation in the Earth's forest resources especially in the tropical regions in South America and Africa (FAO 2010). Particularly, in the sub-Saharan Africa, land use changes are rapid, as nearly 3.4 million hectares of forest and natural vegetation are lost each year due to expansion of agricultural area, logging and other human-related factors (Lambin et al. 2001; Brink & Eva 2008; Paré et al. 2008; FAO 2010). These changes lead to an increased pressure on the available resources and, hence, compromise the livelihood of the local people. In addition, the threat to the biodiversity and the reduced role of the tropical forests in mitigating climate change are significant (UNEP 2007). As most of the problems in the sustainable management of natural resources are confronted in the interface between people and the environment, the solutions lie in the actions of people and the ways they value and use the land. To tackle the alarming forest development, in parallel with global or continent scale estimations (Lambin et al. 1999; Latham et al. 2002; FAO 2010; FAO 2011), information about the past and present landscape dynamics and the variety of landscape functions and services to people is needed in spatial form and at a detailed level. To make better decisions on forest policies and land uses at the regional or local levels, it would be essential to understand the interlinked socio-ecological processes causing landscape change and leading to forest transitions at local levels (Lambin & Meyfroidt 2010). This requires also participation of local stakeholders.

Landscapes can be seen as complex social-ecological systems where the present form is the result of the past development (Naveh & Lieberman 1990; Zonneveld & Forman 1990; Zonneveld 1995; Berkes et al. 2003; Wu & Hobbs 2007). As a system, landscape is considered as a whole, as an entity of human-nature relations (Naveh & Lieberman 1990; Antrop 2009). Landscapes change and evolve continuously, reflecting the ongoing and past interactions of nature and human induced phenomena. Indeed, in most parts of the world, physical landscape patterns are shaped by human action, and the majority of landscapes are thus cultural in character, showing significant hu-

man influence. Human-nature interaction leads to multiple land uses as well as a diversity of perceptions and values attached to the landscape (Tuan 1974, 1977; Relph 1976; Zube 1987; Williams & Patterson 1996; Stephenson 2008). Hence, the landscape concept as a framework for research and sustainable environmental management has been identified widely (Naveh & Lieberman 1990; Luz 2000; Naveh 2001; Tress and Tress 2001; Antrop 2005, 2006; Potschin & Haines-Young 2006; Selman 2006; Stephenson 2008; Termorshuizen & Opdam 2009). It is seen to have potential to serve the practical needs and political decision-making in the society and to prevent inappropriate landscape development.

Information about landscape change is considered essential for landscape monitoring, planning and management, which all aim to build future land use plans on the past and present development on land (Marcucci 2000; Antrop 2005; Marignani et al. 2008). Land cover and land use patterns can be quite effectively studied with spatial data sets, such as aerial photographs, satellite images and historical maps (e.g. Vuorela 2001; Lambin et al. 2003; Pontius et al. 2004; Käyhkö & Skånes 2006; Hartter et al. 2008). Technical development and GIS (Geographical Information Systems) have offered increasing possibilities for the combined use of these data sets, for the analysis and visualisation of human and natural patterns and processes in the landscape. However, there seems to be an obvious gap in linking landscape change processes to local actors and stakeholders (Termorshuizen and Opdam 2009).

Only through stakeholder involvement is it possible to cater for the real users of a specific area; those people who possess local knowledge accumulated through environmental experience and related to specific places (Tuan 1974, 1977; Relph 1976; Pickles 1985; Williams & Patterson 1996; McCall 2003; Stephenson 2008). In the context of sustainable development, comprising of the environmental, social, cultural and economic domains and their interdependent nature, management of the multifunctional landscapes requires spatially targeted practices based on local level participation (Norton 2005; Raquez & Lambin 2006; Mander et al. 2007). Participatory methodologies and approaches in development practice have been in accelerating use since the 1970s as efforts for stakeholder involvement and empowerment (Chambers 2008; Reed 2008). After introducing the concept of sustainable development in the United Nations World Commission on Environment and Development report *Our Common Future* (WCED 1987), the focus of environmental management on stakeholder participation has gained even stronger ground and become the cornerstone of development policy. This participative turn has also been evident during the recent decades within geography and development theory and practice (Chambers 2008; Kindon et al. 2010).

Land management challenges are typical examples where participation of the local level stakeholders, such as community inhabitants, is needed in a spatial form (Williams & Patterson 1996; Luz 2000). Recently, the use of and values and benefits attached to the land have started to gain wide interest in the context of the geographical analysis of landscapes (Brown et al. 2002; Brown et al. 2004; Brown 2005; Black & Liljeblad 2006; Kyttä & Kahila 2006; Tyrväinen et al. 2007; Chambers 2008; Bryan

2010; Raymond et al. 2009; Kyttä et al. 2011; Sherrouse et al. 2011). It has been inspired by the enthusiasm concerning pursuing participation through the use of GIS and to complement the material and visual landscape analysis. However, it has been argued that in the current landscape management efforts far too little emphasis is still given to the expertise of the local communities in relation to, for example, patterns and qualities of vegetation, soils, species and land cover based on disciplinary expertise (Williams & Patterson 1996; Brown et al. 2004). In many developing countries, for example in Tanzania, spatial information describing the multiple land uses as well as the diversity of perceptions and values attached to the landscape by local communities are not included in the resource management processes (MANR 2011). Thus, there is a need to develop spatially explicit landscape assessment methodologies for stakeholder involvement, which is realised on local scales.

Furthermore, when landscape is understood as a geographical space consisting of the heterogeneous places with different physical-material conditions and human uses and values reflecting the past development, then landscape assessment should integrate the multiple data sources derived from the disciplinary expert and local stakeholder knowledge. At the theoretical-methodological level, there is a desire towards integrated approaches within landscape research. These aim to bridge the epistemological gap between the natural and human or social science derived methodologies to develop methods that truly appreciate the different ways of knowing the landscape (Naveh & Lieberman 1990; Luz 2000; Naveh 2001; Tress and Tress 2001; Antrop 2005, 2006; Potschin & Haines-Young 2006; Selman 2006; Stephenson 2008; Termorshuizen & Opdam 2009). Such integrated approach seeking sustainable holistic solutions to landscape management creates a valuable contribution to practical landscape planning needs. Emphasising participation, it promotes the transdisciplinary elements in landscape management (Fry et al. 2007) and leads likely to more robust decisions (Reed 2008). Examples of integrated frameworks include the ecosystem or landscape service framework highlighting the implications of ecosystem change and degradation to human well-being and, hence, the need for integrated landscape level management and conservation (MA 2003; de Groot et al. 2010; Burkhard et al. 2012). In addition, landscape characterisation and assessment can be considered as an attractive answer to the need to create integrated place-based data of both nature and human induced phenomena (Swanwick 2002; Antrop 2003).

In this research, these above-discussed challenges are addressed in the context of Zanzibar, Tanzania. The Zanzibar Islands on the eastern coast of Tanzania represent typical multifunctional landscapes encountered in many developing regions globally. The rural village environment in Zanzibar is tempting for the study of the community inhabitants' landscape values and benefits together with dynamic land cover and land use patterns for several reasons. Firstly, the rural communities in Zanzibar are to large extent subsistence-based, and forests resources have always been offering multiple tangible and intangible benefits for the people, on which they are dependent on in their daily life (Sitari 2005; Tamrini 2009). The tropical forests sustain also a high biodiversity and have

global significance in mitigating climate change (Kombo & Kitwana 1997; Burgess & Clarke 2000; UNEP 2007; FAO 2010). However, land and resources are under severe pressures, for example, due to cultivation, wood collection, extraction of resources and new emerging land uses such as tourism (ZFDP 1997; DCCFF 2008; Tamrini 2009). Secondly, in Zanzibar and in developing countries in particular, environmental decision-making is often limited by restricted information and especially restricted information about the socio-cultural values, which are known to greatly contribute to successful landscape management (Termorshuizen & Opdam 2009). A common situation in many of the developing countries is that operative approaches depicting the interlinked socio-ecological relationships that could provide a solid basis for future decision-making in land use and forest planning processes are often lacking (Bocco et al. 2001; Duvail et al. 2006; Valencia-Sandoval et al. 2010; Bourgoin et al. 2012).

Additionally, existing research collaboration contributed to the selection of the research context. This work has been conducted within the University of Turku Zanzibar research team in well-established collaboration since 2003 with the Department of Forestry and Non-Renewable Natural Resources (DFNR) in Zanzibar (prior to 2011, the Department of Commercial, Crops, Fruits and Forestry, DCCFF) and the Department of Geography at the University of Dar es Salaam in Tanzania (see Sitari 2005; Käyhkö et al. 2008).

The present research focuses on understanding landscape as a social-ecological system. For a geographer, the understanding of the nature and human induced phenomena in spatial context is inherent through the holistic nature of the discipline. My dissertation contributes to understanding the local subsistence-based communities' values and benefits in dynamic tropical forest landscapes and provides a methodological contribution to such research. It also discusses the potential of participatory approach and integrated spatial perspective to create improved premises for landscape planning and management. The applied relevance of the work is realised within the local communities and forest administration in Zanzibar. Thus, it operates as a rationale for the mixed methods research design, i.e. for the integration of different philosophical-theoretical assumptions, approaches of inquiry and multiple methods of data collection and analysis (Tashakkori & Teddlie 2003; Creswell 2009). The research is realised at the local level in two different study sites representing rural Zanzibari communities. The main objectives of this research are:

1. To understand how tropical forest landscapes and their spatial patterns, as indicated by land cover and land use, change over time.
2. To understand the values and benefits that local community stakeholders attach spatially to this landscape.
3. To develop methods for integrating expert and local knowledge of landscapes through spatial analysis and participation.
4. To discusses the potential of participation and integrated spatially explicit knowledge to benefit spatial planning and landscape management in Zanzibar and in the tropical developing regions in general.

Reflecting these objectives, the five constituent articles in my dissertation explore the following themes:

To respond to the first objective, in papers **I** and **IV**, land cover and land use (LC/LU) mapping with change detection analysis is presented for the two Zanzibari study sites. This is realised through the combined use of retrospective spatial data depicting the objective material reality shaped by humans and nature through time. The analyses aim to identify the landscape dynamics over the last 50–70 years in relation to the key traditional and new land uses which drive forest development at the local level.

In papers **II** and **III**, the focus is on the second objective of creating place-based local knowledge through capturing the diversity of the subjective everyday landscape practices and experiences. Methods for participatory mapping, description and spatial analysis of community inhabitants' values and benefits attached to the landscape are explored in the two communities in Zanzibar. The theoretical concepts of social landscape value and landscape service indicator are applied to develop typologies for mapping the material and non-material, cultural landscape values and benefits.

The third objective follows from the first two with the aim to suggest methods for an integrated analysis. The expert and community knowledge are integrated in a GIS environment in papers **III**, **IV** and **V**. Furthermore, in paper **V** a landscape characterisation is suggested as a spatial approach for knowledge integration to enhance spatial argumentation about the complex human-nature interactions in landscapes. The last objective flows through the entire research and brings together the discussions of each paper to consider the potential relevance of place-based local and expert knowledge for sustainability of multifunctional tropical forest landscapes.

In the following section, I shall introduce the theoretical, conceptual and methodological framework of the research in more depth. This is followed by a presentation of the research context and study area, data sources, data collection and methods of analysis. Then, the main findings are presented together with a discussion. I also consider it essential to discuss the methodological aspects of the research and ethical issues related to participatory mapping, which were only briefly referred to in the accompanying articles. Finally, the main conclusions are derived.

2. Theoretical, conceptual and methodological framework

2.1 Holistic landscape concept

The definitions for the concept landscape are multiple and ambiguous. On one hand, they describe the informal vernacular understanding of landscape in everyday language, usually referring either to land or region and stressing the territorial aspects or to a view, scenery or picture laying emphasis on the visuality (Keisteri 1990; Olwig 1996; Lorzing 2001). On the other hand, there are diverging, often opposed and competing, scientific conceptualisations within which the nature of landscape is understood as an ecological entity, a way of seeing, a metaphor, an artistic work, ideology, material culture, an agent of power relations, or as a subjective experience among others, including an extensive list of disciplines such as ecology, history, archaeology, geography, landscape architecture, sociology, anthropology, psychology, and art history (Farina 2006; Wylie 2007; Daniels et al. 2011).

Within the discipline of geography, the notion of landscape is one of the key ideas (Wylie 2007: 12), and the description and explanation of landscapes has an extensive tradition. Landscape has been approached from various directions, since different conceptual understandings of landscape have inspired different types of research and writing. The two main fields of research can in broad terms be identified as landscape ecology, also identified as the ecological branch of landscape geography, and culturally oriented landscape studies practised within human geography. Landscape ecology puts forward systematic and analytic landscape research based on the measurement of the material landscape patterns and processes through changing spatial and temporal scales (Forman & Godron 1986; Naveh & Lieberman 1990; Zonneveld & Forman 1990; Zonneveld 1995; Farina 2006; Hobbs & Wu 2007; Wiens et al. 2007). Within human geography, landscape has been approached in several ways. Adopted within the new cultural geographies of the 1980s, landscape has been understood as a way of seeing, as a visual representation or metaphor of cultural meanings with emphasis on critical

interpretation and symbolisation of social and cultural formations (e.g. Cosgrove & Daniels 1988; Duncan & Duncan 1988; Rose 1993; Raivio 1996). Emerging from these discussions, the material aspects and critical examination of power, subjectivity, representation and visuality in the production of landscapes followed under the post-structural view (e.g. Olwig 1996; Mitchell 1995, 1996). A somewhat different landscape approach was developed from the humanistic geographies of the 1970s, deriving from phenomenology and the subjective experience of landscape (e.g. Relph 1976; Tuan 1974, 1977; Pickles 1985; Buttimer and Seamon 1980). Recently, for instance, a turn to embodiment, practice and performance shaping the landscape has been seen under the non-representational theory (Cloke & Jones 2001; Wylie 2002).

As depicted for instance by O. Granö (2003: 32) and Antrop (2006), landscape today is frequently understood in a holistic sense by geographers. The main differences in theoretical thinking are often represented as conceiving landscape as material and visual or as mental and perceivable (see e.g. Keisteri 1990; Jones 1991; Palang & Fry 2003: 3). However, I consider this dualistic understanding to be somewhat problematic and, hence, refer to Wylie (2011), who suggests three major understandings of landscape within geography: (1) landscape as an objective material record shaped by interacting human and natural forces, (2) landscape as a way of seeing, i.e. a representation, often visual image or painting, enshrining particular ideas about culture, nature and organisation of human societies, and (3) landscape as dwelling intertwining the duality of the previous two approaches and appreciating the subjective human experience and everyday practice in the landscape. The differences in theoretical thinking are reflected in the adoption of natural science and human or social science derived methodologies for the study of landscapes.

In the following chapters, I will mediate how the conception of landscape used in this work has been drawn and developed from the diverging schools of thought within landscape studies, particularly those of landscape ecology and landscape phenomenology (Figure 1). In the context of my research, the landscape concept derives from and aims to bridge the divide between these diverging notions. The reflectance of the theoretical underpinnings and the elaborated landscape conceptualisation in the following chapters provide the intellectual framework upon which this work is resting.

2.2 Landscape as objective material reality

The concept of landscape was introduced into scientific usage by the German physical geographer Alexander von Humboldt in the early 19th century (Naveh & Liebermann 1990: 4). He defined landscape (*Landschaft*) as 'der Totalcharakter der Erdgegend' – the total character of a region of the Earth, which was considered to consist of the physical features and studied by exact measurement. However, von Humboldt also regarded landscape as a perceived image providing aesthetic experiences but did not include perception or aesthetics in his analysis as such (Antrop 2006). The Humboldtian concept of landscape was adopted in the influential paper of the American geographer Carl

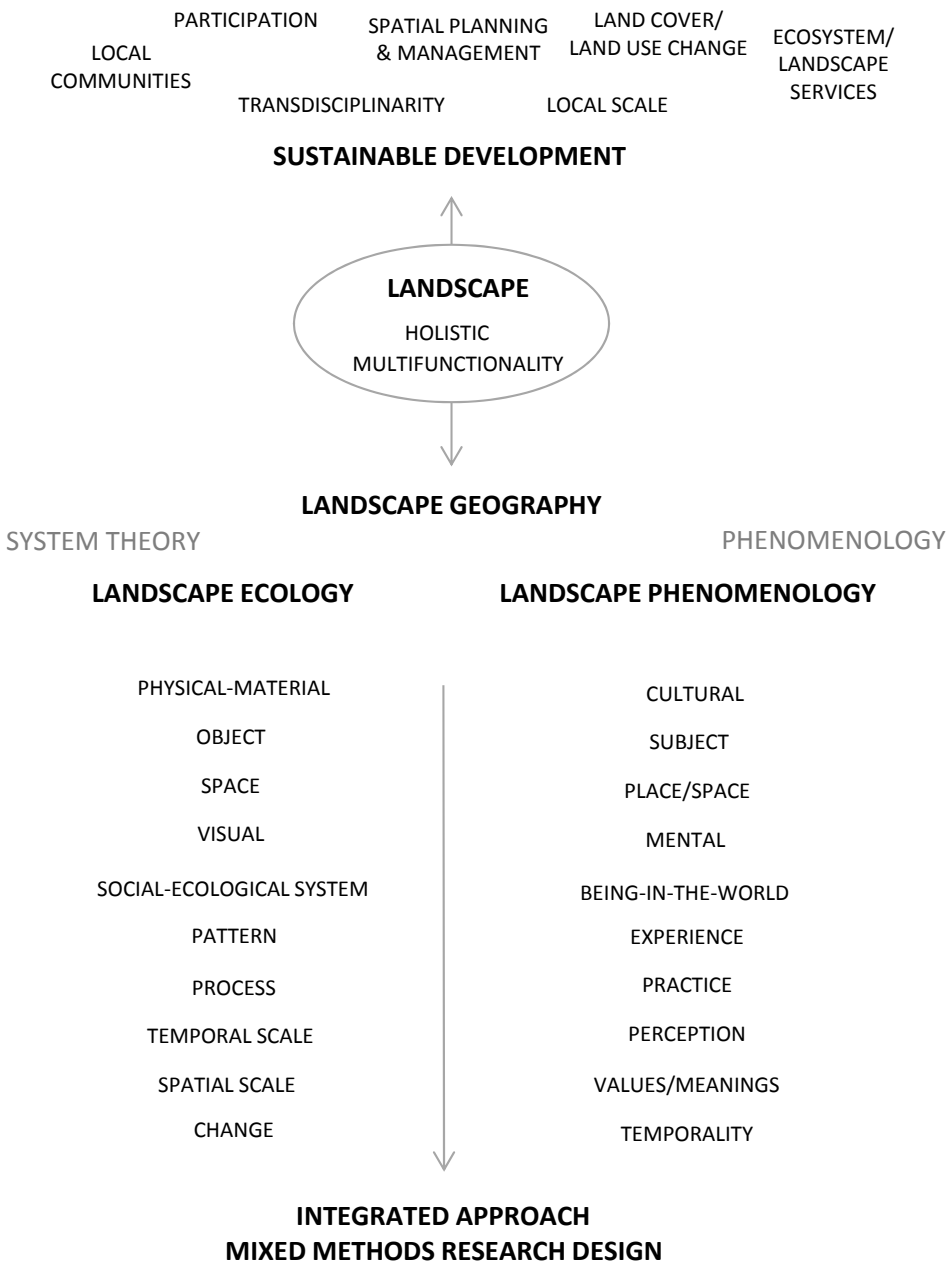

Figure 1. Framework for the integrated landscape conceptualisation used in the research.

Sauer *The Morphology of Landscape* (1925), in which landscape was defined as a material reality of objects and the patterns they form to be studied scientifically through observation and empirical fieldwork experience. The Sauerian approach, also practised by his colleagues and students, the 'Berkeley School', between the 1920s and 1970s sought to describe the interrelations between humans and the environment and to see

landscape as a human crafted cultural entity (Wylie 2007: 27). It was understood that, within the medium of natural landscape, the local culture produced the characteristics of cultural landscapes through time (Wiens et al. 2007: 7). In fact, the term cultural landscape was introduced to English speaking academic literature through Sauer's work and has become a central notion in geography and environmental management (Jones 2003: 21). Culture was given an explanatory power. Later on, the approach has, however, been criticised of masking social, political and economic relationships and lacking ability to explain landscape instead of description (Wylie 2007: 28–29). In the Finnish-Estonian context, the work of the geographer J.G. Granö has had a notable influence on the systematic study of landscape and the development of related vocabulary, which paralleled the ideas of von Humboldt and Sauer. For Granö, evident in his work *Pure Geography* (Granö 1929, 1930, 1997), landscape was an entity perceived by the human senses, but the observed causally linked phenomena in the spatial reality were to be analysed by the methods of natural sciences (O. Granö 2003: 26).

The above-mentioned notions have had an influence on the concept of landscape as understood within landscape ecological research established during the 20th century, particularly in the latter half of it. Linking the geographical and biological approaches, landscape is understood within landscape ecology as 'a complex of relationship systems, together forming (also by virtue of its physiognomy [i.e. image/scenery]) a recognizable part of the Earth's surface, and is formed and maintained by the mutual action of abiotic and biotic forces as well as human action' (Zonneveld 1995: 4). The origin of landscape ecology can be traced to the 1930s and the German biogeographer Carl Troll, who found inspiring the capabilities of aerial images in depicting patterns in units of land (Zonneveld & Forman 1990: 7). Troll's paper from 1950 (Troll 1950), where he made the essential link between geography and the ecosystem concept introduced by Tansley (1935), has been considered as the theoretical foundation of landscape ecology (Wiens et al. 2007: 8). Landscape ecology promotes a spatially explicit perspective on the relationships between the ecological patterns and processes that can be applied across a range of spatial and temporal scales (Wiens et al. 2007). It enhances a spatial perspective to resource management, conservation and planning. The geographical approach with interest in horizontal spatial patterns and human-nature relationships is linked to ecological approach with interest in vertical functions and species-environment interactions (Naveh & Lieberman 1990: 9; Vuorela 2001). Within landscape ecological framework, Neef (1967, cit. Zonneveld 1995: 1) suggest that landscape could be identified as three spatial dimensions. These express vertical and horizontal direction and temporal variation, and are named as topological, geospherical and chorological. In other words, in landscape ecological thinking landscape is seen as a material quantifiable object, which is to be studied as an entity made up of the different structured elements, all influencing each other and creating a constant change in the landscape (Forman & Godron 1986; Zonneveld & Forman 1990). A rather strong linkage in landscape ecology can also be seen to human perception and visual interpretation of landscapes (Nassauer 1995).

Systems approach is a particular feature of the landscape conceptualisation in landscape ecological research. Landscapes are considered as complex social-ecological systems, coupled by relations of direct mutual influences between the elements in this system (Naveh & Lieberman 1990; Zonneveld & Forman 1990; Zonneveld 1995; Berkes et al. 2003; Wu & Hobbs 2007). The present form is a result of the continuous change, of the dynamic development (Zonneveld & Forman 1990; Berkes et al. 2003). As a system, landscape is seen as a whole, an entity of human-nature relations, which is structured hierarchically in subwholes (Naveh & Lieberman 1990; Antrop 2006). This holistic principle, continuous change and systems perspective are considered to provide the philosophical and operational framework for landscape ecological studies (Zonneveld & Forman 1990: 1). The need to consider humans as participants in the study of the landscape systems has been supported, in particular, by Zev Naveh (1988, 2001). In the recent landscape ecological studies, this transdisciplinary conception has gained an increasing support (Tress et al. 2006b; Hobbs & Wu 2007) together with the understanding of landscapes as multifunctional entities providing and supporting a bundle of ecosystem services contributing to human well-being (Mander et al. 2007). The conceptualisation of landscape applied in my research shares features with the landscape ecological thinking. Landscapes can be conceived as social-ecological systems that can be mapped and measured in a factual manner to study the complex mosaic created by the dynamic land cover and land use patterns shaped over time.

2.3 Landscape as subjective practice and experience

Within the landscape studies in human geography, my notion of landscape has been influenced by landscape phenomenology. Phenomenology developed as a tradition of continental philosophy from the late 19th to early 20th century originated in the writings of Franz Brentano and Edmund Husserl. The branch of existential phenomenology, associated with the works of Martin Heidegger and Maurice Merleau-Ponty, was adopted to the humanistic geographies in the 1970s. Landscape phenomenology can be seen to derive inspiration from the Sauerian landscape tradition and criticising the idea that landscape can be regarded as a blank bedrock onto which cultural meanings are projected (Wylie 2007: 13, 154). In landscape phenomenology, it is also pointed out that landscape is not a picture in imagination as suggested by some scholars interpreting landscapes as a way of seeing or as a metaphor (e.g. Cosgrove & Daniels 1988; Duncan & Duncan 1988; Raivio 1996). Instead, the subjective experience of and the direct bodily contact (practice) with the landscape, being-in-the-world, are stressed leading to interpretive modes of inquiry (Wylie 2003: 139; Thompson 2009: 207). The Cartesian dualities, such as mind/body, subject/object and nature/culture, influential on the Western thinking and science in general, were seen as problematic to truthfully describe the lived human experience. Maurice Merleau-Ponty uses the term intertwining; observer and observed are always enlaced. He applies the example of one hand touching the other, the roles are indistinguishable and the separation of the subject and

object are rejected (Merleau-Ponty 1968 [1961]: 133–134). In Heidegger's view, we as humans are embedded in the surrounding world operating practically within it. It is the disruption of this everyday practical space, which opens up the space of objects (Heidegger 2004 [1962]; Joronen 2010: 71–72). For instance, a chair can be used for sitting as an equipment ready-to-hand but when sitting is disturbed (e.g. the chair is broken), the chair opens up as an object present-at-hand. This described relationship between humans and the environment is also evident in relation to landscape. Thus, in addition to the objective material reality, landscape is constituted through everyday experiences and bodily practices.

Concepts of space and place are also relevant to the notion of landscape in this context. As pointed out in the early forms of geographical phenomenology of the 1970s, places have the primary ontological significance as centres of bodily activity, experience and emotional attachment, and defined through comparison to space, as the abstract space derives its meaning from particular places (Relph 1976; Tuan 1977). Hence, space becomes a humanised and enclosed place filled with meaning and values through the cumulative perceptual experience and the act of moving (Tuan 1974, 1977). This feeling of 'insideness' increases the place identity (Relph 1976: 49). Considering this relation between space and place, it has been argued that the geographers' attention should be placed on the spatiality of human existence (Pickles 1985; Schatzki 2007).

Interest to phenomenological inquiry is reflected, for instance, in the edited collections of Meinig (1979) and Buttimer and Seamon (1980) and by Karjalainen (1987), and the re-emergence of the phenomenological approaches within landscape research has been attached, for example, to Tilley (1994), Ingold (1993, 2000) and Cloke and Jones (2001). Archaeologist Christopher Tilley (1994: 15) points out that 'geographical experience begins in places, reaches out to others through spaces, and creates landscapes or regions for human existence'. In the view of cultural anthropologist Tim Ingold (1993), based on the 'dwelling perspective' adopted from Martin Heidegger (2004 [1971]), the observational field sciences, concentrating only on the material and quantifiable landscape or the cultural interpretation of landscape as a way of seeing, miss the point of view landscape's inhabitants. This view outlines a central argument important in my conceptualisation of landscape. Ingold (1993) sees that there is an ongoing togetherness of beings and things which make up landscape and place, bind together nature and culture over time. He argues that landscape is not nature, a natural external backdrop to human activities, nor is it space, a particular cognitive or symbolic ordering of space. He claims that landscape is qualitative and heterogeneous with an inherent temporal dimension: 'it is what you see all around: a contoured and textured surface replete with diverse objects...and through living in it, the landscape becomes part of us' (Ingold 1993: 154).

Han Lorzing, a landscape planner and designer, shares same ideas and writes that 'landscape is not merely a piece of real world, it is also a creation of human mind', referred to as mindscape (Lorzing 2001: 49). Inherently, then, different people comprehend landscapes in different ways. As a consequence, cultural values, attitudes and

ideologies have an effect on how we see, perceive and experience landscape, how we act in it and how the material reality is constructed. Geographer Janet Stephenson (2010: 301) uses the terms 'insiders' (those for whom landscape is a lived experience) and 'outsiders' (those who perceive it as an external realm) to describe the different ways in which landscape is perceived and the space-place duality evident in landscape conceptualisation. She calls the insiders' perspective, founded in personal experience and knowledge of a place and arising from the bodily engagement and awareness of the past, as the 'embedded' landscape (Stephenson 2008, 2010). In phenomenological sense and referring to Tuan, the embedded landscape with tangible and especially intangible values describes the insiders' lived-in experience, and contributes to the sense of belonging (Stephenson 2008). Hence, the insiders' subjective perspective captures the meaningful places in the landscape, instead of objective spaces. However, people may have a different level of attachment to a landscape (Williams & Stewart 1998). For instance, among people living in a close relationship with forests, the everyday experiences of different places have gradually evolved into various practices, values and meanings attached to these forests. For tourists, on the other hand, this bond to the landscape is presumably not as strong although they also might attach some local meanings to the landscape. Altogether, landscape experience and perception as I conceive it here, differs from that applied in environmental psychology and behavioural geography, where emphasis is generally placed on sensory experience and cognitive processes mediating the relationship between the environment and spatial behaviour (see e.g. Ittelson 1973; Craik & Zube 1976; Dows & Stea 1977; Morin 2009).

The dominant modes of understanding the depth and richness of landscape practices and experiences has been through qualitative research. However, the subjective place meanings have started to gain interest within the practical landscape management bound to the geographical context. Williams and Patterson (1996) were among the early researchers to address the relevance of mapping these landscape meanings through participation. They considered the geography of place to be essential in the context of natural resource management, which had shifted to stress the ecosystem view when pursuing sustainable development. Sharing this understanding, I regard participatory mapping as a useful strategy to bring the everyday human practice in and experience of the landscape to spatial context, while acknowledging the underlying phenomenological concern of the experiencing subject.

2.4 Landscape as integrated conceptualisation

Lately, an interest within geography and related disciplines has been towards an integrated and multifunctional view of landscape when the concern lies in sustainable landscape development and practical management needs (Nassauer 1995; Williams & Patterson 1996; Palang et al. 2000; Naveh 2001; Wu & Hobbs 2002; Fry 2001; Brandt & Vejre 2003; Antrop 2006; Potschin & Haines-Yong 2006; Reed 2008; Termorshuizen & Opdam 2009; Stephenson 2010; Bolliger et al. 2011). The phenomenological

approaches have been criticised of lacking practical relevance, as the researcher should be able to sense and experience the landscape from the perspective of another human being (Soini 2007: 40; Wylie 2007: 148). In landscape ecological approaches, on the other hand, the focus is on the biophysical pattern-process dynamics in the landscape where land cover and land use, soils, species, etc. are studied in detail. This often lacks the expertise of local stakeholders and dismisses the appreciation of the subjective ways of knowing and shaping the landscape (Luz 2000; Matthews & Selman 2006; Potshin & Haines-Yong 2006; Kienast et al. 2007; Stephenson 2010). There is a call for research and methodological development that integrates landscape ecology and landscape studies (Termorshuizen & Opdam 2009). Furthermore, within landscape ecological research, the integration of ecological, social, cultural, economic, and aesthetic components together with new methodological developments and holistic approaches are listed among the key topics of research (Hobbs & Wu 2007: 5–6). This endeavour requires also at the theoretical level attempts to an integrated conceptualisation of landscape.

Linking the diverging knowledge systems of natural and human science approaches in studying landscapes is identified as a challenging process. It goes into the level of ontological issues (Pickles 1995), but the development of new theoretical insights in landscape research is a necessity (Palang & Fry 2003). An interesting development towards an integrated landscape theory and methodology, which I consider to have relevance to my work, has been offered by Tress and Tress (2001), Stephenson (2008) and Lorzing (2001). Integrated frameworks have also been suggested by Soini (2001) and Terkenli (2001). Grounding on the landscape ecological discussions, geographers Bärbel and Gunther Tress (2001) have developed a transdisciplinary landscape concept, which unites five existing dimensions of landscape together. It is based on their understanding of landscape as neither a solely objective nor a purely subjective reality but the both simultaneously and integrates the physical-material and cognitive systems aiming to bridge the gap between human and natural sciences. The first three dimensions include considering landscape as an intertwined entity of spatial and mental realities and their temporal dimension. The fourth dimension consists of understanding landscape as a complimentary nexus of nature and culture. Considering landscape as a hierarchically ordered complex system of geo-, bio- and noosphere, which should be studied as a whole, is the last dimension. An important aspect of the approach is the dual role of people. We are not only part of the physical-material reality and influence landscape but the landscape also becomes part of us through our thought and mental reflection.

Secondly, stemming from the landscape phenomenological discussions, Stephenson (2008, 2010) suggests an integrated holistic framework, the Cultural Values Model, which conceptualises landscape values-as-a-whole. Based on a grounded perspective and community interviews, the three interwoven components in the model are determined through the study of insiders' cultural values in landscape. The fundamental components of landscape are identified as forms, practices and relationships, which are in dynamic interaction and occur through time in the sense of the systems approach. The

model is suggested to offer an explicit way of approaching the subjective, intangible landscape values alongside the well-established methods of identifying and measuring the tangible landscape. As a third example, Lorzing (2001: 48) sees landscape as four layers of interaction between humans and nature, i.e. man and landscape. These layers include intervention (how humans make and modify, directly influence, the landscape), knowledge (what we know about a place as factual information), perception (how we subjectively see, hear, smell and feel the landscape), and interpretation (emotional landscape, how we feel and what we believe in the landscape). The identified layers of interaction depict how we humans influence landscape and, vice versa, how the landscape influences us. The two-way relationship, similar to the notion of landscape by Tress and Tress, suggests an understanding of the landscape as a human-nature entity.

These three integrated landscape conceptualisations discussed here seek to understand the relationships and interactions between the material and experienced or mental landscape in different theoretical ways. Worth of pointing out is that Stephenson is the only one to truly address and emphasise the significant aspect of stakeholder participation to create the true understanding of landscape values-as-a-whole. The Cultural Values Model as a conceptual framework includes both the perceptions founded in disciplinary expert methodologies and the rich and dynamic landscape experience and valuation of the stakeholders, the insiders. Common to the three presented approaches, although Lorzing does not specifically identify this in his writing, is that they suggest a framework under which the different ways of knowing the landscape are brought together on equal basis bridging natural, human and social sciences. They do not require all landscape information to be derived from the same philosophical-theoretical assumptions and, hence, promote the application of methods from different academic traditions in order to potentially establish a new inclusive knowledge space and arrive at deeper insights into landscape (Tress & Tress 2001: 154; Stephenson 2010: 315).

In the context of this research, landscapes are regarded as continuously changing and evolving socio-ecological systems, which reflect the ongoing and past interactions of nature and human induced phenomena. Human-nature interaction leads to multiple land uses as well as a diversity of perceptions and values attached to landscape. This creates multifunctional landscapes where the present physical-material form is the result of the historical development. Landscape is understood both as a complex mosaic of the biophysical pattern process dynamics together with the social constructions and processes experienced by people with their senses. I consider landscape defined in the following way as an appropriate integrated conceptual framework for examining the multifunctional tropical forest landscapes when spatial patterns, participation and applied knowledge claims contributing to sustainable development are on the focus of interest (Figure 1). It implies for research that natural and human components should be regarded on equal basis and invites the use of different knowledge systems. Consequently, it leads to quantitative and qualitative approaches of inquiry and multiple methods of data collection and analysis to study these phenomena, discussed in the next chapters.

2.5 Retrospective land cover and land use change

Study of landscape structure and composition is the main interest in landscape ecological research. The early landscape ecological studies relied on qualitative description of landscape (Wiens et al. 2007). However, the development of remote sensing of the environment changed the methodological emphasis drastically. Aerial images available since the early decades of the 20th century, as well as satellite images obtainable since the 1970s were found particularly useful for measuring landscape as a spatial and visual entity (Forman & Godron 1986; Naveh & Lieberman 1990; Lillesand et al. 2008). The technical development of GIS and spatial statistics contributed significantly to the adoption of quantitative methods as an inherent part of landscape ecology (Haines-Young et al. 1993; Farina 2006). Hence, an intensive development of quantitative methods for analysing landscape patterns and structure through spatial variability in the patch interaction at various spatial scales was seen during the 1980s (Wiens et al. 2007). It was also understood that in addition to the studies of these horizontal processes, also the vertical processes were relevant to create understanding of how the landscape has evolved through time. The combined use of various spatial data sets, such as historical maps, aerial photographs and satellite imagery, has been found especially useful via GIS. It enables the combination of effective mapping with retrospective analysis, thus, providing opportunities for temporally extensive and spatially detailed land cover and land use change analyses (Vuorela 2001).

Landscape change analyses are based on the combined use of spatial data and focus on the identification of long-term dynamics and evolution of land cover and land use patterns and processes (Lambin et al. 2003; Bürgi et al. 2004; Pontius et al. 2004; Käyhkö & Skånes 2006). Retrospective analyses generally emphasise understanding of change dynamics and driving forces of change. Historical change analysis is able to address not only the past status of land cover and land use, but also to show long-term patterns, for example, in land use and forest development. This change information is considered essential for landscape monitoring, planning and management, which all aim to build future land use plans on the past and present development and patterns of land (Marcucci 2000; Antrop 2005; Marignani et al. 2008). Despite the urgent needs for projecting global-scale land cover and land use (LC/LU) changes, detailed, historically extensive landscape change studies are strong in emphasising the key change processes and interactions in landscapes (Lambin et al. 2003; Brink & Eva 2008).

LC/LU change analyses extend retrospectively several decades, even centuries, and have been found useful in the exploration of the relationship between land patterns and various environmental variables (Hietel et al. 2004; Reger et al. 2007), in the study of deforestation and reforestation processes (Mertens & Lambin 2000; Kennedy et al. 2007; Hartter at al. 2008), and in the assessment of the status of valuable habitats and species (Johansson et al. 2008; Käyhkö & Skånes 2008). Tropical forest dynamics and especially forest losses have been a recent focus of several landscape change trajectory studies (e.g. Mertens & Lambin 2000; Rembold et al. 2000; Hayes & Sader 2001; Lambin et al. 2003; Mapedza et al. 2003; Verburg et al. 2006). Lambin et al. (2003)

argue that systematic analysis of local scale LC/LU changes, conducted over a range of temporal scales, helps to uncover general principles that provide an explanation and prediction of future changes in tropical forests. Such analyses should be able to address not only the prevailing change dynamics quantitatively, but show where these trajectories are located and how such spatially explicit information could be used to estimate whether forests are sustaining in the long run.

Landscape change analyses have largely been based on the quantitative and visual comparison of spatially explicit land cover and land use mapping and measurement (e.g. Keisteri 1990). Among the well-established methods is the use of cross-tabulation matrices in the analysis of landscape changes as categorical transitions (Forman & Godron 1986: 441; Pontius et al. 2004). Recently, retrospective trajectory analyses have highlighted the temporal data sequence as a whole and sought to identify change structures and functions typical to the studied landscapes (Bürgi & Russell 2001; Bürgi et al. 2004). These often rely on the cell-based simulation of patch dynamics (Franklin & Forman 1987; Costanza et al. 1990), which has evolved to a staple item in landscape modelling (Wiens et al. 2007). Methodological developments in landscape change research have also been triggered by multispectral remote sensing and automatic image analysis techniques (Crews-Meyer 2004; Serneels et al. 2007). The more recent approaches generally emphasise various abiotic and biotic interactions and driving forces of change rather than the measurement of optimal landscape patterning or distribution of land resources at a given moment in time. Eventually, land cover changes are not simple conversions from one cover type to another, but rather continuous transitions of land characteristics through cyclical, linear, secular and reversible processes with variable time-lags (Antrop 1998; Mertens & Lambin 2000; Bürgi & Russell 2001; Coppin et al. 2004).

Retrospective landscape analyses face practical challenges due to combined uses of geographical information originating from multiple data sources. Challenges relate especially to the spatio-temporal accuracy and semantic interoperability of landscape information (Ahlqvist 2002; Vuorela et al. 2002; Bürgi et al. 2004). Hence, landscape change detections studies call for compromises in the scale of analysis, data semantics and accuracy (Bürgi et al. 2004; Käyhkö & Skånes 2006). Even though analogue archival data require laborious processing and may lack geographical coverage compared to satellite imagery, several studies have reported successful integration of historical landscape information into the assessment of contemporary and future landscapes (Lausch & Herzog 2002; Mendoza & Etter 2002; Bender et al. 2005; Martin et al. 2006; Zomeni et al. 2008). When working with retrospective changes across decades, it needs to be appreciated that identified change trajectories are eventually models of landscape development rather than strict documentations of historical events and changes (Käyhkö & Skånes 2008; Van Eetvelde & Antrop 2009). Hence, trajectories can never reveal the true spatio-temporal diversity of landscape changes. Studying forest changes in the tropics, particularly, is methodologically challenging due to lack or inaccessibility of appropriate data sets across multiple time scales. Furthermore, tropical forest land use patterns typically create dynamic, short-term land cover transitions rather than strict,

well-defined borders between various land units (Rudel et al. 2005). Simultaneous occurrence of multiple land uses within a specified land unit is common instead of monocultures, which are often geographically more distinct from the landscape matrix.

2.6 Participatory mapping of local knowledge on landscapes

Local knowledge on landscapes is accumulated through the daily practices, experiences and personal observation of the stakeholders and related to specific places (Relph 1976; Tuan 1974, 1977; Pickles 1985; Williams & Patterson 1996; McCall 2003; Stephenson 2008). On one hand, it relates to the material landscape describing how land is used and, on the other, to the intangible perceptions and valuation of a given landscape through, for example, aesthetic or religious values (Zube 1987; Brown 2005; Stephenson 2008; Williams and Patterson 1996). Both the material and the non-material values and benefits have a significant contribution to human well-being (MA 2003). Capturing local knowledge on landscapes requires dedicated participation of the stakeholders (Norton 2005; Raquez & Lambin 2006; Reed 2008; Mander et al. 2007). It is essential when tackling land use and land management issues for better future development. Participation of local inhabitants especially is crucial to understand the subjective use of and values attached to the land.

When the desire is to include these human uses and valuation into landscape assessment, practical tools and methods that address the geography of place are needed. Participation through traditional non-spatial methods alone has a limited contribution to landscape planning and decision-making, which often incorporates spatial data sources (Selman 2006). For example, several tools and methods, such as wealth ranking, scoring of options, transect walks, social or resource mapping, seasonal diagramming, role playing and storytelling promoting participation, empowerment and action towards social and environmental change, have been developed in development work and research since the 1970s (Chambers 2002; Mikkelsen 2005). Chronologically these have been grouped under a sequence of acronyms identified, among others, as participatory action research (PAR), rapid rural appraisal (RRA), participatory rural appraisal (PRA), and participatory learning and action (PLA) practised by a heterogeneous group of facilitators including academics, non-governmental and international organisations, administration and communities themselves (Mikkelsen 2005; Chambers 2008; Kindon et al. 2010). Towards today, these approaches have multiplied, merged and are practised in a creative pluralism. However, a growing interest can be recognised in the methods of community mapping, which apply the use of spatial information technologies (Corbett et al. 2006; Corbett & Rambaldi 2009).

Maps are powerful means of representation (Wood 2010), and participatory mapping methods have been spreading rapidly since the 1980s after facilitators and researchers came to realize the capability of community people to map and indicate places, share their understanding on maps. Since the 1990s, increasing emphasis has been on mapping using exact spatial locations together with aerial imagery, enabled by

the technical development (Rambaldi et al. 2006b; Chambers 2008: 138). In developing context, participatory mapping approaches, also referred to as participatory GIS (PGIS) techniques, especially aim to make stakeholders more aware, for example, of the use of natural resources or enhance tenure security whilst promoting collaboration and empowerment (Craig et al. 2002; Chapin et al. 2005; Rambaldi et al. 2006b). PGIS techniques combine community participation with the use of digital geospatial techniques and enable the collection, storage and analysis of stakeholder data in a geographical form. In practice, PGIS solutions are various, depending on the aims of the application, the nature of the information needed, and the available technology. In developed context, the same development has been seen with the difference that the examples are often based on understanding the value of public participation under the current collaborative planning paradigm (e.g. Craig et al. 2002; Sieber 2006; Ramasubramanian 2010). The concept PPGIS (public participation GIS) is commonly used to refer to the use of GIS and modern communication technologies to engage the public, local stakeholders, in official decision-making. Noteworthy is that alongside the concepts of PGIS and PPGIS also other concepts, such as GIS for participation (Cinderby & Forrester 2005), community-integrated GIS (Harris & Weiner 2003), GIS-2 (Sieber 2004), collaborative GIS (Shivanad & Dragićević 2006) and qualitative GIS (Cope & Elwood 2009) have been applied within the multidisciplinary practice and the methodological development of participatory mapping approaches.

The above-described development has been triggered by an enthusiasm of pursuing participation through the use of GIS. Place-based local knowledge created through participatory mapping processes has the concrete advantage to depict how people are using the environment and how they perceive and experience it. It allows the use of this information based on the local expertise together with other data sources in spatial decision-making. Thus, participatory GIS methods address the criticised aspects of expertise dominance and undemocratic top-down approach enforced by conventional GIS (Pickles 1995; Dunn 2007; Elwood 2011). Participation in environmental management has been seen to be effective and fundamental in the current societal context and to have many advantages to top-down approaches. On the other hand, mainstreaming of participation into development policies has not always been successful (Mikkelsen 2005: 56; Reed 2008). It has maybe not been realised in an appropriate form, considered as duty by law or stated in documents but the actual implementation has remained modest. With participatory mapping approaches, it is possible to tackle some of these problems and create spatial data together with the stakeholders, which can potentially have a high practical applicability for landscape management. Spatial information technologies are considered to have potential for increasing the degree of stakeholder involvement and influence in the decision-making processes (Craig et al. 2002; Carver 2003; Dunn 2007; Elwood 2011). It may assist the stakeholders to climb the 'ladder' of participation starting from the simple being informed and proceeding to the forms of more dedicated participation and stakeholder control and ownership (Arnstein 1969; Craig et al. 2002; Chambers 2006; Reed 2008).

Recently, the social meanings of places have started to gain wide interest in the context of the geographical analysis of landscapes. Increasing amount of empirical evidence shows that community stakeholders are able to identify and map different landscape-attached values, perceptions and benefits. Social values have been included, for example, to forest and fuel management in the U.S. (Black & Liljeblad 2006). Applying the landscape values research methodology, public values and preferences in national forest planning have been surveyed and mapped through mail surveys in several U.S. and Australian case studies (e.g. Brown et al. 2002; Raymond & Brown 2006; Nielsen-Pincus 2011; Sherrouse et al. 2011). Deriving from the same methodology, the concepts of natural capital and ecosystem services have been applied for targeting landscape planning through interview and Internet mapping methods (Bryan et al. 2010; Raymond et al. 2009; Brown et al. 2011). Participatory approaches have also been used for mapping landscape values through GIS-based tools for management of Indian tribal lands (Carver et al. 2009). To enhance sustainable use of forest reserve in the Brazilian Amazonia, Bernard et al. (2011) have used satellite images and sticker dots in community mapping. In urban setting in Finland, Tyrväinen et al. (2007) have been developing mail survey tools for mapping social values of woodlands and green areas and Kyttä et al. (2011) have studied the perceived locality-based environmental quality through GIS-based Internet query method.

The strength of empirical mapping methods is the possibility to supplement the objective material and visual landscape analysis with information created by local actors. They result to actual local knowledge about the distribution of human uses and values in the landscape as opposite to mapping based on assumptions derived from literature or process modelling (e.g. Costanza et al. 1997; Willemen et al. 2008). A relevant aspect of the stakeholder involvement is the potential to deepen appreciation of the non-material benefits that landscape provides to humans, which quite often have been limited to mapping merely recreation or tourism (e.g. O'Farrell et al. 2010; Willemen et al. 2010). In addition, unlike mental mapping methods applied, for instance, in behavioural geography (Dows & Stea 1977; Soini 2001), the mapped information represents the everyday living environment as place-specific data that can be analysed for collective geographical patterns and distribution.

Participatory mapping has been approached from both the individual and group data collection perspectives, and the most commonly applied mapping methods include drawing or delineating polygons or placing points or point markers on a map or aerial image map. In some cases, route mapping and point weighting have been applied or methods of polygon spraying enabling fuzzy border delineation (see e.g Craig et al. 2002; Shivanad & Dragićević 2006; Carver et al. 2009). Common methods of spatial analysis include studying the intensity, distribution vs. clustering, diversity and co-occurrence of mapped landscape attributes and their distances from the stakeholder perspective. Specifically, a review of social landscape metrics, derived from the quantitative metrics commonly applied in landscape ecology, is presented by Brown and Reed (2012). When using participatory mapping methods it is, however, crucial to note that

not only the geographical data has importance. Also the related qualitative data, such as stakeholders' narrative place descriptions together with researcher observations, are significant (Corbett & Rambaldi 2009). This is important to ensure that the spatiality of human existence is not simply narrowed to geographical locations.

When capturing the diversity of perceptions and values attached to the landscape through mapping, a particular methodological challenge lies in the spatial representation and uncertainty of the landscape attributes. These commonly represent continuums rather than discrete points and patches in the landscape. In fact, their boundaries often have an imprecise or ambiguous delineation, as many natural features, such as habitat boundaries, mountains or town centres (Yao & Jiang 2005). Furthermore, especially the non-material landscape values, such as aesthetic or intrinsic values, may be abstract in nature and as such challenging to map. The subjective experiential space may be distorted when forced into quantitative Euclidian GIS environment (McCall 2003). Participatory mapping and data analysis requires also the collection of extensive spatial sets, making it more suitable for local and regional level studies (de Groot et al. 2010). However, the less labour intensive internet mapping applications (e.g. Kyttä et al. 2011) might have practical operability also in developing context as mobile technology advances.

Furthermore, participator mapping requires sensitivity when it comes to the ethical questions of bringing local knowledge into spatial context (McCall 2003; Rambaldi et al. 2006a). Land is always political and reflects power (Wood 2010) with differing views and interests of the stakeholders. Key to successful PGIS practice is identified as effective participation, which should be seen as a carefully planned and demand-driven process (Rambaldi et al. 2006b; Corbett & Rambaldi 2009).

2.7 Integrated approaches and methods to landscapes

Within environmental management focusing on finding solutions to sustainable human-nature interaction, an interest has started to rise in the use of integrated approaches under a variety of theoretical perspectives, applied especially in human and social sciences and development inquiry (e.g. Nightingale 2003; Tashakkori & Teddlie 2003; Chambers 2008). Several scholars argue that the holistic landscape concept has premises for sustainable environmental management when practical needs and political decision-making are in focus (Naveh & Lieberman 1990; Luz 2000; Naveh 2001; Tress & Tress 2001; Antrop 2005, 2006; Potschin & Haines-Young 2006; Selman 2006; Stephenson 2008; Termorshuizen & Opdam 2009). Hence, there is a strong call for an integrated view of landscapes at the theoretical level, as discussed in section 2.4.

What follows from this theoretical view is the possibility to integrate different approaches of inquiry and multiple methods of data collection and analysis into a mixed methods research design (Creswell 2009). Methodologically, it means the use of quantitative and qualitative approaches and respectively combining multiple methods of data collection and analysis to address the complexity of the studied phenomena. The

research design reminds that of triangulation, however with the difference that data is not only collected and analysed from different perspectives to seek convergence, complementarity or divergence (Nightingale 2009), but the different approaches are used in tandem, weaving together diverse techniques to increase the overall strength of the research leading to the production of new knowledge (Tashakkori & Teddlie 2003; Tress et al. 2006a; Creswell 2009: 14; Elwood & Cope 2010).

Solutions, particularly to environmental and societal issues, often having a spatial dimension, are increasingly found in the integration of expert and local knowledge, descriptive and analytical tools, and supporting quantitative and qualitative forms of analysis in the GIS environment (e.g. Elwood & Cope 2010; Janelle & Goodchild 2011). For instance, Haines-Young and Potschin (2010) seek to emphasise that the understanding of socio-ecological systems requires the development of spatially explicit landscape methodologies in multifunctional holistic context by linking biodiversity to ecosystem function and the benefits people obtain from nature. Furthermore, information needed in decision-making should be spatially explicit on the local scale so that the landscape values and preferences that the local people desire can be related to the changes in spatial patterns and ecological processes of the physical landscape features, as noted by Termorshuizen & Opdam (2009). They also conclude that understanding of landscape changes are in current research rarely linked with local actors. However, combining disciplinary expert knowledge with local knowledge has premises for more comprehensive understanding about human-nature interaction and likely leads to more robust decisions (Reed 2008).

Integrated landscape analysis may reveal interesting associations and spatial relationships between physical-material resources and their anticipated and actualised uses and valuation by humans (e.g. Black & Liljeblad 2006; Alessa et al. 2007). Lately, human dependency on the structures and processes generated by the nature and ecosystems are in political decision-making increasingly understood as services and benefits that crucially contribute to human well-being (Costanza et al. 1997; Daily 1997; de Groot et al. 2002; MA 2003; Wallace 2007; Costanza 2008). Such holistic ecosystem or landscape service framework has been suggested as a motivating ground for integrated spatial assessment of these services and the benefits they create (de Groot et al. 2010; Burkhard et al. 2012). The framework highlights the implications that ecosystem change and degradation have to human well-being and, hence, the need for integrated landscape level management and conservation.

Additionally, to answer the need to create integrated spatial data for practical landscape management, landscape characterisation and assessment can be considered as an attractive approach. Landscape characterisations, realised on different scales from national or international to regional and local (see e.g. Groom et al. 2006; Mücher et al. 2010), aim to express the holistic nature of the landscape (Antrop 2003). They convey an understanding of the unique features, both natural and human induced phenomena, characterising the different parts of a landscape by integrating data of biophysical and anthropogenic features (Swanwick 2002). Thus, especially when producing a local

level landscape characterisation, there is potential to also integrate the local stakeholders' knowledge through participation in the process. This could present a valuable contribution to spatial planning processes (Selman 2006). It has also potential to enhance transdisciplinarity, the combination of cross-disciplinary interaction and non-academic participants, in decision-making process (Fry et al. 2007).

Profound integration from the philosophical-theoretical discussions to the actual level of methodological choices in landscape research is, however, a challenging path, particularly between humanities and natural science (Tress et al. 2004). It may be challenging to master the different theoretical approaches of the various disciplines. Integrating different approaches of inquiry and multiple methods of data collection and analysis demands also a level of methodological sophistication, often found in a research team rather than in one individual (Tashakkori & Teddlie 2003: 205; Creswell 2009: 205).

3. Research context and study area

3.1 Degrading forest resources in the tropics

Recent global land cover estimates show an overall decline and degradation in the Earth's forest resources, which is occurring especially in the tropical regions in South America and Africa (FAO 2010). Losses of forested land have been taken seriously globally and several monitoring programmes, such as FAO Global Forest Resources Assessment carried out at five-year intervals, Land-Use and Land-Cover Change (LUCC) project of the International Geosphere-Biosphere Programme (IGBP), AFRICOVER land cover mapping and, more recently, the FAO's global remote sensing-based surveying, are examples of the implementation of long-term forest cover monitoring (Lambin et al. 1999; Latham et al. 2002; FAO 2010; FAO 2011). It is well understood that forests are multifunctional ecosystems providing material and non-material services and functions to living organisms (MA 2003). Forest are crucial natural resources maintaining biological diversity, water circulation, improving air quality and helping to mitigate climate change. Consequently, forest degradation leads not only to overall impoverishment of the environment and loss of biological diversity (MA 2003; FAO 2010; UNEP 2007; Solomon et al. 2007; Hartter et al. 2008). It is also critical especially in respect to developing countries and rural communities, for which forests and natural resources are the basis of the livelihood and well-being by providing, for instance, life support, energy, shelter, food and means of income. Mechanisms driving the development are complex and relate largely to dynamics of different social, economic and cultural factors. However, expansion of agricultural area, logging and other human-related factors are understood as the main causes (Lambin et al. 2001; FAO 2010; Brink & Eva 2008; Paré et al. 2008).

To find solutions to this alarming development, in parallel with global or continent scale estimations, detailed level and spatially explicit information of both forest transitions and possible driving forces, such as land uses, together with the variety of landscape functions and services to the people are a necessity. Such local level approach is

needed to understand the interlinked socio-ecological processes, since many decisions on forest policies and land uses are made at the regional or local levels. However, there is a lack of local scale studies (Lambin & Meyfroidt 2010). Additionally, inclusion of stakeholder knowledge is essential in these estimations, since expert evaluations and existing proxy data have little potential to reveal the multiple land uses as well as socio-cultural values among the local actors. In this research, these challenges are addressed in the context of Eastern Africa, Tanzania.

3.2 The Zanzibar Islands in Eastern Africa

The Zanzibar Islands, located on the eastern coast of Tanzania just south of the equator, consists of the main islands Unguja and Pemba and several small islets (Figure 2). The total area is approximately 2700 km², and Unguja, the largest of the islands, covers 1 666 km² (OCGS 2010). Zanzibar has a marine tropical monsoon climate, with two annual rainy seasons from March to May (*masika)* and October to December (*vuli*), with an average rainfall of 1 000–2 500 mm per year and an average annual temperature varying between 24 °C and 28 °C (Hettige 1990; Krain 1998). Geologically, the archipelago originated during the lower Miocene (12–26 million years ago) by accumulation of sandy sediments at the mouths of two rivers, Rufiji and Ruvu (Hettige 1990). These deltaic streams flowing in the north-south direction shape the contemporary lineation of landform patterns. Block faulting and uplifting caused the emergence and separation of the islands during the early Pleistocene period (1–2 million years ago), and the decreasing sea level resulted in marine erosion and coralline terrace formation during the Quaternary period (less than 1 million years ago). Therefore, today the western part of the Unguja island consists of undulating sediment deposits with a maximum elevation of 120 metres above sea level. In the eastern part, limestone terraces and corals dominate the landscape, descending from 40 metres elevation to the sea level and continuing off-shore (Kent 1971; Hettige 1990).

The population of Zanzibar is estimated at around one million, of which Unguja hosts approximately 700 000 (census 2002 projection, annual increase of 3.1%, OCGS 2010) and the only urban settlement, Zanzibar Town. Historically, Zanzibar has been part of a greater commercial system operated by the monsoon winds in the Indian Ocean for more than two thousand years, linking the Arabs, Persians, Indian and Chinese cultures and resulting in the emergence of the Swahili-civilization (Krain 1998). Arabs, Portuguese and British have all gained rule of the islands and valued the strategic position as the major trading post of spices, ivory, slaves, cloves and coconuts among others. This history is reflected in the contemporary ethnically mixed population of the islands, the Swahili language and the dominant Islamic religion, which has an important role in the Zanzibari society; although alongside the traditional natural religions continue to prevail.

After the end of the British rule in 1963, the short period as an independent Zanzibar Sultanate ended in revolution in 1964. During the same year, the newly estab-

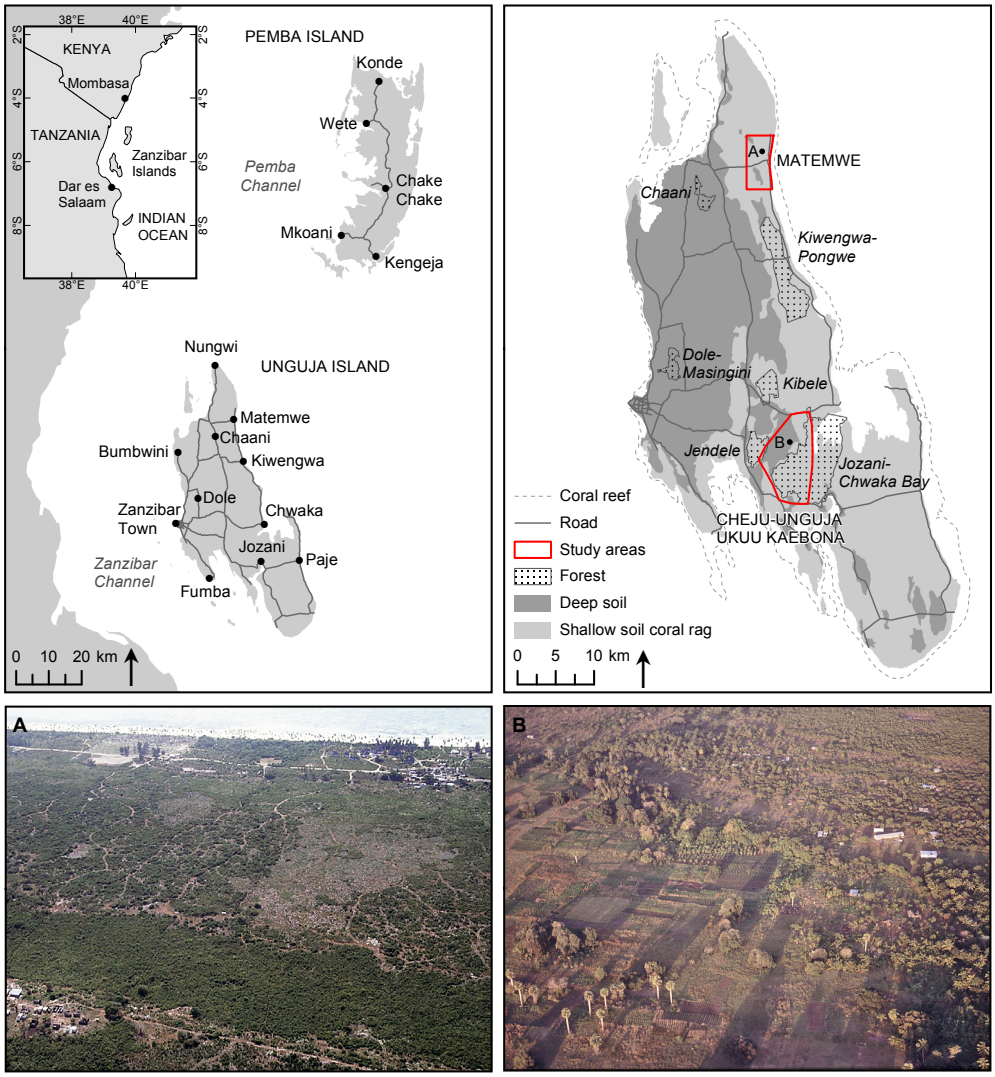

Figure 2. The Zanzibar Islands, Tanzania in Eastern Africa with the main islands Unguja and Pemba. The study sites, the administrative regions of Matemwe and Cheju-Unguja Ukuu Kaebona, are located on the eastern coast and southern inland on the Unguja island. On Unguja, the western part hosts undulating sediment deposits with deep soils and the eastern part consists of coral rag with shallow soil. There are six forest conservation and tree plantation areas on Unguja island. Oblique aerial photograph A represents the coastal forest mosaic with co-existing village settlement and hotel areas, and scrubland encroachment (east direction from the indicated point). Photograph B shows the multifunctional landscape mosaic created by cultivation and settlement (northeast direction from the indicated point). (Photographs: Jukka Käyhkö, 2004)

lished republic formed a union with Tanganjika, which was given the name Tanzania (Törhönen 1998). Zanzibar has a large degree of autonomy in the union with its own government and president. To enhance the declining economy, having a strong orientation to centrally planned African socialism, Zanzibar started to liberate its economy

with free trade policies and encouraging tourism initiatives during the 1980s. In addition, the political system was democratised, leading to the first multi-party elections in 1995. Consequently, Zanzibar continues today its historical role as a site for cultural encounters; currently, tourism is an essential part of the Zanzibari economy with an estimated account of 25% of the GDP (in 2007, Lange & Jiddawi 2009).

The contemporary Zanzibar landscape is characterised by a mosaic consisting of cultivated land, natural forests, thickets, scrublands and grassland, which express the combined and long-term influences of different cultures and land use activities, such as spice farming, shifting cultivation and tree plantation. The Zanzibar Islands belong to the Swahilian regional centre of endemism and form part of the Coastal Forests of Eastern Africa, extending from southern Somalia to southern Mozambique and in west to Malawi (Burgess & Clarke 2000: 71–73). The original vegetation of Unguja has been tropical high forest in deep soil areas and deciduous woodland in the coralline areas (Hettige 1990). However, due to human activities, these occur today only in limited areas in the natural forest reserves, on coral rag and mangrove sites. In general, forest vegetation covers 16% of the total land area of the Unguja island (DCCFF 2008). Today, 'the environment is being more heavily utilised than ever before' (RGZ 2004) and the significant population increase together with the fast growing tourism are major contributing factors. The well-being of the subsistence-based rural communities is dependent on the natural resources, and forests in particular offer a variety of crucial tangible and intangible livelihood benefits for the people (Sitari 2005; Tamrini 2009). Moreover, forests offer key habitats for a high diversity of endemic plant and animal species, such as the Zanzibar Red Colobus (*Procolobus kirkii*) (Kombo & Kitwana 1997; Burgess & Clarke 2000: 177).

3.3 Landscape management challenges in Zanzibar

The Zanzibar Islands have experienced dramatic changes in land use and land ownership throughout their history (Lofchie 1965). Since the Revolution, all the land has been technically owned and controlled by the state (DCCFF 2008). The present land tenure system is a complex combination of legislation, and communal and colonial traditions (Krain 1998; Törhönen 1998). According to the traditional communal *Shirazi* land tenure, land use rights were given by the village elders and the actual land ownership claimed through planting permanent trees such as mango, coconut and citrus trees. These land plots were transferred following the inheritance order accordant to Islam. The Arab rulers enacted a plantation system where the former slaves were allowed to squat on their plantations. However, this system was changed after the Revolution with the nationalisation of the land. The Government of Zanzibar had an objective to redistribute the land as three acre plots to secure land for the whole population, but the realisation of the system was ineffective. Another national land reform, started in the 1980s, led to the Land Tenure Act of 1992, with the aims to support secure tenure, resource monitoring, effective land use, improved transactions, and revenue collection.

However, the realisation of this act has had a limited impact, particularly on the coral rag and land registration has proceeded slowly (Harvey 1997: 15).

In general, the foundation of the current land tenure in rural Zanzibar is the *shamba* land, originating in the communal and colonial traditions, where the land itself belongs to the Government but is cultivated and transferred on individual ownership basis (Törhönen 1998: 69). In practice, new land for cultivation is requested from the village leader (Swahili: *sheha*) who discusses and decides the land allocation within the *shehas* council. For the landholder, it is common, and legal, to sell the improvements (e.g. trees, constructions) on the land. At the community level, limited knowledge of the legislation and uncertainty of tenure is considered to influence the willingness to long-term investments and sustainable management practices (DCCFF 2008). This has negatively affected community forest development, and the process of determining land ownership is seen necessary by the Government. In fact, sustainable management of land and environment is currently advanced in Zanzibar through a Finnish Government supported project (SMOLE 2004).

The land and natural resources are subject to intense pressures (Burgess & Clarke 2000), as forestry, agriculture and hunting are the dominant sources of income contributing together to the national economy of Tanzania with approximately 30% of the GDP (MFEA 2010). On Unguja, the prevailing cultivation practice on the western deep soil part is permanent cultivation. Shifting cultivation and agroforestry are practised in the eastern coral rag areas, typically hosting rather shallow soils. In addition, new land uses, such as tourism and related extraction of the natural resources, have made especially the coastal space an arena of competitive land uses (Gössling 2001; RGZ 2004). The authorities and communities in Zanzibar are concerned about the long-term sustainability of the natural resources (ZFDP 1997; DCCFF 2008; Tamrini 2009). Furthermore, FAO (2010) has listed Tanzania as one of the countries facing severe deforestation (annual loss of 403 ha/yr, -1.13%).

The Government of Zanzibar has since the 1980s introduced land demarcations and extensive tree plantations of exotic species to protect the forests and biodiversity from over-exploitation and degradation (DCCFF 2008). These interventions have also included establishment of forest administration and training of foresters. The activities were supported by foreign donors, such as forest management projects and plantation programmes under the support of the Finnish Government (ZFDP 1997). Currently, the Department of Forestry and Non-Renewable Natural Resources (DFNR, previously DCCFF) in the Ministry of Agriculture and Natural Resources has responsibility to protect, conserve and develop forest resources in Zanzibar Islands. This includes management of protected areas and biodiversity, as well as coordination of farm forestry, which produce commercial crops, building materials and wood fuel. Special emphasis is given to the coral rag forests, where communal land management, tree farming, agroforestry and forest protection objectives meet and often clash. Institutionally DFNR has strong capacity to be involved in various forest related initiatives locally and nationally. The staff is well trained in forestry and the recently established GIS unit supports

forest cover mapping and participatory forest management in particular. Much of this capacity-building is a result of long-term collaboration between the University of Turku and DFNR. Thus, DFNR is the essential institutional administrative actor regarding this research and the implementation of the results.

To guide sustainable forest practices, Zanzibar has implemented two national forest plans. Based on the Forest Resources Management and Conservation Act No. 10 of 1996, the *Zanzibar National Forest Resources Management Plan 2008–2020* was created through an adaptive conceptual model (DCCFF 2008). This followed the first management plan drawn in 1997 (ZFDP 1997). Sustainability is enhanced also in the form of community forestry, which was taken into active agenda during the 1990's through Resource Use Management Agreements (RUMA). Currently these activites are promoted by the recently published community forest management (CoFM) guidelines (**V**: Figure 2). Aim of the CoFM process is to create management plans and agreements at the local level, however, lacking guidance about the concrete tools to be used for participation in the process (MANR 2011). Interestingly, in the absence of local level land use plans, it seems also that CoFM in practice executes overall land use planning on community-managed land. However, it gives legislative and institutional entitlement only to forest management. The CoFM process is also connected to global efforts of tackling climate change as part of REDD+ (Reducing Emissions from Deforestation and Forest Degradation, Parker et al. 2009) piloting, in which Tanzania among some other countries is currently participating (UN-REDD Programme 2009). REDD Programme is expected to tackle with human-forest interactions especially at local scales, and build operative ways to compensate countries and farmers for the prevention of forest losses (Parker et al. 2009).

Under the described circumstances in Zanzibar, gradual uncontrolled landscape change is reality. The process is familiar in many tropical developing regions facing the similar challenges (Valencia-Sandoval et al. 2010; Bourgoin et al. 2012). It is enhanced in a policy environment where land use planning is loosely coordinated, practical implementation of land tenure and security is weak and stakeholder participation not realised in full potential (Törhönen 1998; Gössling 2001; RGZ 2004; Myers 2008). An issue of growing importance is to create information about the past and present landscape dynamics and the variety of landscape functions and services to the local communities and other stakeholders. It is urgently needed to find solutions and secure the sustainable use of natural resources for not to compromise local livelihoods, biodiversity or the role of tropical forests in mitigating climate change (UNEP 2007).

3.4 Case study sites

In this study, the administrative regions of Matemwe and Cheju-Unguja Ukuu Kaebona, located in the northeastern coast and southern inland area of the Unguja island respectively (Figure 2), were chosen for study sites to increase understanding of the human-nature interaction in the tropical forest landscapes in question. The differences in biophysi-

cal and geographical conditions and policy implementation form a basis for the diverse land uses between the two study areas and contributed to the selection of these two sites from the six study areas (in addition to the former Dole-Masingini, Kiwenga, Chaani and Pete), where the University of Turku Zanzibar research team has been conducting research (Sitari 2005; Käyhkö et al. 2008). The areas have originally been suggested for research sites by the Zanzibar forest administration as communities facing challenges in the management of land and resources. The communities of Matemwe and Cheju-Unguja Ukuu Kaebona represent in the Zanzibari context typical rural subsistence-based communities where approximately half of the population lives below the basic needs poverty line (OCGS 2010). The main livelihoods are cultivation, grazing, fishing and extraction of forest products such as fuel wood, construction poles and coral stones (Sitari 2005; Käyhkö et al. 2008). The landscape also provides other benefits, such as medicinal plants, materials for handicrafts, and sites for practising traditional beliefs.

Matemwe (population around 7 300), lies in the shallow soil coral rag area, where shifting cultivation is practised widely across the forested and scrub covered land as the dominant form of agriculture, and occasional permanent fields and agroforests can be found in the vicinities of the villages. As a coastal village, the sea resources are consequently important for the villagers, and fishing and seaweed farming within the intertidal zone are essential sources of livelihood. In Matemwe, local level forest or land use management has not been planned through official processes. Matemwe, like many coastal regions with sandy beaches, is facing the traditional and new land use pressures, as tourism is rapidly intensifying along the coastal fringe. Tourism potentially creates new opportunities for employment and the market in general, but tourist facilities also push local people to migrate inland, sell their lands, change areas for cultivation, and restrict access to beach areas and sea resources in particular (Gössling 2001; Mustelin 2008).

In Cheju-Unguja Ukuu Kaebona (population around 3 220) the eastern and southern parts lie in the coral rag with semi-open grassland and encroached evergreen and semi-deciduous bushes, as well as natural thicket and high forests with shifting cultivation practices. The western lowland deep fertile soil is used for permanent rice cultivation. Use of natural resources in these villages is restricted by the conservation area, Jozani-Chwaka Bay National Park (JCBNP, 5000 ha). The current national park was established in 2004 by merging Jozani Forest Reserve, Unguja Ukuu Forest Plantation Reserve and Chwaka bay mangrove forest but, in fact, it is the oldest forest reserve in Zanzibar going back to the 1960s and managed as a conservation forest since 1990 (CNR 1997; Burgess & Clarke 2000: 326; Tamrini 2009). Hence, today the conservation area includes high forest, forest plantation and mangrove areas and covers a significant part of the studied Cheju-Unguja Ukuu Kaebona area (39.3%). Collaborative forest management in Zanzibar has the longest history in Cheju, where in cooperation with the Government, the Cheju Shehia Forest Management Plan was first drawn up in 1997 (Uki & Mäkelä 1995; Williams et al. 1997). However, these efforts have not been successful in understanding the actual benefits local people spatially attach to the landscape.

4. Material and methods

4.1 Integrated research approach

Within the interwoven theoretical understanding of the landscape concept applied in this research, I have used various sources of data and applied multiple methods of analysis. This approach aims to converge and integrate the different ways of understanding the socio-ecological processes in the tropical landscapes in question. The case study approach was considered suitable for the study of the complex landscape phenomena based on real world empirical examination (Yin 2009). Although restricting the analysis to these study sites inherently expresses uniqueness in results, the resulting understanding can to some extent be generalised to tropical developing regions.

Measurement and analysis of the contemporary landscape patterns and retrospective landscape change is realised through spatial data sources extending from the 1930s to the 2000s. Deriving from the landscape ecological perspective, the analyses of the change trajectories and transitions are based on mapping and sampling of land cover and land use (**I**; **IV**). Methodologically, and also at the personal level, the major focus in this research lies in the mapping, description and spatial analysis of community landscape values and benefits (**II**; **III**). The purpose is to capture the diversity of the subjective everyday landscape practices and experiences in spatial form through the participation of community stakeholders. This part of the research has required comparison and exploration of participatory mapping methods and typologies suitable for the study context and extensive data collection through participatory mapping campaigns.

To build synthesis from the change detection of the objective material landscape based on disciplinary expertise and experiential landscape values and benefits mapped by the local communities, integrated methods of analysis have been applied to study their spatial relationships (**III**; **IV**). In addition, landscape characterisation methodology is applied to integrate these multiple spatial data sets (**V**). Mapping and analysis of the data has been performed using the following software ArcGIS 9.2/9.3/10, Erdas

Imagine 9.0, Excel, Fragstats 3.3/3.4, and SPSS14.0/19. Field observation and documentation have been carried out throughout the research during field work phases.

Some relevant concepts used in this research deserve elaboration here. The 'local community' is defined as the group of inhabitants living in the studied administrative regions with shared experiences and perspectives (Agrawal & Gibson 1999; Craig et al. 2002; Corbett & Rambaldi 2009). However, it is recognised that community does not refer to a homogenous entity but rather to an affiliation of individuals with multiple interests and diverging status, income and power. The concept 'stakeholder' refers to those people, especially community inhabitants, who have an interest in the landscape and are likely to be affected by a planning or management intervention (Swanwick 2002; Mikkelsen 2005; Hickey & Kothari 2009).

4.2 Research materials

The spatial data sources of the physical-material landscape used in this research covering the temporal period between 1930 and 2009 consist of topographic maps (1930, 1985, 2009, 1:10 000–1:30 000), vertical aerial photographs (1952–53, 1977–78, 1989–90, 2004–05, spatial resolution 0.5–1.5 m), and physiographic map (1990, 1:100 000) (**I**: Table 1; **V**: Table 1). The topographic maps and aerial images were obtained from the Department of Urban and Rural Planning, Government of Zanzibar by the University of Turku Zanzibar research team. Excluding the digital map of 2009, the topographic maps and aerial photographs were scanned, mosaicked and georectified into orthoimages. The aerial photographs were also processed into digital stereo-models for visual stereoscopic interpretation. In addition, oblique aerial photographs, acquired by the Zanzibar research team during a light aircraft flight in 2004, were found useful in visualising landscape patterns. Based on the contours of the topographic map of 2009, a digital elevation model (DEM) was calculated. The physiographic map by Hettige (1990) was scanned and digitised. These spatial data sets constitute a significant material for the analysis of land cover, land uses and settlement patterns and changes in paper **I**, land cover change detection in paper **IV** and landscape characterisation in paper **V**.

To create spatially explicit data of the community inhabitants' landscape values and benefits, two participatory mapping campaigns (PGIS campaigns) were organised in 2007–08 and 2010–11. These data sets are the primary material for papers **II** and **III**, describing the mapping and analysis of the collected material. The community mapping data is also used in papers **IV** and **V** in integrated analysis. Field observation and documentation by taking notes and photographs were carried out throughout the research during seven field work phases, partly also through personal experience of residing within the study area during the second PGIS campaign. The purpose of field documentation was to complement the interpretation of LC/LU patterns observed from the aerial images and to document the village landscapes. In addition, some points of interest rising during and from the results of the participatory mapping campaigns were visited.

Main documents relevant for the Zanzibar research context include publications on land use practices, forest planning and community forest management produced by the Government of Zanzibar (e.g. CLE 1993, 1995; Kombo & Kitwana 1997; Williams et al. 1997; RGZ 2004; ZFDP 1997; DCCFF 2008; Tamrini 2009; MANR 2011). These together with other published and unpublished documents, reports, academic research publications, and statistics collected in Zanzibar for the University of Turku Zanzibar library offered valuable information about landscape development and related issues. However, the local level reports and studies represent an emphasis on Cheju-Unguja Ukuu Kaebona and JCBNP, while few of them can be found considering the more peripheral Matemwe. In general, the written materials required critical evaluation, as the final version of a document could not always be found and sometimes the reports were missing pages or appendices.

4.3 Mapping and sampling of land cover and land use

Information about land cover and land use was obtained through visual stereoscopic interpretation of aerial images and topographic maps. The primary reason for using these materials for landscape change detection was their rich temporal availability and the detailed spatial resolution provided by aerial photographs required in the local scale analysis.

In both study areas, land cover was delineated from the 4-sequence aerial photograph data into three classes illustrating the horizontal gradient from open to closed forest cover (**I**: Table: 2; **IV**). For change trajectory analysis, these temporal data layers were combined into point lattice databases with 10 x 10 meter (0.01 ha) cell size, sufficient to sustain the cartographic accuracy of the digitised polygons, and containing information about the land cover class on each time layer for both study areas respectively. The chosen data structure reminds that of a raster-based multilayer data structure often applied in remote sensing analyses (see e.g. Kennedy et al. 2007). Land use classification into four classes was made in Matemwe from the same 4-sequence aerial photograph data using 50 x 50 m (0.25 ha) grid cell matrix (**I**: Table 2). The random sampling method was selected for the analysis of retrospective transitions due to gradual and overlapping borders of land use activities. In addition, in Cheju-Unguja Ukuu Kaebona study area the 2004–05 LC/LU was mapped as seven classes reflecting the open, semi-open and closed land covers and their land use (**IV**; **V**).

Land use was also studied through mapping the settlement and roads. Settlement data was mapped as building points for both study areas from aerial photographs and the 1930 topographic map (**I**: Table 2; **V**). To analyse historical settlement continuity, the building point layers were converted into raster layers with absence and presence information about the buildings in each cell area. In Matemwe, the resolution of 100 x 100 m (1 ha) was considered suitable to depict the settlement pattern and distribution in different years without concentrating too much on individual buildings. In Cheju-Unguja Ukuu Kaebona, a coarser resolution of 200 x 200 m (4 ha) was selected to

identify the general patterns of settlement development on the local scale. Contemporary settlement density was also calculated in these 200 m cells. As for the retrospective land cover data, the settlement data layers were combined into point lattice databases for trajectory analyses. To visualise the contemporary settlement, the most recent point data layer was used to delineate polygonal settlement areas for both study areas. For visualisation purposes, the road network was mapped and classified in both study areas based on a visual interpretation of 2004–05 aerial photographs, 2009 topographic map and knowledge about the main routes in use between the sub-villages.

4.4 Participatory mapping campaigns

The PGIS campaigns organised in the study sites preceded an extensive literature review and thorough practical preparations. Among the main theoretical considerations was the selection of the concepts around which the mapping of landscape attributes was framed. During the first PGIS campaign organised in Matemwe, the concept of social landscape value, mainly derived from the works of McIntyre et al. (2004, 2008), Brown (2005), Black and Liljeblad (2006), and Tyrväinen et al. (2007), was applied (**II**). According to Brown (2005), the concept of social landscape value can be seen to act as an operational bridge in applied landscape management and planning connecting the geography of place with the underlying place-related perceptions. Among the local communities of Matemwe, four social values (subsistence, aesthetic, traditional and leisure) were chosen to the study of the social dimension in the landscape based on the commonly practised land use activities as well as the values people attach to their village landscape (**II**: Table 1). This value typology was developed through literature review and contextual experience, and modified to the Zanzibar context.

In the second PGIS campaign in Cheju-Unguja Ukuu Kaebona, the concept of landscape service was applied (**III**; **IV**; **V**). I considered the ecosystem service agenda to have potential in the context of landscape management and participatory mapping of landscape-attached practices and values. However, based on the argumentation by Termorshuizen and Opdam (2009), I conceive the landscape service concept, derived from the concept of ecosystem services (MA 2003), to give broader room for local scale stakeholder involvement, where there is a need to develop spatially explicit assessment methodologies. A typology of 19 material and cultural landscape service indicators was established. The typology depicts the tangible and intangible benefits provided by the landscape services (Haines-Young and Potschin 2010) that the local inhabitants give value to through their everyday landscape practices and experiences. It represents the long-term adaptation of local people to the surrounding environment. The typology was modified according to existing literature and contextual experience to capture both the tangible (food, raw materials, geological resources, fuel, and medicinal and ornamental resources consisting of 14 indicators) and the intangible benefits (aesthetics, social relations, and spiritual, religious, cultural heritage and intrinsic values consisting of 5 indicators) relevant in the local context (**III**: Figure 2). The supporting and regu-

lating service categories were found challenging to map and, thus, not included in the typology (see also Brown et al. 2011).

The PGIS campaigns were realised under the mandate of the DFNR in Zanzibar. The practical preparations included informing the leaders of the administrative regions, *shehas*, about the purpose of the research. In Cheju-Unguja Ukuu Kaebona, an introductory community meeting was also organised. The interviews and meetings were facilitated by native Swahili speakers, for most part by the local field assistants and forest officers from the DFNR. In addition, the fieldwork team consisted of researchers and students from the University of Turku and researchers from the University of Dar es Salaam. My personal skills in Swahili allowed following the topics of discussion and making simple conversations and questions, which was very useful during the field work. Before starting the campaign, the meanings of the mapped values and indicators were discussed within the research team to ensure shared understanding and applicable translations.

Data collection was implemented through single-informant interviews combining participatory mapping with semi-structured interview questions (see e.g. Black & Liljeblad 2006; Gunderson and Watson 2007, questionnaires: Appendices I & II). Mapping was based on the use of the most recent colour orthoimages on which the main roads and village names were visualised. In total, 149 and 218 community informants, geographically and proportionally representing all the sub-villages, were interviewed in Matemwe and Cheju-Unguja Ukuu Kaebona respectively. The informants were selected by the *shehas* according to detailed instructions, balancing both the gender and age structure. Two different mapping methods and scales were used. Mapping of social landscape values was made as drawn polygon delineations on a 1:5 000 orthoimage map (**II**) and landscape service indicators were collected through placing points on a 1:12 000 map (**III**). Each mapped feature was complemented with descriptive questions to associate the related attribute information. Data was manually collected in the field and compiled into geodatabases connecting each informant's background and attribute data with the mapped spatial data. After initial analysis, the results were in both study sites reflected in community meetings. Documentation was written from these meetings. In Cheju-Unguja Ukuu Kaebona, the meetings included also a landscape service importance ranking exercise.

4.5 Non-spatial and descriptive analysis

To create an overall understanding of the general community profiles and of the descriptive attribute information related to the mapped social landscape values and landscape services, the non-spatial data collected during the PGIS campaigns was analysed with descriptive statistics and cross-tabulations (**II**; **III**). Documentations from the community meetings were structured for the identification of the main topics of discussion, expressed statements and interesting observations. Results of the ranking exercise were analysed for the average importance rank value for landscape services.

4.6 Spatial analysis

4.6.1 Change trajectories and transitions of land cover and land use

Spatio-temporal analysis of the LC/LU data was realised through various spatial and statistical methods. Analysis of the retrospective land cover change trajectories, described in papers **I** and **IV**, were calculated through the four time layers and subsequently classified into qualitative trajectory classes expressing the main trends of forest cover conversions in both study areas. The classification was based on a combination of quantitative (number and frequency of unique trajectories) and qualitative (distinct direction of change during the observed period) criteria (see e.g. Käyhkö & Skånes 2006, 2008) (**IV**: Figure 2). In addition, in Cheju-Unguja Ukuu Kaebona data, the qualitative trajectories were further scaled into a continuous variable, indicating the degree of land cover quality. Identified change trajectories were converted into raster and vector layers, which were analysed quantitatively with patch and cell statistics, such as variety and diversity statistics, to measure land cover changes. The results were visualised as maps and figures for the interpretation of their spatial patterns, such as fragmentation and clustering. Land use changes in Matemwe (**I**) were analysed statistically using cross-tabulation matrices (transition matrices) to compare changes in land use categories between time layers, following the methodology presented by Pontius et al. (2004). Settlement change trajectories were analysed through the time layers and classified according to the main trends of settlement changes in both study areas (**I**; **IV**; **V**). The data was converted into raster layers to calculate relative proportions of the trajectories and visualised as maps for the interpretation of the spatial patterns. For the part of Matemwe (**I**), settlement change trajectories were further analysed in relation to land cover trajectories, using overlay statistics to describe their spatial relationship.

4.6.2 Geographical patterns of landscape values and services

The spatial analyses of the landscape values and services data presented in papers **II**, **III** and **IV** were focused on identifying geographical patterns on the local scales of data collection and on the broader landscape scale. Multiple methods of analysis using cell-, point- and distance-based approaches were applied. Spatial intensity in the data was analysed through overlapping delineations of landscape values (**II**) and by calculating point density surfaces (Silverman 1986) for landscape services (**III**; **IV**). Intensity of social landscape value data was also analysed through spatial clustering using the Getis-Ord Gi* statistics to identify hot spots (Haining 2003) (**II**). To determine randomness in landscape service indicator distribution, spatial arrangement was analysed with nearest neighbour point statistics (Ebdon 1985) (**III**). In addition, a bivariate correlation analysis was performed to examine the spatial relationship between the landscape service indicators. As it was expected that the distance between the informant home and value/service indicator locations might explain some of the variation in the spatial patterns (Brown et al. 2002), the Euclidian distance between home and mapped values and services was calculated (**II**; **III**). A selection of landscape metrics was used to meas-

ure patch context and isolation of social landscape values on the landscape scale (**II**). Shannon diversity index (H'), being a popular measure of species diversity and which has also been used to study social data (Krebs 1989; Reed & Brown 2003; Bryan et al. 2010; Brown & Reed 2012), was applied to analyse the diversity and relative occurrence of the landscape values and service indicators in both study areas (**II**; **III)**. Landscape service indicator data was also analysed for richness (**III**; **IV**). The results were visualised as maps, figures and tables.

4.6.3 Spatial relationships between LC/LU and landscape service indicators

As it was expected that specific land cover and land use areas and their underlying change trajectories associate with the spatial occurrence of certain landscape services, the spatial relationships between LC/LU and the mapped landscape service indicators were analysed through overlay statistics (**III)**. Furthermore, landscape level spatial generalisations of the material and cultural services in Cheju-Unguja Ukuu Kaebona were established from landscape service indicator data (**IV**; **V**). The LC/LU classification was used to assist in the interpretation of the service indicators and their spatial distribution, intensity, diversity, relationships and descriptive attributes to manually delineate spatial generalisations with consistent classifications. This generalisation excluded the indicator 'fishing & seafood catching' locating mainly ouside the shehia borders. The spatially generalised land uses were also compared in relation to land cover change trajectories through overlay statistics (**IV**)**.** In addition, bivariate correlation between landscape change data and landscape service richness, intensity and distance from the settlement areas were analysed (**V**). For this purpose, a straight-line Euclidean distance from the village centres was calculated.

4.6.4 Producing and visualising landscape characterisation

The landscape characterisation introduced in paper **V** is realised under the integrated landscape conceptualisation and the four layers of interaction between people and landscape, suggested by Lorzing (2001: 48). Under this framework, the characterization was established as four thematic representations accompanied by photographic visualization focusing on the identified information needs for the CoFM process (MANR 2011) in Cheju-Unguja Ukuu Kaebona (**V**: Figure 2). The materials used for the characterisation include physiographic map, digital elevation model, land cover change detection data, contemporary LC/LU, settlement continuity, road network and PGIS campaign data. For each thematic representation, selected combinations of landscape features with defined variables (**V**: Table 2) were overlaid for visual interpretation and manual delineation of patches, areas and zones of similar homogenous character (see e.g. Bocco et al. 2001; Valencia-Sandoval et al. 2010; Cullotta & Barbera 2011). Visually informative representations (Mäki & Kalliola 2000; Flavelle 2002; MacEachern 2004; Rambaldi 2010) of the landscape character were produced as four maps. To appreciate the inherent uncertainty in the spatial dimension of the mapped phenomena and gradual changes in borders, three of the characterisation maps were visualised by using a fuzzy method (Yao & Jiang 2005).

5. Main results and discussion

5.1 Material landscape values and benefits create prerequisites for the interpretation of landscape dynamics

As indicated by the change detection analysis, the coral rag landscapes for large part show transformation and turnover. For example, in Matemwe the majority (70%, **I**: Figure 3) of the land area has been transforming between closed and open land covers in the course of the studied decades. In fact, hardly any forest and scrubland areas are left untouched by this change, which is mainly due to swapping between the land use classes (**I**: Table 3, 4). The same trend with fragmented pattern of consecutive de- and reforestation phases is also evident in Cheju-Unguja Ukuu Kaebona, especially in those coral rag forest areas nearby the settlement (**IV**: Figure 4, 5; **V**: Figure 5E). On the other hand, there are also extensive areas showing closed forest cover particularly as a result of resource use restrictions (**IV**: Figure 4; **V**: Figure 3A). When it comes to tropical forest landscapes, it is well understood that subsistence economies, especially the rotating shifting cultivation practices, create fragmented and heterogeneous patterns and dynamics (Southworth 2004; Rudel et al. 2005; Serneels et al. 2007; Hartter et al. 2008). However, participatory mapping, description and geographical analysis of the landscape-attached values and benefits among the rural communities revealed the actual spatial dimension, diversity and importance of the material assets creating the observed dynamics within the studied landscapes.

In both study areas, it was shown that the material landscape values and benefits, primarily concerning those land use practices satisfying the basic daily needs of the subsistence-based families, result to scattered patterns in the landscape with low intensities and cover large spatial extent (**II**: Table 2, Figure 5; **III**: Table 1, Figure 4). This is due to their individual character. The majority of mapped subsistence areas, for example in Matemwe, were individual patches with little overlap between informants. In these rural communities, families in general have 1–3 fields under cultivation, which

is the primary reason causing this pattern. Subsistence assets were also the most important and frequently mapped material benefits and, for instance in Cheju-Unguja Ukuu Kaebona, the food services represent almost a third of all the mapped points, indicating the areas of fundamental resource use value for the communities. Based on the analysis of the spatial relationships of the landscape service indicators, it can also be seen that the material benefits have a tendency to co-existence in the same areas, especially those of cultivation, livestock keeping and collection of wild fruits (**III**: Table 2).

Noteworthy is, however, that within these studied landscapes, agricultural practices have also the potential to create homogenous land cover patterns (**IV**: Figure 4). This is seen especially in Cheju-Unguja Ukuu Kaebona where permanent rice farming, possible in the western low-land plain with deep soil (**III**: Figure 4A; **V**: Figure 4C; **V**: Figure 5B), has sustained open land through time and, hence, shows stability in change trajectories (**IV**: Figures 4, 5A; **V**: Figure 3A). In addition, agroforestry practices, farmland with mixtures of planted and indigenous trees and crops, have the potential to some extent sustain closed and semi-open forest land covers (**IV**: Figure 8; **V**: Figure D).

Collection of various forest products, the most important of them being firewood, is crucial for the livelihoods of the rural families and shows a dispersed pattern in the landscape extending outwards from the villages (**II**: Figure 5D; I**II**: Figure 4B; **IV**: Figure 6B). Almost all households collect firewood. In fact, in Cheju-Unguja Ukuu Kaebona it was also seen that the majority (87%) of the informants stated to collect all their consumed firewood. Together with extraction of other forest products, these create a constant element of change on the landscape. However, this effect is not reflected in the change detection, as land cover classification used in this study was unable to reflect such subtle and scattered influence on forests conditions.

Material landscape assets and their spatial patterns, providing the essential contribution to the individual family strategies of subsistence, are for most part behind the human-nature interaction seen concretely in the landscape. Hence, understanding the multiple material benefits related to land and their patterns on the landscape creates the prerequisites for the interpretation of the observed landscape dynamics. Depicted by the material uses, it can be stated that the pressure on land is substantial in the two Zanzibari study sites. Especially forest and scrubland areas surrounding the villages are the basis of the subsistence activities for the local inhabitants. Although, closed forests have sustained throughout the decades and cover a significant part of both study areas, it is mainly scrubland and the spatial extent has been decreasing during the observed period in Matemwe (**I**: Figure 2). In Cheju-Unguja Ukuu Kaebona, on the other hand, the turnover trajectories subject to rapid changes are abundant in the landscape (**IV**: Figure 4). In general, land cover transitions gradually lead to loss of old mature forest and create a continuum of secondary forests at various stages of succession. However, it can be seen that the role of external drivers, such as government intervention through conservation and tree planting, has had a substantial positive influence on the total amount of forest (**IV**: Figure 4).

5.2 Non-material, cultural landscape values enrich the interpretation of community-forest interaction

In addition to the scattered subsistence-related and other material landscape benefits, the overall well-being of the local communities is also crucially dependent on the non-material, cultural values. On one hand, these are very much clustered with high intensities in and nearby the settlement areas and, on the other, show dispersed patterns in the landscape with low intensities (**II**: Table 2, Figures 4, 6B; **III**: Table 1, Figure 4C).

The non-material values and benefits with intensive clustering depict the shared key sites of social interaction and cultural traditions. These collective meeting places, soccer grounds, graveyards and sacred sites, show stability established through the long-lasting past and present interaction of community members. For example in Matemwe, the traditional, aesthetic and leisure values cluster significantly to the same socially meaningful sites, mainly in the sub-villages along the coast, appearing as hotspot clusters (**II**: Figure 6B). In Cheju-Unguja Ukuu Kaebona, it can be seen that especially men have a tendency to gather to the main sub-villages along the main roads from the more peripheral locations in their free time (**III**: Figure 4C; **IV**: Figure 6D). The clustered pattern reflects also the historical settlement development, as for the most part these core areas indicate settlement continuity since the 1930s (**I**: Figure 4E; **V**: Figure 3B) and experience the intensive contemporary settlement increase. The same areas also seem to depict a tendency for negative forest development (**I**: Figure 5).

Moreover, distinct patterns arise especially for the traditional, spiritual and religious values, which are readily mapped and among the most important cultural values among the community members, clustered mainly nearby the sub-villages (**II**: Figure 4B; **IV**: Figure 6E; **V**: Figure 5F). Interestingly, as the results in Cheju-Unguja Ukuu Kaebona suggest, there is no significant spatial association to any other landscape service within the sacred sites (**III**: Table 2). In addition, the majority of the informants (90%) consider these sites to be protected from cultivation and tree cutting activities. Due to these characteristics, shared cultural traditions were also identified as a distinctive class when producing the spatial generalisation of the non-material landscape services (**IV**: Figure 7B; **V**: Figure 4D). Their explicit appearance in change detection analysis is, however, challenging as the spatial extent of these sites is rather limited and LC/LU varies from graveyards with scattered trees to sites of practicing traditional beliefs in closed forests.

In both community studies, the aesthetic values were the most heterogeneous by their descriptive attributes, size and spatial patterns. Aesthetic landscape values were for the most part associated with social interaction, infrastructure, services, possibilities for shopping, and home. Aesthetics was less related to natural features, sea breeze or beautiful scenery. It might be that within such subsistence-based communities where nature has a high utility importance, it is mainly seen as a resource (see also Gössling 2001). This concept of aesthetics differs from societies without direct contact to nature, seen, for example, in landscape value studies by Brown and Raymond (2007) and Tyrväinen et al. (2007). In developed context, it is commonly understood that aesthetic places, es-

pecially in natural landscapes, are much appreciated and have restorative influence both psychologically as well as physiologically (e.g. Ulrich 1986).

Nevertheless, when considering the intrinsic and aesthetic values mapped by the informants in Cheju-Unguja Ukuu Kaebona, there is a unique appreciation of natural features shown by the values attached to high forest areas, forest plantations, individual trees, places where the possibility to spot wild animals exists, and to other subjectively meaningful natural features or to good and deep soil properties. These indicate a highly dispersed landscape patterns found mainly within the rice farming area in western Cheju and scattered on the forest covered land with furthest distances from informant home sites (**III**: Table 1, Figure 4D; **IV**: Figures 6F, 7B; **V**: Figures 4D, 5AB). Hence, the landscape dynamics varies significantly from stability to continuous change within the intrinsic and aesthetic value sites (**IV**: Figure 4; **V**: Figure 3A). The appreciation of natural features especially within the forest areas, imply quite interesting and contradictory community-forest interaction. While material uses are the ones that may lead to forest losses and degradation, these intangible benefits may do the opposite and create circumstances for forest conservation arising from the communities.

By interpreting the non-material, cultural landscape values and their spatial patterns, it can be concluded that the cultural values, often being intangible, play a significant role in complementing the material landscape values and benefits. Thus, the non-material values enrich the interpretation of the community-forest interaction. Although, not all of this interaction is captured through the generalised LC/LU change models (**IV**). In addition, it seems that the cultural landscape values co-exist with the material assets mainly in the settlement areas. This indicates that for the most part the tangible and intangible benefits relate to different areas and places in the landscape (**II**: Figure 6B; **III**: Table 2).

5.3 Knowledge integration increases spatial understanding of the complex socio-ecological systems

Information created through the place-based assessment of the multifunctional and dynamic tropical forest landscapes enables the identification of spatially significant landscape entities. These reflect the factual understanding of the retrospective land use and land cover change and the experiential local knowledge created through participatory mapping. The following discussion focuses on two examples indicating multiple needs and actors creating a significant pressure on the land and forest resources.

The first example is derived from Cheju-Unguja Ukuu Kaebona. Interpreting the geographical patterns and distances of the mapped values and benefits from informant homes alongside the contemporary LC/LU data, approximately a kilometre wide subsistence zone can be identified around the settlement areas in the studied landscape. This zone manifests multiple material landscape values and benefits to the local communities fulfilling their basic daily needs and having hardly any non-material benefits (**III**: Figure 5; **IV**: Figures 7A, B; **V**: Figure 4). In the spatial generalisation of the mate-

rial landscape benefits, this multifunctional zone of agroforestry, shifting cultivation, livestock keeping, collection of wild fruits, medicinal species, handicraft materials, and extraction of coral rock and soil extends to the forest and scrubland areas, covering a significant part of the landscape (**IV**: Figure 7A; **V**: Figures 4C, 5CDE). Resulting from the multiple subsistence uses creating quite a substantial pressure on natural resources, particularly on indigenous forests and semi-open grasslands, these areas show also a constant land cover change in the landscape (**IV**: Figures 4, 8; **V**: Figure 3A).

Another example is the coastal zone in Matemwe, which can be acknowledged as a specific land use entity with a distinct character. The coastal zone between the forest and sea resources, both crucial for the community livelihoods, has been hosting the longest continuity of settlement and attracting a significant part of the recent settlement expansion (**I**: Figure 4). As indicated, for instance, by the hot spot clusters (**II**: Figure 6B), the non-material, cultural values are abundant within this zone, depicting the key areas of community well-being. However, intensive tourism with new local actors and infrastructure development has changed the landscape substantially during the last decades (**I**: Figure 1). Revealed by the change detection analysis, the coastal zone also shows the highest decrease and decline of forest resources during the studied period (**I**: Figure 3C).

The pressure on land in both the subsistence zone and the coastal zone is evident. Although, it should also be noted that the coral rag land with shallow soil in Matemwe, in general, offers poorer environmental conditions compared to Cheju-Unguja Ukuu Kaebona. In the case of Matemwe, it is also likely that forest degradation has largely occurred beyond the time frame of this research. However, influences on the land cover development within these two zones are different due to the local circumstances. Land cover in the subsistence zone is heterogeneous and dynamic but does not seem to show threat of deforestation or actual loss of forest covered land (**IV**: Figure 8). This is due to rotating shifting cultivation with fluctuating de- and reforestation phases and gradual conversion of the indigenous vegetation through agroforestry practice with mixtures of planted and indigenous trees and crops. These farming practices seem to be long-term adaptations to the prevailing physical site conditions and resources and, thus, especially agroforestry has potential to sustain closed and semi-open forest cover over the decades to come (Michon et al. 2007).

Within the coastal zone in Matemwe, the pressure on land, on the other hand, results to forest deterioration, as both the traditional and new land uses seek to co-exist. The coastal zone, as in many other parts in the Zanzibar Islands (Käyhkö et al. 2008) and certainly in other parts of the world (Honey & Krantz 2007; UNEP 2009), is a contested space. There is a risk that the important key sites of the social landscape within the local communities are gradually transformed into aesthetic holiday paradises for international tourists. Hence, the traditional landscape becomes a commodity (Gössling 2001). This hegemony of tourism may lead to unsustainable losses regarding the local community inhabitants. Traits of such development can already be seen as, in addition to the inland relocation of families, access to sea resources has diminished and

sacred sites have been sold and transferred away from the coast (Gössling 2001; Mustelin 2008). However, also positive trade-offs occur in the form of employment, collaboration with the communities, material donations, and trading of construction materials (Gössling 2001; Andersson 2004). The latter, then again, causes increased pressures on the natural resources within the village landscape and neighbouring areas.

The previously discussed examples highlight how the integration of disciplinary and stakeholder expertise in spatial context facilitates understanding about complex socio-ecological systems. Identification of spatially significant entities depicted here focuses on the spatial interactions between local community inhabitants and forest and land resources.

5.4 Participatory mapping enhances place-based assessment of landscape values and benefits

The widespread adoption of participation to development policies often faces practical challenges. For instance in Zanzibar, the value of participation and the appreciation of local knowledge is stated in several national documents (e.g. *National Land Use Plan* (CLE 1995), *Zanzibar National Forest Resources Management Plan 2009–2020* (DCCFF 2008)). However, the practical implementation of dedicated community participation has thus far remained modest although village conservation committees exist in the villages and resource use management agreements have been drawn up with local stakeholders (Williams et al. 1997; DCCFF 2008). Interview-based participation has been realised but the here presented studies are among the first to collect place-based stakeholder knowledge. It can be seen that participatory mapping, description and geographical analysis of the landscape-attached values and benefits from the community perspective enabled the local stakeholders, having limited experience in landscape management, to create valuable spatial data of their landscapes practices and experiences (**II**; **III**). Moreover, in the community meetings, the participants were enthusiastic to read this information in cartographic form and discuss their everyday spatial realities.

The elements of spatiality and participation are both known to be crucial for an effective landscape management process (Termorshuizen and Opdam 2009). Thus, local scale and spatially explicit landscape information produced through participation presumably has practical applicability for the purpose of planning and management of the land and resources. It can be captured only when local expertise is involved at the local level, where individuals and resources meet in everyday context (Luz 2000). I consider the participatory techniques, where multiple stakeholder preferences are collected and analysed in spatial form, for example, to have potential to target priority areas for landscape management or conservation. As observed during the community meetings, map data successfully facilitates understanding about the various landscape values and benefits through visualising their distribution in the landscape. Furthermore, the created information is represented in a legitimate spatial form and may be integrated with other official and expert data sets in GIS for integrated landscape analysis.

One of the main advantages of the PGIS approach is that the non-utilitarian value of landscapes and sensitivity to cultural landscape services, to which many expert evaluations fail to do justice, was captured with participatory mapping and applied landscape value and service typologies. These intangible values have a relevant contribution to human well-being alongside the material values and benefits, and can potentially even exceed the tangible benefits as suggested by Vejre et al. (2010). Hence, their inclusion in landscape assessments and decisions-making upon land should be equally regarded alongside the material values and benefits. The results also indicate a tendency for cumulative place relationship as the theoretical framework suggests. Those informants who mapped more than average amount points were also the ones who had the longest dwelling experience in the village and evaluated their self-perceived knowledge with highest scores (**III**). It can be suggested that these informants have developed a deepened, embedded, relationship to the landscape and the abstract space has become multiple places with attached values and practices (Ingold 1993; Stephenson 2008).

The participatory mapping methodology applied in this research can be applied in and adjusted to different contexts with purposeful conceptualisations and typologies for landscape values and benefits. It can be suggested that especially for practical management of multifunctional landscapes, inclusion of participatory mapping methods may be crucial for two reasons. Firstly, when true collaborative, bottom-up landscape development aiming to sustainability and empowerment is wanted, and secondly, when the desire is to capture also the non-material values of land and resources. However, as Stephenson (2008) has pointed out, community members' views are not necessarily more 'right' than those of experts; the crucial issue is that both forms of knowledge contribute to understanding landscape values-as-a-whole. Agreeing with previous, information needed in decision-making should be spatially explicit on the local scale and based on spatial data and visual representations that go beyond the description of the biophysical values, land cover and land use based on disciplinary expertise and towards the appreciation of the local stakeholder expertise (Brown et al. 2004; Black & Liljeblad 2006; Bohnet and Smith 2007; Alessa et al. 2008; Burkhard & Müller 2008). Such spatial perspective is fundamental since it allows local-level, spatially specific discussions between local stakeholders and has potential to benefit spatial planning.

5.5 Landscape characterisation is a valuable spatial approach for integrating multiple data sources

An integrated landscape conceptualisation, offered by Lorzing (2001), proved to be a valuable theoretical framework to integrate the different ways of knowing the landscape within a landscape characterisation (**V**). Multiple data sources derived from disciplinary expert knowledge as well as place-specific local knowledge of the community inhabitants were integrated to produce a local scale characterisation. The approach acknowledges the inclusion of local participatory input from the beginning and the importance of historical landscape change in understanding the contemporary landscape. The char-

acterisation had a focus on the expected information needs for community forest management (CoFM) planning process in Zanzibar, but the methodology is applicable also in other contexts. Through interpreting the landscape characterisation as four thematic representations accompanied by photographic visualisation (**V**: Figures 3, 4, 5), it is possible to facilitate information of the landscape as a whole in spatial context; to depict the physical-material landscape features, human intervention in landscape as well as the subjective perceptions of the landscape. The characterisation mediates information of the character of areas and places in the studied landscape and of the role of the forest resources in question as part of the landscape entity.

Landscape characterisation can be regarded as a valuable spatial approach for the integration of multiple data sources. These kinds of operative local scale planning tools, which appreciate both expert and local knowledge, are urgently needed in the developing countries context (Duvail et al. 2006; Rambaldi 2010; Valencia-Sandoval 2010; Bourgoin et al. 2012). They have potential to create consistent and effective information about the land. It has been suggested that integrated spatial methods of landscape visualization, such as landscape characterisation, have the practical advantage to facilitate knowledge creation, enhance communication among the stakeholders, build social capital and capacity for participation, and potentially encourage more informed decision-making (Bohnet and Smith 2007; Rambaldi 2010; Vervoort et al. 2010; Bourgoin et al. 2012). Additionally, transdisciplinarity in spatial planning may be enhanced when participation is realised from the beginning in the process and the resulting characterisation used in practice with stakeholders in the decision-making (Fry et al. 2007; Reed 2008).

Especially in circumstances such as Zanzibar, where local level general land use plans guiding resource management do not exist, landscape characterisation might have significance in participatory spatial planning. Thus, it is anticipated that the proposed characterization could be used in CoFM process in the studied areas to make judgments about the landscape and specifically forest management in collaboration with the stakeholders. The actual implication of the characterisation in planning is beyond the scope of this work. However, it is important to emphasise that negotiations about the future land management are intensely political and include power relations (Wood 2010). Regarding Zanzibar, land negotiations may be challenged by the diverging interests of the ethnically mixed population, the complex system of land allocation and the Government planning practice, and insecurity of tenure. Hence, to avoid the potential negative consequences of participation in spatial planning, emphasis should be placed on skilled facilitation and on building trust between the involved actors (Kyem 2001; Fox et al. 2006; Rambaldi et al. 2006b; Bourgoin et al. 2012).

5.6 Participation and spatial knowledge in multifunctional tropical forest landscapes: practical reflections

Scattered and dynamic subsistence use of natural resources in tropical forests is challenging to manage in a sustainable way when balancing between community livelihood

needs and other essential ecosystem services on the local, regional, national as well as on the global scale (UNEP 2007). This is also identified within the REDD+ framework (Parker et al. 2009). Among the studied rural communities in Zanzibar, the scattered pattern of the use of natural resources, especially nearby the settlement areas, generates a constant element of change in the landscape, creates land use pressures and may trigger conflicts. In general, the community members in the studied areas are aware that the natural resources are under high pressure and have been deteriorating. They are worried that the situation will be worse in the future with the increasing population, as observed during the community meetings.

Conservation initiatives regarding forests and natural resources aim to maintain the biodiversity and safeguard crucial ecosystem services by enforcing limitations for the use of material resources (FAO 2010). This is, however, problematic when subsistence-based communities influenced by these initiatives have little options for alternative livelihood development or for the creation of monetary income. As shown in Cheju-Unguja Ukuu Kaebona, the spatial distribution of the mapped material services indicate that even inside the protected forests in the Jozani-Chwaka Bay National Park, resources are extensively used (**III**). For many of the communities, those gazetted forests are appealingly close to their homes. While, for example, the collection of dry wood is allowed within the so-called low impact zones of the national park, families are also forced to cut wood and extract other materials due to limited resource base. Hence, forests are not truly protected. On the contrary, gazetting forces pressures elsewhere but simultaneously is too weak in itself to sustain from pressures.

For the part of Matemwe, it is suggested that a protected area could be established to conserve the remaining forest resources from deterioration (**I**). However, this can only be made successfully in collaboration with the local stakeholders, especially the farmers, and cannot be realised if effective mechanisms enhancing permanent agriculture, such as agroforestry, and alternative livelihood and income generation are not realised simultaneously. At the government level, investments should also be directed to the promotion of fuel wood saving stoves, alternatives for wood fuel, compensation mechanisms and nature tourism revenue sharing to make the absolute use restrictions beneficial for the communities. Such supportive policy environment is considered successful to tackle forest and livelihood losses in tropics (Müller & Zeller 2002; Rudel et al. 2005). Moreover, community-based tourism has unrealised potential in Zanzibar (Lange & Jiddawi 2009; Tamrini 2009).

Highlighted by these challenges, it can be stated that there are hardly sustainable solutions to tropical forest management or conservation strategies without the dedicated participation of local community stakeholders, who interact with the land on daily basis. Especially local level spatial information, depicting how these actors use and value the land and resources and operate in this socio-ecological system, is crucial. Thus, I argue that place-based local knowledge has potential for improved decision-making when institutionalised in landscape and forest management processes. At policy level, approaches combining participation with spatiality and aiming at knowledge integra-

tion may have several premises and, for instance, could be included in the community forest management (CoFM) guidelines.

The crucial aspects of participation and spatiality should be bound together to identify priority areas for management and conservation, at the same time allowing subsistence uses. Both the local stakeholders and the Government should be active in together finding areas of multifunctional land uses under community-based forest management. The results suggest that agroforestry has potential to sustain forest cover and offers multiple material benefits for the farmers. Thus, it could be promoted as a cultivation strategy. This farming practice, also identified as domestic forestry, has also premises to maintain the multifunctionality and biological diversity of ecosystems (Michon et al. 2007; Lambin & Meyfroidt 2010). Additionally, agroforestry may have practical relevance when tackling forest losses globally, for instance within the REDD+ process aiming to find operative ways to compensate countries for the prevention of forest losses while mitigating climate change (Parker et al. 2009; Burgess et al. 2010). There is an increasing understanding that multifunctional land use is not only ecologically more sustainable but also preferred socio-culturally and often also more beneficial than intensive conversion to mono-use (e.g. conservation or economic activity) (de Groot et al. 2010). The solutions should be found on the local scale, from where these can be projected to the global efforts of conserving biodiversity and sustaining the crucial ecosystem services. However, an important factor to acknowledge is the extensive population growth, which may bring drastic changes to the local situations. To manage these challenges, the importance of family planning besides the development of more effective spatial planning practice is very important.

5.7 Considerations of methodological and ethical issues

5.7.1 Landscape patterns and change detection

Some methodological challenges related to the measurement and analysis of the LC/LU change, based on the combined use of historically extending aerial photographs and maps, and implemented on heterogeneous landscapes can be outlined. These relate especially to the availability and temporal frequency of the data sets, mapping, and methods in the identification of meaningful changes for an established purpose, as described earlier also by other authors (e.g. Ahlqvist 2002; Petit and Lambin 2002; Strand et al. 2002; Vuorela et al. 2002; Fuller et al. 2003).

At the most fundamental level, the study of landscape patterns is constrained by the availability of spatial data sources. Zanzibar has wealthy records of archival spatial data with rather sufficient temporal sequence for change detection. However, the temporal extent is rather narrow and covers only the past 70 years. The discrete time layers represent snapshots across decades and, thus, should be considered as spatio-temporal models of forest dynamics aiming to generalise and emphasise characteristic development rather than underlying individual changes in the studied areas (**I**; **IV**; **V**).

In the case of Zanzibar, three central challenges in landscape mapping efforts can be identified. Firstly, it is difficult to establish common nominators for homogeneous mapping units at detailed levels along the temporal sequence, which would take into account the *in situ* LC/LU patterns simultaneously. Secondly, it is challenging to determine between within-patch and between-patch heterogeneity, which means that one needs to be quite knowledgeable of the influences of spatial scale on the visual interpretation of land cover patterns. Thirdly, black-and-white aerial images can have poor visual quality for identifying individual buildings, especially those with palm leaf roofs. Due to the challenges and image quality differences in the data sequence, simple structural classification was applicable to overcome the problem of delineating land cover patches on the basis of multiple simultaneously occurring land uses in the analyses of forest cover change trajectories from the 1950s to the 2000s (**I**; **IV**; **V**). Land use changes were also decided to be studied independently from land cover (**I**) and land cover together with land use was interpreted only from the most recent colour aerial image (**IV**; **V**). Due to the difficulties in interpreting buildings, settlement trajectory analyses excluded the 1950s data (**I**; **V**).

Detailed mapping of landscape features was a tedious process where stereoscopic interpretation offered valuable support. Problems of harmonising the information content, on the other hand, were avoided as the spatial data sets shared rather similar scales. Land cover, land use and settlement patterns were analysed with different methods and spatial scales enabling evaluation and comparison of the results in terms of the key change processes that each of the analysis reveals (**I**; **IV**). Furthermore, the aggregation of change trajectory classes on the basis of combining statistical and expert knowledge rather than automated clustering or grouping techniques was considered a valuable approach, as it allowed the generation of meaningful change trajectories from the perspective of tropical forest development (Käyhkö & Skånes 2006, 2008).

5.7.2 PGIS campaigns and spatial analysis

Based on the experience gained from organising PGIS campaigns and analysing the collected data, some methodological aspects regarding applied typologies and concepts, informant sampling, map reading and precision in mapping, spatial representation and analysis are also worth of discussion.

Modifying a suitable typology capturing the essential values and perceptions attached to the landscape is challenging, as these vary between cultures and contexts. In this research, the selection of the mapped landscape value and service typologies was researcher-based. However, I considered it crucial that these were discussed and the interview questions modified together with the local members of the research team, based on experience from other studies and cumulated through the research process. The interview questionnaires were also tested *in situ*. Alternatively, for discovering values arising from the community itself, for example, a grounded perspective method (Stephenson 2008) could be applied. In addition, as our findings indicate coexistence and contextual interpretation of landscape values and benefits, it would also be worth

of exploring the conceptualisation of typologies arising from the context of developing societies. Furthermore, exploring a combination of landscape benefits that together establish the essential contribution to community well-being would be useful, as mapping several services is relatively laborious.

When comparing the two different concepts applied to mapping in this research, I consider the landscape service concept and framework (**III**; **IV**; **V**) potentially indicate higher relevance for political decision-making, although both concepts were operable in conceptualising the diversity of the subjective everyday landscape practices and experiences. Capturing local knowledge of landscape services in spatial form creates a significant contribution to the political use of landscape and ecosystem service framework. The traditional ways to assign value to nature's services have been realised through ecological assessment and economic valuation, which often fail to describe or even neglect the socio-cultural values (e.g. Daily 1997; de Groot et al. 2002; Lange & Jiddawi 2009). Ecosystem and landscape service concepts are philosophically founded on an anthropocentric philosophical approach, namely utilitarianism, which is based on the notion that nature has value only when it can provide some satisfaction or benefit to humans. Criticism that utilitarianism has faced deals especially with the concern of over-exploitation of natural resources (Goulder & Kennedy 1997). However, as humans, we have also the possibility to understand the limits of sustainable use, the unique value and need for conservation. In this context, an important notion worth of emphasising is the identification of the non-use or existence values of nature that can be captured through stakeholder participation.

Analysis of the individually identified social landscape values and landscape service indicators for collective characteristics and spatial patterns requires representative samples in terms of their geographical distribution and content. Hence, each sub-village in both study areas was included in the sample, which was based on the relative amount of buildings/inhabitants in the sub-village, as census enumeration data enabling geographically balanced random sampling was not available (**II**; **III**). However, this applied sampling method has shortcomings that should be acknowledged. Firstly, the amount of buildings does not reflect the actual number of inhabitants but rather gives an approximate estimation. Furthermore, informants were selected by the village leaders, who were instructed to select only one person from each household. However, it is possible that some informants were close relatives to each other or even relatives of the village leaders. On the other hand, the rural villages are traditionally clan-based and I consider it not likely that such subjective selection had too much influence on the validity of the sample.

Participatory mapping was in both PGIS campaigns realised by using aerial photographs. In contrast to abstract map representations, which have found to be problematic in participatory mapping (Zurayk et al. 2001), use of orthoimage maps proved to be successful and visually attractive without too much abstraction (Corbett et al. 2006). Community stakeholders were able to identify places and areas on the map with little support, engaging even illiterate informants (see also Taylor et al. 2006; Bernard et al. 2011). Furthermore, during the reflective community meetings, participants were

able to interpret the orthoimage maps where the results of the mapping were shown. However, personal differences were evident and in some occasions, the facilitators were guiding informants who had difficulties in map reading. It was also interesting to observe, how well-established site knowledge the community people have, especially in the north-south direction located Matemwe. The chosen map scales were both appropriate for mapping. However, it was observed that the larger scale orthoimage map used in Matemwe (**II**) was somewhat better for comprehending distances. Within this research, no field verifications were made for the data mapped by the community informants. However, Bernard et al. (2011) completed a same type of community mapping campaign, where field verification of located points revealed high accuracy rates. It was observed during the fieldwork that mapping is simpler when accomplished close to the informant's home, allowing perception of the environment from a familiar point of view. It is also likely that the precision in mapping was increased by the fact that interviews were made outside in a setting where the landscape surrounds the informant and where it is, for example, easy to point directions. Precision was also increased through the available support for map reading and mapping in the interview situation. Additionally, Zanzibar has a relatively flat topography, which might have helped in the interpretation of the orthophoto map.

Inherently, the mapped data includes ambiguity as the mapped sites can be spot-like features (e.g. beautiful house) and others having a wider extent or an imprecise boundary in the real world (e.g. field or site for collecting handicraft materials). However, the same ambiguity applies in the real world as well, and it has been questioned whether participatory mapping approaches necessarily have to aim for exact accuracy to be regarded as scientific (McCall 2006). When landscape-attached values and benefits are mapped, they need to obey the prerequisites of the chosen mapping format. Polygonal data collection method requires the creation of exact borders even for continuous features. In this research, some of this accuracy was lost when the data was collected through a grid-cell approach, creating fuzziness in the data (**II**). The map scale affects the size of the delineations made by the informants and, hence, area sizes vary between studies (see e.g. Black & Liljeblad 2006). Because of the detailed scale orthoimage, the social landscape value delineations were, in general, quite small in size and area specific. Then again, when using the point data collection method the points are considered to represent the centroids of the spatial occurrence of a feature with indeterminate extent, and point accuracy is affected by the actual size of the mapping medium in relation to the map scale (**III**).

The results suggest that both settlement-related and geographical distance-dependent functions play an important role in the assessment of landscape values and benefits. When the polygon and point mapping methods are compared, the spatial patterns and also the distances between the home and mapped features, show consistency (**II**; **III**). This suggests validity for both applied methods. Moreover, Brown and Pullar (2011), in a comparative quasi-experiment setting, concluded that points and polygons mapped through stakeholder participation converge on a collective spatial 'truth' provided there

are enough observations. However, a crucial question to address is the number of informants needed to identify a collective, spatially significant location. Brown and Pullar (2011) argue that there can be no definitive answer, although more spatial agreement among respondents suggests higher confidence. Fraser et al. (2006) claim that collecting data through participatory processes should be realised at detailed local scale, which can be aggregated into larger planning units. The challenge, though, remains to extrapolate and generalise this data to higher spatial scales, an issue related to this research and discussed by many scholars (e.g. de Groot et al. 2010; Schaich et al. 2010). Within this study, the approach to up-scaling was to analyse the landscape service indicators with a coarser cell size (**III**). However, there is a need to further develop the methods for up-scaling.

Given the previous discussion, I consider it important to acknowledge but also to accept the geospatial uncertainty in mapping and analysis of landscape values and benefits (MacEachern 2005; Yao & Jiang 2005). Eventually, the interest in this research was not in exact locations and the highest precision but in the spatial landscape patterns. Based on experience from the two PGIS campaigns, I have methodological preference for the point mapping method when realised in single-informant interviews. Points are rather easily mapped by the informants and the method also avoids the problem of mapping large polygonal areas, covering a substantial part of the study area, which have little significance for identifying collective spatial patterns (Brown & Pullar 2011).

This research did not touch the trade-offs of landscape values and services between the studied villages and the surrounding areas, which would offer a further challenge for research. The data collected in the PGIS campaigns is also due to change over time. Significant changes in the spatial patterns could result, for instance, through improved connections to the more remote sub-villages through road pavement. For future applications of mapping, the inclusion of other stakeholder groups would be an essential step not implemented in this research and the gender differences would certainly deserve greater attention. My interest lies also in analysing the actual communication process where PGIS and integrated data would be used in spatial landscape planning. Moreover, it would be interesting to apply participatory mapping in other societal contexts with a different type of community structure as a contrast to these spatially clustered communities in Zanzibar. Another interesting addition to future studies would be a stronger mixed methods research by including qualitative ethnographic approaches, for example, in the form of oral histories and narratives (see e.g. Nightingale 2003; Kwan & Ding 2008) or walking interview methodologies (Evans & Jones 2011). This could enrich the lived experiences of the informants and, hence, deepen the understanding of different landscape values and benefits in relation to geographical patterns.

5.7.3 Integrated methods in spatial context

The integrated methods of spatial analysis applied in this research were, firstly, making simple combination of the data by analysing the spatial relationships (**III**; **IV**). Secondly, an attempt was made to spatial generalisation of the landscape services in relation to

LC/LU (**IV**; **V**). Given the heterogeneity and sensitivity in the ways landscape benefits are distributed in relation to actual land resources and the contextual nature of many especially cultural services, it was considered that the applied interpretative approach was a suitable first step to explore the possibilities for spatial generalisation at the landscape level. Other generalisation methods based on quantitative comparison to physical landscape attributes have been adopted, for example, by Sherrouse et al. (2011). However, the interpretative delineation of generalised classes allowed reflecting both the spatial patterns and the descriptive attributes of the landscape benefits in relation to LC/LU. The inherently uncertain nature of the collected data was appreciated when creating the spatial generalisation of the landscape services for the characterisation purpose through the use of a fuzzy visualisation technique (**V**). Thirdly, more dedicated integration was explored at the theoretical-methodological and the actual level of data in the landscape characterisation, where the emphasis was also on the interpretative approach.

I found the integrated research approach and the use of various sources of data and multiple methods of analysis useful to address the complexity of the multifunctional and dynamic tropical forest landscapes in spatial context. The landscape service mapping approach proved to be successful in linking the site-specific land cover transitions to their potential causes. It can be argued that understanding the multidimensional phenomenon of tropical forest decline and degradation requires approaches and methods bridging natural, human and social sciences. More dedicated integration to studying the community-forest interaction could be reached with the integration of socio-economic or ecological spatial data (e.g. Opdam et al. 2006). Thus, the challenge remains to further elaborate the integrated research approach and methods of analysis.

5.7.4 Good practice and ethical challenges of participatory mapping

Mapping is evidently an activity related to power. The development of cartography depicts how maps have traditionally been used as tools for representing power (Wood 2010). For a researcher and facilitator having the power in a participatory mapping process, crucial is the commitment to ensure that the process leads to sustainable gains, not losses, for the rural communities. Conducting a participatory research in a developing context and following a good practice are, however, embedded in ethical dilemmas throughout the work. There exist ethical guidelines to follow, such as the codes of ethics in anthropology, ethnobiology and GIS (AAA 1998; ISE 2006; URISA Board of Directors 2003). Challenge is that every research setting is unique and, in the end, the researcher must subjectively make the best judgement to ensure good practice and make decision about the best ethical choices. As a guide towards a good practice in participatory GIS, Rambaldi et al. (2006a, Figure 3) have suggested a compilation of 'Who?' and 'Whose?' questions dealing with the planning and mapping process, information control, ownership and empowerment. In the following discussion, I seek to reflect these questions in the context of this work.

An essential aspect of participatory mapping activities is to consider who is included in and who excluded from the process. For research purpose, informant sampling

STAGE 1: PLANNING

Who participates?
Who decides on who should participate?
Who participates in whose mapping? …and who is leftout?

Who identifies the problem?
Whose problems?
Whose questions?
Whose perspective?
…and whose problems, questions and perspectives are leftout?

STAGE 2: THE MAPPING PROCESS

Whose voice counts? Who controls the process?
Who decides whati s important?
Who decides, and who should decide, on
whatt o visualise and make public?
Who has visual and tactile access?
Who controls the use of information?
And who is marginalised?

Whose reality? And who understands?
Whose reality is expressed?
Whose knowledge, categories, perceptions?
Whose truth and logic?
Whose sense of space and boundary conception (if any)?
Whose (visual) spatial language?
Whose map legend?
Who is informed whati s on the map? (Transparency)
Who understands the physical output? And who does not?
And whose reality is leftout?

STAGE 3: RESULTING INFORMATION CONTROL, DISCLOSURE AND DISPOSAL

Who own the output?
Who owns the map(s)?
Who owns the resulting data?
Whati s leftwith those who generated the information
and shared their knowledge?
Who keeps the physical output and organises its regular updating?

Whose analyses and use?
Whose analyses the spatial information collated?
Who has access to the information and why?
Who will use it and for what?
And who cannot access and use them?

ULTIMATELY…

What has changed? Who benefits from the changes?
At whose costs?
Who gains and who loses?

Who is empowered and who is disempowered?

Figure 3. Compilation of 'Who?' and 'Whose?' questions as a pathway leading towards a good PGIS practice (Rambaldi et al. 2006a, modified).

in the studied communities was aimed at a valid representation of informants. Hence, the decision of who were considered as interesting informants in the studied communities was researcher-based. The procedure of informant sampling by the village leaders raises questions about who actually controls the process. When the language barrier prevented personally understanding all aspects of discussions during the field work, the role of the facilitators was emphasised in assuring a good practice in informant selection. Participation in the interviews was also to be on voluntary basis, but it is not certain if some of the informants had been pushed to participate during the informant selection, compromising the informed consent (ISE 2006). On the other hand, local circumstances need to be accepted and respected. A population register enabling valid sampling was not available and the *shehas* had to have permission to follow the on-going research activities and had an obligation to accompany the researchers. Additionally, informants received a small monetary compensation after the interviews, which may have generated some prejudice in the results (Mikkelsen 2005: 344). Then again, had compensation not been given, the motivation to participate would have been lower, as the informants could not, for example, attend their normal daily field activities. During the reflectory meetings, remuneration was realised in the form of food and drink.

Because of the subjective nature of the mapped information, single-informant interviews were preferred as the data collection method. This ensured that every informant's voice was heard in the process as opposite to group mapping setting, in which the common risk is that some persons dominate the process while shy ones stay observing (Chambers 2002; Mikkelsen 2005; Bernard et al. 2011). However, also the interpersonal power relations affect the interview process and are linked to ethical issues (Madge 1997). What the informants are willing to share with the researcher depends on the appraisal of and the trust they place in the researcher. Hence, the informant ultimately has the power to decide what kind of a voice is heard. This is especially relevant when considering that the interviews were partly facilitated by the forest officers from the DFNR, who are engaged with forest planning and management in Zanzibar. During the fieldwork, their position as researchers and not as forest officers was emphasised and the informants were ensured that the mapped information, particularly concerning the use of resources within national park, was confident, would not expose the community to a difficult situation and authorities will not use the information against the community.

Despite the positive aspects of collecting local knowledge in spatial form, there are issues of representation that one should be aware of. When community inhabitants' knowledge is represented on a map, it consequently becomes available for public, even for outsiders, and the relevant questions to address are: who will use it and for what purpose? As an ironic effect that could undermine the goals of participatory mapping, Fox et al. (2005) have pointed out that map representations of local knowledge on land could potentially weaken the existing common property management systems. As Abbott et al. (1998) have noted, there are also risks of visualising spatially explicit local knowledge. Potential for exploitation exists if the use of the data goes out of local control and, for example, instead of locating development needs, the data might be used for extracting more taxes or for exclusive land privatisation (Abbott et al. 1998; Fox et al. 2005). In the Zanzibar research setting, a potential threat is, for instance, the representation of religious and sacred sites on the maps and by doing so, not appreciating the confidentiality of these traditional values. I have avoided representing the collected data in exact precision in the produced cartographic representations of the location of the religious and sacred places. Most of which, however, are well-known sites with long traditions, but some might be used only by a few people.

The reflective community meetings had an important role in sharing the information and raising discussion among the community members. The topics of discussion also raised concerns related to the use of natural resources, level of collaboration and gender differences in resource management. Personally, this part of the research was significant, as I conceive it crucial to respect and show commitment to the communities involved in the study. Local knowledge was returned to those who actually generated it, an aspect related to the protection of intellectual property rights (ISE 2006). As maps are not an end but a means for further interpretation, the community reflection had also a significant role in deepening the interpretation of the results. In most meetings,

the discussion proved to become very lively after a quiet beginning when participants were interpreting the map data. However, it was also noticed that the facilitators of the discussion had to be aware of the sensitivity related to land management and to avoid inflaming any potential conflicts among the stakeholders. Such situations included, for example, corruption related to the sales of land plots, where the *shehas* often make profit, and the competitive use of coastal land and resources. To appreciate the input of the community members and the data generated by the informants, maps and printouts with Swahili information and legends used in the meetings were given to the communities. These could potentially be used when discussing the use and valuation of natural resources. However, we cannot be sure if this gesture, aiming to strengthen the ownership of the local knowledge, makes the data publicly available in the communities.

One of the most important questions to address in participatory mapping exercises is the fundamental one of empowerment, which is an essential aspect of participation and related to capacity-building of the stakeholders. One of the main purposes of this research has been to create a scientific contribution. To justify this, the purpose of the research and the potential lack of concrete benefits were explained to the community stakeholders in order to not to raise too much or false expectations. However, the participatory process itself may have the advantage to promote capacity-building and empowerment of the stakeholders (Kyem 2001; Kesby 2000; Reed 2008; Corbett & Rambaldi 2009). Thus, the applied relevance of this research is to promote community empowerment and capacity-building and capacity-building within the research team. The value of a participatory process is stronger when different members and groups within the community are equally participating (Chambers 2008), which was realised through the applied informant sampling method. After the participatory mapping campaigns, positive feedback was given by the local level administration. The village leaders appreciated that not only those community members who regularly are engaged in environmental issues at the village level were participating but informants also represented the community as a whole, creating extensive information sharing. However, it is important to notice that not everyone had the possibility to participate, as the informants were selected through sampling.

In the end, mapping is always a political process and there could be some unintended consequences of the research activities that cannot be known (Madge 1997; Corbett & Rambaldi 2009). I have grown familiar with the Zanzibar context and come closer to the insider's perspective, especially when residing within the community. Yet I acknowledge being an outsider, having the visitor's gaze already laden with particular cultural values, attitudes, ideologies and expectations (Wiley 2007). We have to be critical about our own positionality in the research team consisting of academics and forest officers working as reserachers, and identify that we are not politically neutral. Indeed, there are power relations involved that should be acknowledged to ensure a good practice and to identify embedded ethical dilemmas when working with local inhabitants.

6. Conclusions

In this dissertation, I have put forward the use of an integrated landscape conceptualisation for the study of community inhabitant's values and benefits in dynamic tropical forest landscapes. I have studied the land cover and land use changes and the stakeholder practices and experiences in the landscape. Furthermore, my interest has been to explore methods for integrating the expert and local knowledge of landscapes. I have also discussed the potential contribution of participation and integrated spatially explicit knowledge for landscape planning and management in Zanzibar and in the tropical developing regions in general. A greater focus in the dissertation was placed on exploring the participatory GIS methodologies and their implementation in the spatial analysis of landscapes. The central conclusions of the research can be highlighted through the following notions:

The prerequisites for the interpretation of the land cover and land use change over time are created through understanding the multiple material benefits related to land and forest resources and their patterns in the landscape. However, the cultural values, often being intangible, play a significant role of complementing the material landscape values and benefits and, thus, enrich the interpretation of the community-forest interaction. An increased understanding of the complex socio-ecological landscape system is reached once the expert and local knowledge are integrated in spatial context.

The studied tropical forest landscapes in Zanzibar are highly dynamic, spatially heterogeneous and fragmented in character due to multiple land uses. Closed forest and scrubland cover is dominant in the landscape and external forest conservation and plantation interventions of the Government of Zanzibar have had a substantial positive influence on this. However, the extent of forest is constantly decreasing. Land cover transitions gradually lead to loss of old mature forest and create a continuum of secondary forests. In subsistence-based communities, these transitions are created by the use of material resources fulfilling the crucial basic daily needs of the families. The most important subsistence activities include shifting cultivation, agroforestry, grazing and

fuel wood collection. Since the patterns of the material activities in the landscape are scattered and individual in character, they create a significant pressure on the land.

Alongside the material landscape benefits, the well-being of the rural communities is dependent on the non-material, cultural landscape values. Their intensive clustering in and nearby the settlement areas depicts the shared key sites of social interaction and cultural traditions established through the long-lasting past and present interaction of the community inhabitants. Highly dispersed landscape patterns are shown by intrinsic and aesthetic values attached especially to various natural features in forested land covers and open cultivation land. However, community-forest interaction depicted by the cultural values is not entirely captured through the LC/LU change models. Reflecting the place-based landscape information created by experts and local communities, it is possible to identify spatially significant landscape entities. This information facilitates understanding about the spatial interactions between local actors and land and forest resources occurring at the local village level.

Participatory mapping, description and spatial analysis of landscape values and benefits has broadened the understanding of the uses and values attached to the land. The PGIS methods applied in this research enabled the community inhabitants to create valuable spatial data of their subjective everyday landscape practices and experiences. This information was reflected and interpreted in community meetings. Participatory mapping of local knowledge was successful through applying the concepts of social landscape value and landscape service indicator. However, the latter potentially indicates higher relevance for political decision-making, presuming the holistic ecosystem and landscape service frameworks gain stronger ground. One main advantage of the participatory approach is capturing the non-utilitarian and intangible value of landscapes, to which many disciplinary expert evaluations of landscapes fail to do justice. Hence, it is crucial that both the material and the non-material, cultural, landscape values and benefits exist in balanced representation in landscape assessment.

Local scale and spatially explicit landscape information produced through participation presumably has practical applicability to enhance collaborative, bottom-up landscape development. The participatory mapping process itself may enhance capacity-building and empowerment of local communities but requires the thorough consideration of the questions of good practice, power relations and ethical issues. When the community stakeholders' knowledge of landscapes is represented in a spatial form, it can be integrated with other official and expert data sets in the GIS environment. Both of these forms of knowledge contribute to understanding landscape as a whole. An integrated spatial perspective is fundamental since it allows local-level, spatially specific discussions between stakeholders and has potential to benefit spatial planning. Landscape characterisation can be regarded as a valuable spatial approach for knowledge integration and visual representation on a local scale, mediating understanding of forest resources as part of the landscape entity. Characterisation supports participation throughout the process and, hence, has potential to enhance communication and transdisciplinarity in planning processes.

Sustainable solutions to tropical forest management require the dedicated participation of local community stakeholders. It is argued that place-based local knowledge has potential for improved decision-making when institutionalised in landscape and forest management processes. At policy level, approaches combining participation with spatiality and aiming at knowledge integration may have several premises. Supportive policy environment promoting multifunctional land use practices, such as agroforestry, should be appreciated as a strategy towards sustainability in subsistence-based communities. At the same time, alternative livelihood options need to be promoted. Sustainable solutions should be found on the local scale, from where these can be projected to the global efforts of conserving biodiversity and sustaining the crucial ecosystem services.

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Appendices

Appendix I. Questionnaire for Matemwe participatory mapping campaign.

Participatory mapping questionnaire Matemwe

You will be participating in a study where we ask you about your use of environment. The results will be used only for research purpose and your name will not be mentionad at any stage. We start by asking some background questions and then we ask you to draw important areas on this aerial image. This is a map that presents the whole shehia of Matemwe. Let's take a look at the image. We are now here. Where do you live? Can you show us. Let's mark your home on the map.

Katika utafiti huu tutakuuliza juu ya mazingira unayoishi. Matokeo ya Utafiti huu yatatumika kwa ajili ya utafiti tu na jina lako litahifadhiwa. Kwa kuanzia tutakuuliza Historia ya Kijiji na baadae tutakuomba utuchore maeneo muhimu katika picha hizi za angani. Hii ni ramani inayooensha eneo la shehia ya Matemwe. Kanza hebu tuiangalie Ramani yetu. Sawa tupo hapa. Wapi unaishi? Unaweza kutuonesha? Hebu itie alama nyumba yako.

Background information

Date: *Tarehe:*	Time: *Muda:*	Interview village: *Jina la kijiji:*	Respondent ID:
Respondent's name: *Jina la mhojiwa:*		Sex: M F *Jinsia:*	Year of birth: *Mwaka wa kuzaliwa:*
Martial status: *Ndoa:*		Number of children: *Idadi ya watoto*	

Members in the household (who lives together?):
Idadi ya wakaazi mnaoishi ndani ya nyumba

Source of living (where do you get money and food?):
Kipato chako kinategemea shughuli gani

Schooling and education:
Shule na elimu yake:

1 No formal education	2 Some elementary ed.	3 Comleted elementary
4 Secondary ed.	5 High school graduate	6 Other ed. (specify)

Lived in this village (yrs): *umeishi kwa muda gani hapa?*	Moved from: *lini umehamia?*

Moving and visiting places (do you stay in your village or do you go regularly somewhere/occasionally to some place?:
Huwa unakwenda kutembelea vijiji vingine au hutoki katika kijiji unachoishi?

1 village scale	2 shehia scale	3 Unguja scale	4 even further

Now we will start the mapping. We ask you some questions and you get to draw areas on the map.
sasa tutaanza kuchora ramani. Tutakuuliza baadhi ya masuali na tunaomba uchore katika ramani.

Additional notes:

Economic value

1. Do you or your family cultivate crops or seaweed? Yes No
   Unalima au familia yako inalima mazao? Au mwani?

   Can you show from the aerial image where your field/fields are? Please draw the area/areas on the map. Where are your spouses fields?
   Unaweza kuonyesha katika ramani wapi mnalima? Tafadhali chora eneo hilo katika map. Shamba la mke/mume wako lilipo?

   What do you cultivate in this field/these fields? (Write codes to the table.)
   Mazao gani mnapanda katika shamba lenu/yenu (Chagua alama katika jedwali.)

   Is this shifting type of cultivation? What is the rotation perioid? (Write to the table if a field is under shifting cultivation and the perioid.)
   Je hiki ni kilimo cha kuhama? Kama ni sahihi, muda gani unapita kabla ya kulima tena sehemu iliyohamwa (Andika kwenye jedwali iwapo kilimo ni cha kuhama, pamoja na muda shamba linaopumziswa)

   Do you or your family have livestock? Yes No
   Je,kuna mmoja katika familia yenu anayetunza wanyama wa kufugwa?

   Can you show from the aerial image the grazing areas? Please draw the area/areas on the map.
   Unaweza kuonyesha katika ramani maeneo ya malisho ya mifugo? Tafadhali chora maeneo hayo.

   What kind of livestock and how much do you have? (Write codes to the table.)
   Ni wanyama aina gani na wangapi ambao mmoja wa familia yenu anafuga? (Tafadhali andika alama katika jedwali)

2. Do you collect forest products? For example something that you use at home or sell. (Give some examples.) Yes No
   Unakusanya bidhaa zinazotokana zozote zinazotokana na misitu mfano kwa ajili ya kuuza au kwa matumizi ya nyumbani? (Muulizaji tafadhali toa mifano).

   Where are you doing this? Let's look at the map. Could you draw the area/areas on the map?
   Ni wapi unakusanya bidhaa hizi? Tuangalie ramani. Tafadhali chora kwenye eneo unalokusanya hizo bihaa.

   What products do you collect in this area/these areas? (Write codes to the table.)
   Ni aina gani ya mazao unayoyakusanya katika maeneo haya? (Jaza alama zilizopo katika jadueli.)

   If several areas are drawn:
   If you think about your livelihood, which of these areas (Q 1 and Q 2 together) that you have now drawn are the three most important ones for you? Which is the most important for your living, which is the second and which the third important areas? (Write importance ranking codes 1-3 to the table.)

   Iwapo umechora maeneo mengi unayoyategemea kwa maisha, ni maeneo mangapi (swali 1 na 2) ambayo ni muhimu kuliko yote kwako? Lipi ni muhimu kwa maisha yako, lipi la pili kwa umuhimu, an lipi ni la tatu? Ainisha umuhimu wake kwa kuyapa namba moja hadi tatu.

Traditional value

3. Are there religious or sacred places for you? We mean places where you practice some traditional activities (e.g. praying, worship, bury people, kumbaya). Yes No

   Je, kuna maeneo yanayotumika kwa kuabudu au matakatifu kwenu? Tunamaanisha maeneo ambamo mnafanya shughuli za kiasili, kwa mfano kuomba, kuabudu, maziko.

   Can you show this place/these places on the aerial image? Please draw the area/areas on the map.
   Unaweza kuyaonyesha maeneo haya katika ramani? Tafadhali chora eneo hilo katika ramani.

   What do you do in this place/these places? (Write answers to the table.)
   Mnafanya nini au mnayatumiaje maeneo haya? (Andika majawabu katika jadueli.)

   If several are drawn:
   Which is the most important of these places? Which are the second and the third important? (Write importance ranking codes to the table.)
   Kama yatakuwa yameoneshwa mengi. Ni lipi muhimu zaidi? Na lipi la pili na lipi la tatu. (Andika umuhimu wake kufuatia alama za jadueli.)

Leisure value

4. What are you doing after working hours? Are there for example some meeting places for you or do you go somewhere? Where do the children play regularly? Yes No

   Unakwenda wapi baada ya muda wa ziada? Mfano mnakutana na watu au sehemu nyingine? Kwa kawaida watoto wanacheza maeneo yapi?

   Can you show us this area/these areas? Please draw the place/places on the map.
   Unaweza kuyaonyesha naeneo haya? Tafadhali chora katika ramani.

   Why do you go there? Please tell shortly. (Write answers to the table.)
   Kwa sababu gani unakewnda huko? Tafadhali eleza kwa kifupi. (Andika majawabu katika jadueli.)

   If several are drawn:
   Which is the most important place for you? Which are the second and the third important ones? (Write importance ranking codes to the table.)
   Kama yatakuwa mengi. Eneo lipi ni muhimu sana kwako? Na lipi ni la pili na lipi ni la tatu. (Andika umuhimu wake kufuatia alama za jadueli.)

Aesthetic value

5. Where are the most beautiful places here? Could you draw the three most beautiful on the map?
   Kwa maoni yako ni yepi maeneo mazuri kuliko yote? Unaweza kutuchorea maeneo matatu ambayo ni mazuri kuliko yote?

   Why do you like these places? Please describe each shortly. (Write answers to the table.)
   Kwa nini unayapendelea maeneo haya? Toa sababu kwa ufupi (andika majawabu katika jadueli)

   Which is the most beautiful of these places? Which is the second and which is the third? (Write importance ranking codes to the table.)
   Eneo gani ni zuri zaidi katika eneo hili? Lipi la pili na lipi ni la tatu? (Andika umuhimu wake kufuatia alama za jadueli)

Free access value

6. Are there areas where you are not allowed to go in your shehia? Yes No
   Kuna maeneo ambayo hamruhusiwi kwenda katika shehia hii?

   Could you draw this area/these areas on the map?
   Unaweza kuyaonesha maeneo hayo katika map?

   Why are you not allowed to go to this place/these places? (Write answers to the table.)
   Kwa sababu gani hamruhusiwi kwenda katika maeneo hayo. (Andika majawabu katika jadueli.)

Special place

7. Are there some other areas that are important to you for some specific reason that you would like to show to us? Yes No
   Je kuna maeneo muhimu zaidi ambayo unataka kutuonesha?

   Where is this area/are these areas? Please draw on the map.
   Ni wapi hizo sehemu? Tafadhali zichore katika ramani

   Why is this area/are these areas special for you? Please describe shortly. (Write answers to the table.)
   Kwanini sehemu hizi ni maalum kwako? Tafadhali elezea kidogo

Final question:
Let's take a look at this map and all these areas that you have drawn here. Which three are the most important areas for you, those three areas that you would not like to give up? (Write total importance codes to the table.)

Hebu tutizame hizi sehemu ulizozichora katika ramani. Ni maeneo yepi muhimu (matatu) ambayo hutotaka kuyatoa? (Andika katika jadueli.)

We are now finished. Thank you very much for participating. Here you'll receive a small compensation for the time that you spent on this interview.
Sasa tumemaliza. Ahsante sana kwa kushiriki katika utafiti huu. Hichi kidogo tunaomba upokee kwa muda wako uliotumia nasi. Ahsante.

Appendix II. Questionnaire for Cheju-Unguja Ukuu Kaebona participatory mapping campaign.

Questionnaire for participatory mapping of community stakeholder ecosystem services

Introduction

Aim of this research is to collect information of the use of the environment and natural resources in Cheju and Unguja Ukuu Kaebona shehias. We are also interested to know what kind of values you attach to your local environment and what places are important for you. The results will be used only for research purpose and your name will not be mentioned at any stage. We start by asking some background questions and then we ask you to show important areas on this aerial image. This is a map that presents the shehias of Cheju and Unguja Ukuu Kaebona. Let's take a look at the image. We are now here. Where do you live? Let's start by marking your home on the map.

Utangulizi

Lengo la utafiti huu ni kukusanya taarifa za matumizi ya maliasili na mazingira yake katika Shehia za Cheju na Unguja Ukuu Kaebona. Vile vile tungependa kufahamu jinsi gani mnanyoyathamini maeneo yamazingira yenu na sehemu gani ni muhimu kwenu. Habari hizi zitatumika kwa ajili ya utafiti tu na jina lako halitatajwa kwa hali yeyote ile. Basi tuanze kwa kuulizana masuala kuhusu historia ya hapa, na baadae tutakuomba utuoneshe maeneo muhimu ndani ya picha hii iliyopigwa juu ya anga. Hii ni ramani ambayo inaonesha shehia ya Cheju na Unguja Ukuu Kaebona. Sasa wacha tuangalie picha hii. Sasa tupo hapa. Wapi unaishi? Tuanze kwa kutia alama katika nyumba yako kwenye ramani hii.

Background information

1. Date / *Tarehe* _____ 2. Time / *Muda* _____

3. Informant ID number / *Mhojiwa nambari ya kitambulisho* (no name data – anonymity preserved) _____
   MAPPING QUESTION <u>At this point map the informant home!</u>

4. Home village / *Kijiji unachokaa* _____ Home area ID(s) _____

5. Gender / *Jinsia*
   a) male / *mume* b) female / *mke*

6. Year of birth / *Mwaka wa kuzaliwa* _____

7. Place of birth / *Pahala pa kuzaliwa* _____

8. Marital status / *Hali ya ndoa*
   a) married / *umeowa/umeolewa* b) divorced / *umeachika*
   b) widowed / *mjane* d) single / *hujaowa/hujaolewa*

9. No. of members in the household (Who lives together?) / *Idadi ya wakaazi mnaoishi ndani ya nyumba*

	HH 1	**HH 2**	**HH3**	
Females	_____	_____	_____	
Males	_____	_____	_____	
Children	_____	_____	_____	(0-14 yrs)

10. Major sources of living (Where do you get money and food?), choose 3 most important and give them ranking 1= most important, 3 = least important
Vyanzo vikuu vya maisha mnavyotegemea? (Wapi mnapata pesa na chakula), ranking chagua 5 kati ya hizi na zipangilie 1= muhimu kabisa 5 = ilokuwa sio muhimu sana
   a) cultivation for home consumption / *kilimo kwa ajili ya matumizi* ____
   b) cultivation for selling / *kilimo cha biashara* ____

c) livestock keeping & poultry / *ufugaji wa wanyama na kuku* ____
d) hunting / *kuwinda* ____
e) fishing / *kuvua* ____
f) tree planting / *upandaji miti* ____
g) cutting wood for sale / *ukataji wa miti kwa biashara* ____
h) preparing and selling handicrafts / *kutengeneza na kuuza kazi za mikono* ____
i) small-scale business / petty trade (specify what) / *biashara ndogo ndogo (ziainishe)* _____
____
j) working for salary (specify what) / *unafanya kazi kwa kutegemea mshahara (ainisha)* _____
____

12. Schooling and education / *Shule na elimu yake*
a) no formal education / *hujasoma kabisa*
b) some elementary education / *elimu ya maandalizi*
c) completed elementary/ *elimu ya msingi*
d) secondary education / *elimu ya secondari*
e) high school graduate/ *elimu ya juu sekondari*
f) other higher education (specify) / e*limu ya juu zaidi (ainisha)* _____
g) adult education (specify) / *elimu ya watu wazima (ainisha)* _____
h) Quran (madrasa) school / *elimu ya chuoni Kur-an*

13. Lived in this village (since when / how many yrs) / *Umeishi kwa muda gani hapa* _____

14. Moved from (village name) / *Umetokea wapi (kijiji gani)* _____

15. Reason for in migration / *sababu ya kuhamia*
a) Better income/ *kipato kizuri*
b) Relatives living here / *jamaa zako wanaishi hapa*
c) Marriage/ *hali ya ndoa*
d) Other (specify) / *sababu nyengine (ainisha)* _____

16. Self perceived familiarity and knowledge of Cheju / Unguja Ukuu Keabona landscape /
Elimu ya binafsi kuhusu mandhari/mazingira ya Cheju / Unguja Ukuu Kaebona
Please evaluate using the scale card.
Scale score: _____ (1 = very limited knowledge, 5 = well established knowledge)

17. Moving and visiting places (Do you stay in your village or do you go regularly somewhere/occasionally to some place?) / *Kuondoka na kutembelea sehemu nyengine (Jee unakaa katika kijiji chako tu au baadhi ya wakati unatembelea sehemu nyengine?)*

	Daily Za kilashiku	Weekly Za wiki	Monthly Za mwezi	Rarely	Never Maisha
a) in neighbouring villages / katika vijiji vya jirani	_____	_____	_____	_____	_____
b) in neighbouring shehias / katika shehia za jirani	_____	_____	_____	_____	_____
c) to town /	_____	_____	_____	_____	_____
d) in other parts of Unguja / katika sehemu nyengine za kisiwa cha Unguja	_____	_____	_____	_____	_____
e) to Pemba / Kwa Pemba	_____	_____	_____	_____	_____
f) to mainland or further / Tanzania bara au mbali zaidi	_____	_____	_____	_____	_____

18. Are you involved in NGOs? / *Jee unajihusisha katika asasi za kiraia?*
    a) daily (specify what) / *za kilasiku (ziainishe)*
       _____
    b) weekly (specify what) / *za wiki (ziainishe)*
       _____
    c) monthly (specify what) / *za mwezi* (ziainishe)_____
    d) every now and then (specify) / *kwa sasa na baadae (ainisha)*
       _____
    e) no activity / *sina shuguli*

19. In which local NGO(s) are you active? / *Majina ya asasi za kiraia unafanya kazi?*
    a) The Conservation Committee of Cheju / *Jumuiya ya uhifadhi ya Cheju*
    b) Hifadhi ya Mazingira Ufufuma/Jendele
    c) Jozani Environmental Conservation Association (JECA) / *Jumuiya ya kuhifadhi Mazingira Jozani*
    d) Jumuiya ya Mikopo na Maendeleo Jozani
    e) Jozani Credit Development Organization (JOCDO) / *Mfuko wa maendeleo*
    f) Society for Natural Resources Conservation and Development, Zanzibar (SONARECOD) / *Jumuiya ya uhifadhi na uendelezaji rasilimali za asili*
    g) Farmers Association (UWEMAJO) / *Umoja wa Wenye Mashamba Jozani*
    h) Zanzibar Farmers and Fisheries Development (ZAFFIDE) / *Jumuiya ya maendeleo ya wakulima na wavuvi Zanzibar*
    i) World wildlife Conservation Society (WCS) / *Jumuiya ya kuhifadhi Wanyama pori*
    j) Women and girls empowerment in Zanzibar (WEZA)
    k) other (specify) / nyengine (ainisha)
       _____
    l) other (specify) / nyengine (ainisha)
       _____

20. Are you involved in shehia activities (e.g. sheha, assistant sheha, elected representative of community etc…) / *Jee unajihusisha katika shughuli za utawala katika Shehia (Mfano Sheha, Msaidizi wa Sheha, Diwani…)*
    a) daily (specify what) / *za kilasiku (ziainishe)* _____
    b) weekly (specify what) / *za wiki (ziainishe)* _____
    c) monthly (specify what) / *za mwezi* (ziainishe)_____
    d) every now and then (specify) / *kwa sasa na baadae (ainisha)* _____
    e) no activity / *sina shuguli*

Additional notes / *Taarifa za ziada:*

Provisioning services – products obtained from ecosystems

Your village and the surrounding areas provide a variety of natural resources and products. With the following questions, the aim is to understand what kind of natural resources and products can be obtained from your local environment.

Kijiji chako pamoja na maeneo yaliyokizunguuka, kinatoa mazao na rasilimali za aina tofauti. Kufuatia masuala yafuatayo, lengo ni kufahamu aina gani za maliaasili na mazao yake ambayo yanapatikana mazingira yenu ya asili.

MAPPING QUESTION

1. Do you or your family cultivate? If yes, please show on the map where your field(s) and other cultivation areas (e.g. agroforestry) are. What are the cultivated crops on each area?
   Je wewe au familia yako mnalima? Kama ndio, tafadhali naomba uoneshe konde zako na maeneo mengine ya kilimo (Mfano Kilimo mseto) ndani ya ramani.

	Eng	Swa	Around home	Area ID(s)
1	Cassava	Muhogo	_____	_____
2	Maize	Mahindi	_____	_____
3	Sorghum	Mtama	_____	_____
4	Yams	Viazi vikuu	_____	_____
5	Potato	Viazi mbatata	_____	_____
6	Rice	Mpunga	_____	_____
7	Sweet potato	Viazi vitamu	_____	_____
8	Tomato	Tungule	_____	_____
9	Eggplant	Bilingani	_____	_____
10	Pumpkin	Maboga	_____	_____
11	Onions	Vitunguu maji	_____	_____
12	Banana	Ndizi	_____	_____
13	Chick peas	Fiwi	_____	_____
14	Beans	Choko	_____	_____
15	Pigeon peas	Mbaazi	_____	_____
16	Cow peas	Kunde	_____	_____
17	Mango tree	Muembe	_____	_____
18	Papaya tree	Mpapai	_____	_____
19	Orange tree	Mchungwa	_____	_____
20	Lemon tree	Mlimau	_____	_____
21	Coconut tree		_____	_____
22	Other _____		_____	_____
23	Other _____		_____	_____

MAPPING QUESTION

2. Are the field(s) and cultivation areas irrigated or rain fed? If irrigated, ***where*** do you get the water (where is the source of water)?
   *Je? Konde zenu na maeneo mengine ya kilimo mnamwagilia maji au mnategemea mvua? Na kama mnamwagilia je **wapi** mnapata maji (maji inapatikana wapi)?*

	Eng	Swa	Source, how often?	Area ID(s)
1	irrigation water	Maji ya kuwagilia	_____	_____
2	irrigation water	Maji ya kuwagilia	_____	_____

MAPPING QUESTION

3. Do you or your family have livestock, which areas do you use for grazing?
Je wewe au familia yako mnayo mifugo, maeneo gani mnayatumia kwa malisho?

	Eng	Swa	How many	Area ID(s)
1	Cows	Ng´ombe	_____	_____
2	Goats	Mbuzi	_____	_____
3	Chickens	Kuku	_____	_____
4	Ducks	Bata	_____	_____
5	Donkey	Punda	_____	_____
6	Other _____	_____	_____	_____

MAPPING QUESTION

4. Do you collect ***wild*** fruits/vegetables for eating, where are the most important areas?
*Je hua mnavuna matunda **pori** au mboga kwa ajili ya chakula, ni sehemu gani muhimu zinazotumika?*

	Eng	Swa	Purpose	Area ID(s)
1	Guava	Pera	_____	_____
2		Zambarau	_____	_____
3		Topetope	_____	_____
4		Fuu	_____	_____
5	Other	Mbungo	_____	_____
6	Other	_____	_____	_____
8	Other	_____	_____	_____
9	Other	_____	_____	_____

MAPPING QUESTION

5. Do you catch fish or other seafood, where?
Mnavua samaki au mazao yeyote ya chakula kutoka baharini?

	Eng	Swa	How often	Area ID(s)
1	_____	_____	_____	_____
2	_____	_____	_____	_____
3	_____	_____	_____	_____

MAPPING QUESTION

6. Do you practice beekeeping, where? Is produced honey used in your household or sold?
Je, unafuga nyuki, wapi? Asali unauza au unakula nyumbani?

	Eng	Swa	HH or sold	Area ID(s)
1	Honey production	Utengenezaji wa asali	_____	_____
2	Pollination services	Uchevushaji	_____	_____
3	Other	_____	_____	_____

7. Do you produce rice in your family? If yes, estimate how much of your consumption is produced ***within*** the family? Please evaluate using the scale card.
   Jee unazalisha mpunga ndani ya familia yako? Kama ndio ni kiasi gani ya matumizi yako yanazalishwa ndani ya familia? Tafadhali tathmini kwa kutumia kadi.

   Scale score: _____ (1 = very little, 5 = all of it)

8. What about other food products? Please estimate how much of your consumption is produced ***within*** the family? Please evaluate using the scale card.
   Vipi kuhusu mazao mengine ya chakula? Tafadhali kadiria kiasi gani ya matumizi yako yanapatikana ndani ya familia yako?

   Scale score: _____ (1 = very little, 5 = all of it)

9. What food products are bought and where are these mainly purchased?
   Mazao gani ya chakula mnayonunua na wapi hasa mnanunua?

10. Are you exchanging food products? Which, with whom and where?
    Mazao gani ya chakula mnabadilishana? Mnabadilishana pamoja na nani na wapi?

MAPPING QUESTION

11. Do you use firewood in the household? If yes, where do you collect firewood, on which areas?
    Jee mnatumia kuni majumbani? Kama ndio, wapi mnakusanya kuni, katika maeneo gani?

	Eng	Swa		Area ID(s)
1	Firewood	Kuni	_____	_____
2	Firewood	Kuni	_____	_____

12. Please estimate how much of the consumed firewood is collected by yourself or other household members? Please evaluate using the scale card.
    Tafadhali unaweza kukadiria kiwango cha kuni mnazotumia unazitafuta wewe au yeyote katika familia yako?

    Scale score: _____ (1 = very little, 5 = all of it)

13. Where do you get the rest of your firewood?

MAPPING QUESTION

14. Do you use or collect charcoal? If yes, where do you obtain it?
    Jee unatumia au anachimba mkaa? Kama ndio wapi unapata?

	Eng		Area ID(s)
1	Charcoal collected for home consumption	_____	_____
2	Charcoal burned for home consumption	_____	_____
3	Charcoal collected for selling	_____	_____
4	Charcoal burned for selling	_____	_____
5	Charcoal bought	_____	_____

MAPPING QUESTION

15. Are you involved in planting trees, what species do you plant and on which areas?
Jee unashiriki katika upandaji miti, aina gain ya miti unayopanda na mahala gani?

	Lat/Eng	Swa	Fam./Gr.	How many	Harv.	Repl.	Use	Area ID(s)
1	Casuarina equisetifolia	Mvinje	_____	_____	_____	_____	_____	_____
2	Acacia mangium	Mkeskia mangiam	_____	_____	_____	_____	_____	_____
3	Acacia auriuliformis	Mkeshia	_____	_____	_____	_____	_____	_____
4	Cashew nut tree	Mkorosho	_____	_____	_____	_____	_____	_____
5	Pinus caribaea	Msonobari	_____	_____	_____	_____	_____	_____
6	Eucalyptus	Mkaratusi	_____	_____	_____	_____	_____	_____
7	Tectone grandis	Msaji	_____	_____	_____	_____	_____	_____
8	Other _____		_____	_____	_____	_____	_____	_____
9	Other _____		_____	_____	_____	_____	_____	_____

Fam./Gr.: owned by family = 1, group activity = 2
Harv.: amount of times woodlot/forest has been harvested
Repl.: amount of times woodlot/forest has been replanted
Use: firewood = 1, construction wood = 2, logs for making charcoal = 3, logs for burning lime = 4, income = 5, fruits = 6, medicine = 7, other (specify what) = 8

MAPPING QUESTION

16. Do you collect or harvest construction materials in the nature and forests, what kind of materials and on which areas?
Je unakusanya au kuvuna mazao ya misitu kwa ajili ya kujengea, ni aina gani ya mazao hayo na maeneo gani yanapopatikana?

	Eng	Swa	How often/how much	Area ID(s)
1	Coconut thatches	Makuti	_____	_____
2	Wood cutting for selling	Kukata mbao kwa ajili ya kuuza	_____	_____
3	Wood cutting for own use	Kukata mbao kwa ajili ya matumizi yako	_____	_____
4	Other _____	_____	_____	_____
5	Other _____	_____	_____	_____

MAPPING QUESTION

17. Do you collect handicraft materials, what kind of materials and on which areas?
Jee unakusanya bidhaa za kazi za mikono, ni bidhaa gani na maeneo yepi?

	Eng	Swa	Purpose	Area ID(s)
1	Reed	Ukindu	_____	_____
2	Bark	Magome	_____	_____
3	Wood / timber	Gogo / mbao	_____	_____
4	Flowers	Maua	_____	_____
5	Roots	Mizizi	_____	_____
6	Kapok tree 'seeds'	Usufi	_____	_____

MAPPING QUESTION

18. Do you collect coral rocks for lime making or do you burn lime, where?
Jee unachimba mawe kwa ajili ya chokaa, wapi?

	Eng	Swa	How often/how much	Area ID(s)
1	Coral rock	Mawe	_____	_____
2	Lime burning	Kuchoma chokaa	_____	_____

MAPPING QUESTION

19. Do you extract the soil, where and for what purpose?
Jee unachimba udongo? Wapi na kwa matumizi gani?

	Eng	Swa	Purpose/how often/how much	Area ID(s)
1	Loamy (silt, sand + clay)	Mfinyazi	_____	_____
2	Silt	Tifutifu	_____	_____
3	Sand	Mchanga	_____	_____
4	Other	_____	_____	_____

MAPPING QUESTION

20. Do you collect medicinal plants, which species and on which areas?
Jee unakusanya miti shamba kwa dawa, ni aina gani na ni maeneo yepi?

	Eng	Swa	Purpose	Area ID(s)
1	Aloe vera	Mshubiri	_____	_____
2	Ginger	Tangawizi	_____	_____
3	Black seed	Habbat saudaa	_____	_____
4	Pawpaw's roots	Mizizi ya mpapai	_____	_____
5	Neem tree	Mtunda	_____	_____
6		Mtunguja	_____	_____
7	Other	_____	_____	_____
8	Other	_____	_____	_____

MAPPING QUESTION

21. Where do you obtain drinking water for your household? Do you experience lack of water?
Wapi mnapata maji yenu ya kunywa kwa matumizi ya nyumbani? Jee kuna upungufu wa maji?

	Eng	Swa	Description of shortage (e.g. periodically or all the time)	Area ID(s)
1	Gov. Pipeline	Maji ya mifereji/bomba yanayotolewa na serikali	_____	_____
2	Well	Visima	_____	_____
3	Cave	Mapangoni	_____	_____
4	Other	_____	_____	_____

MAPPING QUESTION

22. Do you use flowers or other materials from nature for decorative purposes? Where do you collect or buy these?
Jee unatumia maua au mapambo mengine kwa kupambia? Wapi unapata au kununua?

	Eng	Swa	Purpose	Area ID(s)
1	Flowers	Maua	_____	_____
2	Shells	Kombe	_____	_____
3	Other	_____	_____	_____
4	Other	_____	_____	_____

Cultural services – nonmaterial benefits obtained from ecosystems

Your village and the surrounding areas provide also nonmaterial value and benefits for the communities living here. With the following questions we are interested to know, what kind of nonmaterial value and benefits you obtain from the environment and the people living here.

Kijiji chako na vijiji vinavyokuzunguka bila shaka vinatoa faida mbali ambazo zinaonekana wazi wazi kwa macho lakini pia kuna faida ambazo ni za kihisia kwa jamii inayoishi ndani yake. Kutokana na maswali yafuatayo tungelipenda kufahamu ni faida gani hizo za kihisia/kimila ambazo zinapatikana kutokana na mazingira unayoishi.

MAPPING QUESTION

23. What are the favourite things you like to do after working hours and after you have finished the daily chores, where are these activities done? Are there for example some important meeting places for you or do you go somewhere? Please indicate also the importance of these activities.
Unapendelea kufanya nini baada ya kufanya kazi zako za kawaida? Unazifanyia wapi shughuli hizi? Jee kuna sehemu maalum ambayo mnakutana au unakwenda wapi? Tafadhali ainisha umuhimu wa shughuli hizi.
(ranking 1 = most important, 2 = second most important etc.)

	Activity Eng	Swa	Importance ranking	At home	Other area ID(s)
1	Meeting people	Kukutana na watu	_____		_____
2	Making handicrafts	Kufanya kazi za mikono	_____		_____
3	Playing soccer	Kucheza mpira	_____		_____
4	Playing cards	Kucheza karata	_____		_____
5	Playing bao	Kucheza bao	_____		_____
6	Other		_____		_____

MAPPING QUESTION

24. Which three sites are the most beautiful/attractive here, why?
Yepi kati ya maeneo matatu ambayo ni mazuri zaidi au yanayokuvutia hapa? Kwanini?

Interviewers: We are now talking about visual aesthetic experiences, things that you see with your eyes and consider attractive, beautiful views.

Ranking	Site + short description	Area ID(s)
1st	_____	_____
2nd	_____	_____
3rd	_____	_____

MAPPING QUESTION

25. Are there religious or sacred places for you in the environment, where? Do you attach a specific spiritual or religious feeling or value to some specific place?
Kuna maeneo ya kidini au kimila katika mazingira haya kwa ajili yako? Wapi? Jee wewe unajihusisha na moja kati ya hayo katika sehemu fulani maalumu.

	Eng	Swa	Description	Area ID(s)
1	Graveyard	Kaburi	_____	_____
2	Sacred site / worshipping	Mzimu	_____	_____
3	Visiting sorcerer	Kutembelea waganga	_____	_____
4	Traditional dancing	Kumbwaya	_____	_____
5	Sacred forest		_____	_____
6	Other	_____	_____	_____

26. Because these areas are sacred, do you think they are managed differently than environment in general? If yes, how?
Kwa sababu maeneo haya yana abudiwa, jee unafikiria yanahifadhiwa tofauti kuliko uhalisia? Kama ndio, kivipi?

MAPPING QUESTION

27. Are there specific areas of local culture, traditions or wisdom that you appreciate and think are important, why?
Jee kuna maeneo maalum ya kiutamaduni na ya kimila ambayo unayahisi ni muhimu? Kwa nini?

	Eng	Swa	Description	Area ID(s)
1	Singing		_____	_____
2	Dancing		_____	_____
3	Story telling	Hafadthi	_____	_____
4	Initiation rites	Jando na ungago	_____	_____

MAPPING QUESTION

28. Are there some places in your local environment that you value just because they exist?
Jee kuna maeneo ambayo unayajali tu kwa kuwa yapo?

	Eng	Swa	Description	Area ID(s)
1	_____	_____	_____	_____
2	_____	_____	_____	_____
3	_____	_____	_____	_____

29. If you consider social relations, which of the villages around here are the three most important ones for you and why?
Ukichukulia uhusiano wa kijamii, nini vijiji vipi katika mazingira ambavo ni muhimi zaidi kwako? Chagua vitatu bora.

Ranking	Village name	Description	Area ID(s)
1st	_____	_____	_____
2nd	_____	_____	_____
3rd	_____	_____	_____

Final question – related to the interview and mapping <u>as a whole</u>

MAPPING QUESTION

30. Let's take a look at this map and all these areas that you have indicated here. If you consider your ***well-being***, which three are the most important areas for you, those three areas that you would not like to give up?
Hebu tuitizame hii ramani na maeneo yote haya yalioainishwa. Kwa mtazamo wako, ni maeneo matatu yepi, ambayo ni muhimu zaidi kwako? Maeneo ambayo hutaki kuyawachia?

<u>Delineate three areas on the paper map!</u>
And write also down here:

1st _____
2nd _____
3rd _____

31. Do you have anything to add to any of these topics we have discussed?
Jee unachochote cha kuongeza kwa hizi mada tulizozungumza?

Thank you for participating!
Ahsante kwa ushirikiano wako!