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Community stakeholders' knowledge in landscape assessments – Mapping indicators for landscape services

Nora Fagerholm[a,*], Niina Käyhkö[a], Festo Ndumbaro[b], Miza Khamis[c]

[a] Geography Division, Department of Geography and Geology, University of Turku, FI-20014 Turku, Finland
[b] Department of Geography, University of Dar es Salaam, Tanzania
[c] Department of Forestry and Non-Renewable Natural Resources, Government of Zanzibar, Tanzania

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ABSTRACT

The evaluation of landscape services essentially deals with the complex and dynamic relationships between humans and their environment. When it comes to landscape management and the evaluation of the benefits these services provide for our well-being, there is a limited representation of stakeholder and intangible values on the land. Stakeholder knowledge is essential, since disciplinary expert evaluations and existing proxy data on landscape services can reveal little of the landscape benefits to the local stakeholders. This paper aims at evaluating the potential of using local stakeholders as key informants in the spatial assessment of landscape service indicators. A methodological approach is applied in the context of a rural village environment in Tanzania, Zanzibar, where local, spatially sensitive stakeholder knowledge is crucial in solving land management challenges as the resources are used extensively for supporting community livelihoods and are threatened by economic uses and agricultural expansion. A typology of 19 different material and non-material, cultural landscape service indicators is established and, in semi-structured interviews, community stakeholders map these indicators individually on an aerial image. The landscape service indicators are described and spatially analysed in order to establish an understanding of landscape level service structures, patterns and relationships.

The results show that community involvement and participatory mapping enhance the assessment of landscape services. These benefits from nature demonstrate spatial clustering and co-existence, but simultaneously also a tendency for spatial dispersion, and suggest that there is far more heterogeneity and sensitivity in the ways the benefits are distributed in relation to actual land resources. Many material landscape service indicators are individually based and spatially scattered in the landscape. However, the well-being of communities is also dependent on the non-material services, pointing out shared places of social interaction and cultural traditions. Both material and non-material services are preferred closest to settlements where the highest intensity, richness and diversity are found. Based on the results, the paper discusses the role of local stakeholders as experts in landscape service assessments and implications for local level management processes. It can be pointed out that the integration of participatory mapping methods in landscape service assessments is crucial for true collaborative, bottom-up landscape management. It is also necessary in order to capture the non-utilitarian value of landscapes and sensitivity to cultural landscape services, which many expert evaluations of landscape or ecosystem services fail to do justice.

1. Introduction

Humans are dependent on ecosystems and their ability to provide services contributing to our well-being (Daily, 1997; Ehrlich and Mooney, 1983). These services are derived from the structures and processes generated by nature and ecosystems, and can be understood as benefits, which people obtain from ecosystems. Defined by MA (2003), these include provisioning, regulating, cultural, and supporting services. MA typology has resulted in the discussion of the role of ecosystem functions, the mechanisms that services are based on, and the actual services. Several typologies for ecosystem services have been developed, some of them preceding, but many being slight modifications of the suggested MA typology (e.g. De Groot et al., 2002; Costanza et al., 1997; Daily, 1997; Costanza, 2008; Wallace, 2007). A similar theoretical discussion has been published also in the field of landscape research, where the relationship between ecosystem or landscape functions, services, benefits and human well-being have been debated through, for

* Corresponding author. Tel.: +358 2 333 5596; fax: +358 2 333 5896.
E-mail addresses: nora.fagerholm@utu.fi, ncfage@utu.fi (N. Fagerholm), niina.kayhko@utu.fi (N. Käyhkö), fndumbaro@yahoo.co.uk (F. Ndumbaro), mizakhamis@gmail.com (M. Khamis).

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example, the 'cascade model' (Haines-Young and Potschin, 2010), the 'structure–function–value chain' (Termoschuizen and Opdam, 2009), or the 'ecosystem properties, potentials and services (EPPS) framework' (Bastian et al., 2011). All of these point out that functions, whether ecosystem or landscape, become services when their benefits are valued by humans. The benefits are contextual depending on the needs, choices and values of the people. Hence, these subjective benefits are also place-related and tend to vary in geographical space.

The ecosystem service concept may be a promising and comprehensive approach for decision-making, but in the context of landscape research the theoretical underpinnings are not very explicit. Ecological assessments, and economic and monetary valuation are the traditional ways to assign value to nature's services (e.g. Daily, 1997; De Groot et al., 2002; Lange and Jiddawi, 2009). However, these capture only partly the true value of the land and resources when the third value domain, socio-cultural, is neglected. As humans constantly modify their land and living space, which leads not only to multiple land uses, but moreover to the diversity of perceptions and values attached to the landscape (Luz, 2000; Mander et al., 2007; Raquez and Lambin, 2006; Zube, 1987), the evaluation of services is dealing essentially with the complex and dynamic relationships between humans and their environment, rather than simply ecosystems per se. Given the interwoven character of the landscape as social constructions and processes together with biophysical pattern process dynamics, concerns have been raised about the limited representation of stakeholder and intangible values on the land. This concern has been addressed also in conjunction with the Millennium Ecosystem Assessment (MA, 2003) and among the scientific community (Burkhard et al., 2010; Vejre et al., 2010). Stakeholder knowledge is essential, since disciplinary expert evaluations and existing proxy data on landscape services reveal very little of the landscape benefits to the local stakeholders.

Based on the idea that landscapes should be seen as spatial human-ecological systems delivering functions valued by humans, and that humans change the landscape to improve its functioning, to obtain added ecological, social and economic value, Termoschuizen and Opdam (2009) suggest the concept of landscape services. This concept could be used as a specification of ecosystem services when the desire is for sustainable landscape development, because it has local level relevance and legitimacy matching the scales at which the stakeholders act and perceive their environment. It also better captures the spatial pattern relationships and is more interdisciplinary in nature compared to the concept of ecosystem services, which highlights the functional relationships between ecosystem components and is used among environmental sciences and associated with biodiversity and natural ecosystems. We consider the landscape service concept to give broader room for stakeholder involvement, which has to be realised at a local scale, and where there is a need to develop spatially explicit assessment methodologies. Hence, this study introduces a method of mapping *indicators* for landscape services through community involvement and participation applied in a rural village environment in Tanzania, Zanzibar. The term indicator is used in a broad sense, relating to human valuation as opposite to a parameter type of measured indicators. Referring to Haines-Young and Potschin (2010), these indicators for landscape services can also be called the 'benefits' the local communities give value to.

1.1. Mapping landscape service indicators through community participation

In a geographical context, the value and meaning of landscape services to local stakeholders is created from the everyday experience of different places where values are attached (Tuan, 1977). This local knowledge emerges from personal observation and environmental experience, and is related to the subjective perceptions and valuation of the landscape (Zube, 1987; Brown, 2005; Williams and Patterson, 1996). As local people are the true experts of their environment, they are the 'insiders' for whom the landscape is a lived experience with tangible and intangible values (Stephenson, 2008).

An increasing amount of empirical evidence shows that community stakeholders are able to identify and map different landscape-attached values, perceptions and services. Landscape values and preferences in national forest planning have been surveyed and mapped in several case studies in the U.S. and Australia (Brown et al., 2002; Bryan et al., 2010; Raymond et al., 2009; Sherrouse et al., 2011). In Finland, Tyrväinen et al. (2007) mapped successfully the social values of urban woodlands and green areas. Participatory approaches have also been used in mapping landscape values for the management of Indian tribal lands in the U.S. (Carver et al., 2009) and for conservation in Amazonia (Bernard et al., 2011). In a developed context, the concept of PPGIS (public participation GIS) is commonly used to refer to the use of GIS and digital communication technologies to engage the public and local stakeholders in official decision-making under the collaborative planning paradigm (e.g. Brown and Reed, 2009; Craig et al., 2002; Ramasubramanian, 2010; Sieber, 2006). In a developing context, participatory mapping approaches, also referred to as participatory GIS (PGIS) techniques, have proven to be useful in making stakeholders more aware of the use of natural resources, whilst promoting collaboration and empowerment (Craig et al., 2002; Chapin et al., 2005). PGIS techniques have developed from the well-established community participation and mapping tradition in a developing context (Chambers, 2008) to combine community participation with the use of digital geospatial techniques.

The strength of empirical mapping methods is that they are based on the true local knowledge of the distribution of landscape services, which differs from mapping based on assumptions derived from literature or process modelling (e.g. Costanza et al., 1997; Nedkov and Burkhard, 2011; Willemen et al., 2008). Stakeholder involvement also has the potential to deepen the assessment and appreciation of the non-material benefits that the landscape and ecosystems provide to humans. These cultural landscape services have quite often been limited to mapping a few indicators, such as recreation and tourism (e.g. O'Farrell et al., 2010; Willemen et al., 2010).

This paper aims at evaluating local stakeholders' knowledge in the spatial assessment of landscape service indicators. Firstly, a typology of 19 material and cultural landscape service indicators, relevant in the local context, is established based on the existing literature and contextual experience. Secondly, these indicators are mapped at a local scale through the participation of community stakeholders and, then, the collected data on the indicators are described and spatially characterised. Thirdly, the spatial relationships between the landscape service indicators and linkages to existing land resources are analysed in order to establish an understanding of existing landscape level service structures, patterns and diversity. Based on the findings, the paper discusses the role of the local stakeholders as experts in landscape service assessments, and debates the implications of landscape service mapping and stakeholder participation for landscape management in multifunctional cultural landscapes.

The methodological approach is applied in the context of a rural village environment in Tanzania, Zanzibar. The study setting is tempting, as local, spatially sensitive stakeholder knowledge is crucial in solving land management challenges. This is true especially in tropical forests where resources are extensively used for supporting community livelihoods and are threatened by economic uses and agricultural expansion (FAO, 2006; Fagerholm and Käyhkö, 2009). Furthermore, in the context of local Zanzibar circumstances and developing countries in particular, environmental decision-making is often limited by very restricted information on socio-cultural values, which are known to greatly contribute to successful landscape assessments (Termoschuizen and Opdam, 2009).

2. Methods

2.1. Typology of landscape service indicators in the context of Zanzibar

The Zanzibar Islands, located on the Eastern coast of Tanzania, host a landscape mosaic of indigenous and cultivated forest vegetation, which offers several tangible and intangible benefits for its people. The socio-economic importance of the material resources is high as forestry, agriculture and hunting contribute to the national economy of Tanzania, with circa 30% of the GDP (Ministry of Finance and Economic Affairs, 2010). The crucial livelihood benefits contributing to the well-being of the people include also a diversity of cultural and non-material services from the forests. Contemporary forests reflect the historical interactions of different cultures and land use activities, such as spice farming and shifting cultivation across hundreds of years, but like in many tropical regions globally, land and natural resources are under severe pressures (Burgess and Clarke, 2000). One fundamental reason for overexploitation is the high population increase (annual increase 3.1% in Tanzania, Office of Chief Government Statistician, 2010). The authorities and communities in Zanzibar are concerned about the long-term sustainability of the natural resources (ZFDP, 1997; DCCFF, 2008). Furthermore, FAO has listed Tanzania as one of the countries facing severe deforestation (FAO, 2006).

The rural communities in our study site, the administrative regions (in Swahili: shehia) of Cheju and Unguja Ukuu Kaebona located in the Southern inland area of the main island Unguja (Fig. 1), are typical examples of the dependence on multiple landscape services. The benefits these services create, many of them created by the forest covered land, contribute crucially to the well-being of the local communities. Like in Zanzibar in general, approximately half (53.8%) of the population live below the basic needs poverty line, and these communities are also to a large extent subsistence-based (Office of Chief Government Statistician, 2010; Sitari, 2005). The population in Cheju is 1800 inhabitants and in Unguja Ukuu Kaebona 1320. Settlement is concentrated particularly along the main tarmac roads in the northern and southern parts of the study area. Two major land cover and land use zones characterise the study area (Williams et al., 1997). The eastern and southern parts lie on coral rag with semi-open grassland, encroached evergreen and semi-deciduous bushes, as well as natural thicket and high forests. Shifting cultivation is commonly practiced in coral rag and a variety of forest products are harvested or extracted, such as firewood, construction poles, wood for charcoal production, and coral stones. The forests also provide other important material and non-material services, such as medicinal plants, materials for handicrafts, and sites for practicing traditional beliefs (Fagerholm and Käyhkö, 2009; Sitari, 2005). The western lowland with its deep fertile soil and scattered trees in Cheju is mainly used for permanent rice cultivation. In addition to these, agroforestry is dominant within and close to settlement areas. Because of the good agricultural areas, the villages have been attracting migrants from other areas of Zanzibar and mainland Tanzania since the 1960s.

Since the 1980s, the Zanzibar Government has tried to protect the forests and biodiversity from overexploitation and degradation by land demarcations and extensive tree plantations (ZFDP, 1997). From 2002, these plantations have been gazetted as part of the Jozani-Chwaka Bay National Park (JCBNP, 5000 ha), famous for its rare endemic species such as the Zanzibar Red Colobus (*Procolobus kirkii*) (DCCFF, 2008). JCBNP covers a significant part (39.3%) of the shehias (Fig. 1), and thus use of natural resources is limited. In addition, the southwestern part of the study area is a training area for the military and hence not allowed for any use by the communities. Collaborative forest management in Zanzibar has the longest history in Cheju, where the Conservation Committee of Cheju was established by a community initiative in 1992 to tackle unsustainable forest use. In cooperation with the government, the Cheju Shehia Forest Management Plan was drawn up in 1997 (Williams et al., 1997), but so far, none of the management plans have tackled the actual benefits, which communities spatially attach to the landscape.

The landscape service typology used in this study (Fig. 2) is based on the modification of the categories of provisioning and cultural ecosystem services identified initially in the Millennium Ecosystem Assessment (MA, 2003), and other suggested typologies developed by Costanza et al. (1997), Daily (1997) and De Groot et al. (2010). The typology is locally adjusted with the ideas of social landscape value mapping (Fagerholm and Käyhkö, 2009; Raymond et al., 2009), the economic valuation of marine ecosystem services in the Zanzibar context (Lange and Jiddawi, 2009), and ecosystem service classification at the local level (Costanza, 2008). This established typology aims to capture both the tangible and intangible benefits of landscape services as identified and valued by local communities. These include the uses of natural resources, products obtained from nature, and nonmaterial benefits from the land and natural resources. The focus is on concrete and easily articulated landscape services and their indicators in the landscape, which are linked to daily life. The material landscape services are captured as food, raw materials, geological resources, fuel, and medicinal and ornamental resources consisting of 14 indicators (Fig. 2). For the part of cultural landscape services, the typology includes five indicators for aesthetics, social relations, and spiritual, religious, cultural heritage and intrinsic values. The inclusion of the aesthetic, local culture and existence value indicators aims to capture the non-utilitarian and intangible value of the landscape.

2.2. Participatory mapping, stakeholder meetings and field observation

Data collection was organised through a participatory mapping campaign in the local communities in September 2010. The PGIS campaign was based on the use of the most recent digital georeferenced aerial photographs (2004, 0.5 m pixel size, Department of Survey and Urban Planning, Zanzibar), which were mosaiced, printed and laminated at a scale of 1:12,000 (size A0). The campaign started with an introductory meeting where 26 community members representing community specialists (e.g. forest guards, the village committee and NGO members, teachers, village leaders) were present. The case study was introduced following a free discussion over the printed aerial photographs. This meeting was followed by the actual data collection, which consisted of a combination of semi-structured interview questions completed with participatory mapping. Indicators for landscape services were mapped individually with 218 community members representing all the 14 sub-villages in Cheju and Unguja Ukuu Kaebona. Informant sampling, covering 7 and 9% of the adult population in Cheju and Unguja Ukuu Kaebona, respectively, was spatially designed to assure the validity of the geographical analysis. Informants were selected by the village leaders in each sub-village according to detailed instructions, balancing both the gender and age structure (15–30 years, $\geq$31 years).

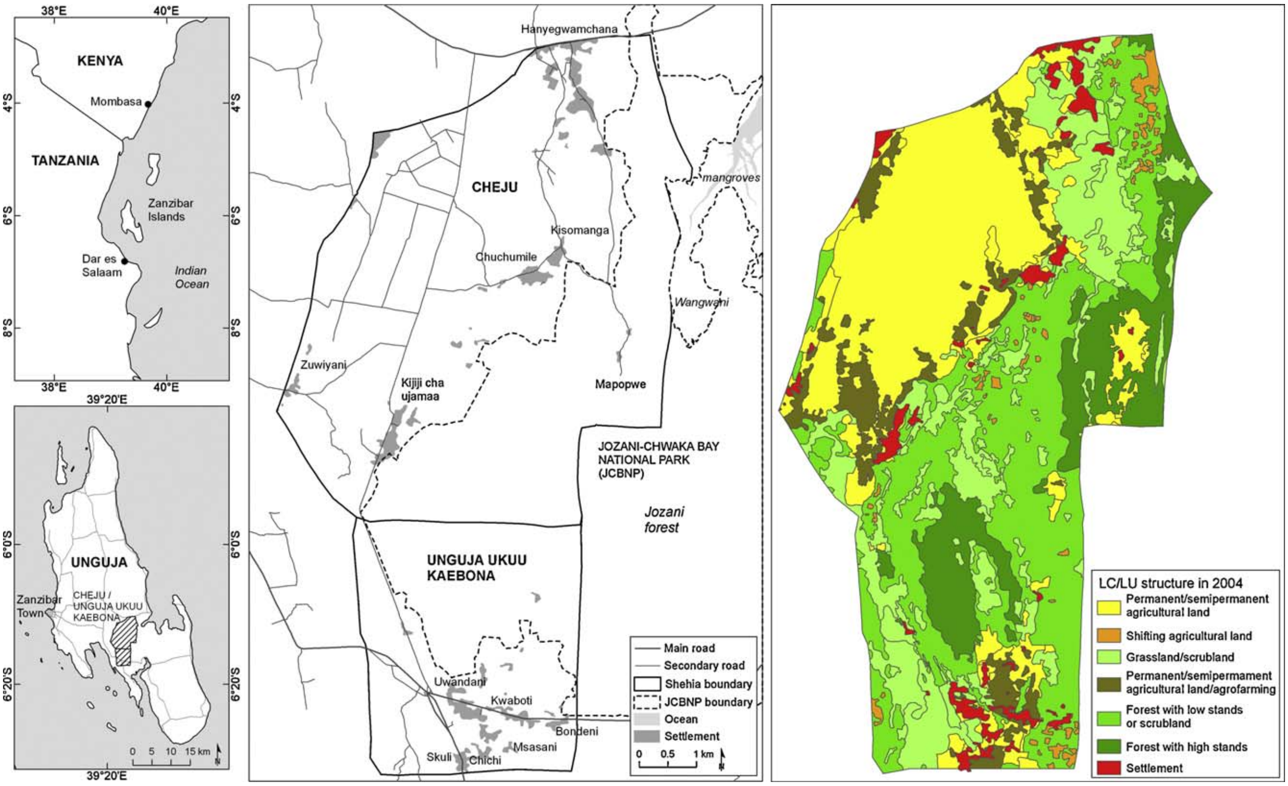

Fig. 1. Study site in Eastern Africa, Tanzania. The administrative regions of Cheju and Unguja Ukuu Kaebona (60.9 km^2) are located inland on Unguja Island in Zanzibar Islands. The eastern and southern coral rag areas and the western low land deep soil areas are the basis for the land cover and land use mosaic consisting of various agricultural land uses and rural settlement together with forested land covers and grass/scrubland.

Each interview (0.45–1.5 h) started with an introduction to the topic and collection of informant background information (e.g. age, household details, main livelihoods, education, self-perceived knowledge of the landscape), followed by orientation on the aerial image map. At first, the informant marked his/her home on the map and then indicators for different landscape services (Fig. 2) were mapped one by one using different coloured wooden beads (1–2 cm in diameter). Informants were allowed to map as many places for each indicator as they wanted, but for aesthetic values the three most important were indicated. The beads could also be placed on identical places, attached on top of each other. When the site was outside the area of the aerial image map, only the attributes were noted. Each mapped indicator was complemented with descriptive questions to append related attribute information, such as what crops are cultivated, how medicinal plants are used, and why certain places are considered beautiful. In addition, informants were also asked to evaluate on scale of 1–2–3–4–5, for example, self-perceived familiarity and knowledge of the landscape (1 = very low, 5 = very good), or how much of the consumed firewood is collected by household members (1 = none, 5 = all of it). All mapped points had a unique informant identifier. The locations of beads were manually colour-copied on an A3 paper sheet copy of the aerial image map. In the end of each interview, the original image map with pebbles data was also photographed for verification.

Six months later, community-level landscape indicator maps, based on the compiled initial analysis of the mappings, were reflected on in six community meetings (app. 3 hours each). All the interviewed persons were invited to participate and a total of 186 informants attended the meetings. These meetings had an important role in raising discussion among the community members and in deepening the interpretation of the results. In each meeting, the participants were asked to rank the landscape service indicators according to their importance for the life and well-being of the community. The ranking was done in groups of men, women and community specialists, aiming to create a shared consensus opinion within the group. The research team collected descriptive data by making field notes and observations of places of interest rising from the results.

2.3. Spatial database and data analysis

Data collected in the field was inserted into digital data tables in Excel, and the locations of the mapped landscape indicator points were digitised in ArcGIS9.3/10 software. The created geodatabase connected each informant's background and attribute data with the spatial data of the informant's home and landscape service indicator points. Structured documentation was written from the community meetings and the main topics of discussion, expressed statements and interesting observations were identified. Based on the results of the ranking exercise in the community meetings, an average rank value was calculated for material and cultural landscape service indicators by summing the values of each group in each community meeting.

To create an overall understanding of the general community profile and landscape service indicators with associated attributes, they were analysed with descriptive statistics and cross-tabulations using SPSS19 and Excel software. The descriptive analysis of the indicators includes both the attributes of the places mapped on the aerial image and places located outside of it. Analysis of the geographical patterns of the landscape services was done in GIS using several techniques as follows.

Firstly, the Euclidian distance between home point and mapped point locations was calculated, based on point coordinates (x,y); as it was expected that the distance between the home and each landscape service indicator might explain some of the variation in the spatial patterns of each indicator (Brown et al., 2002; Fagerholm

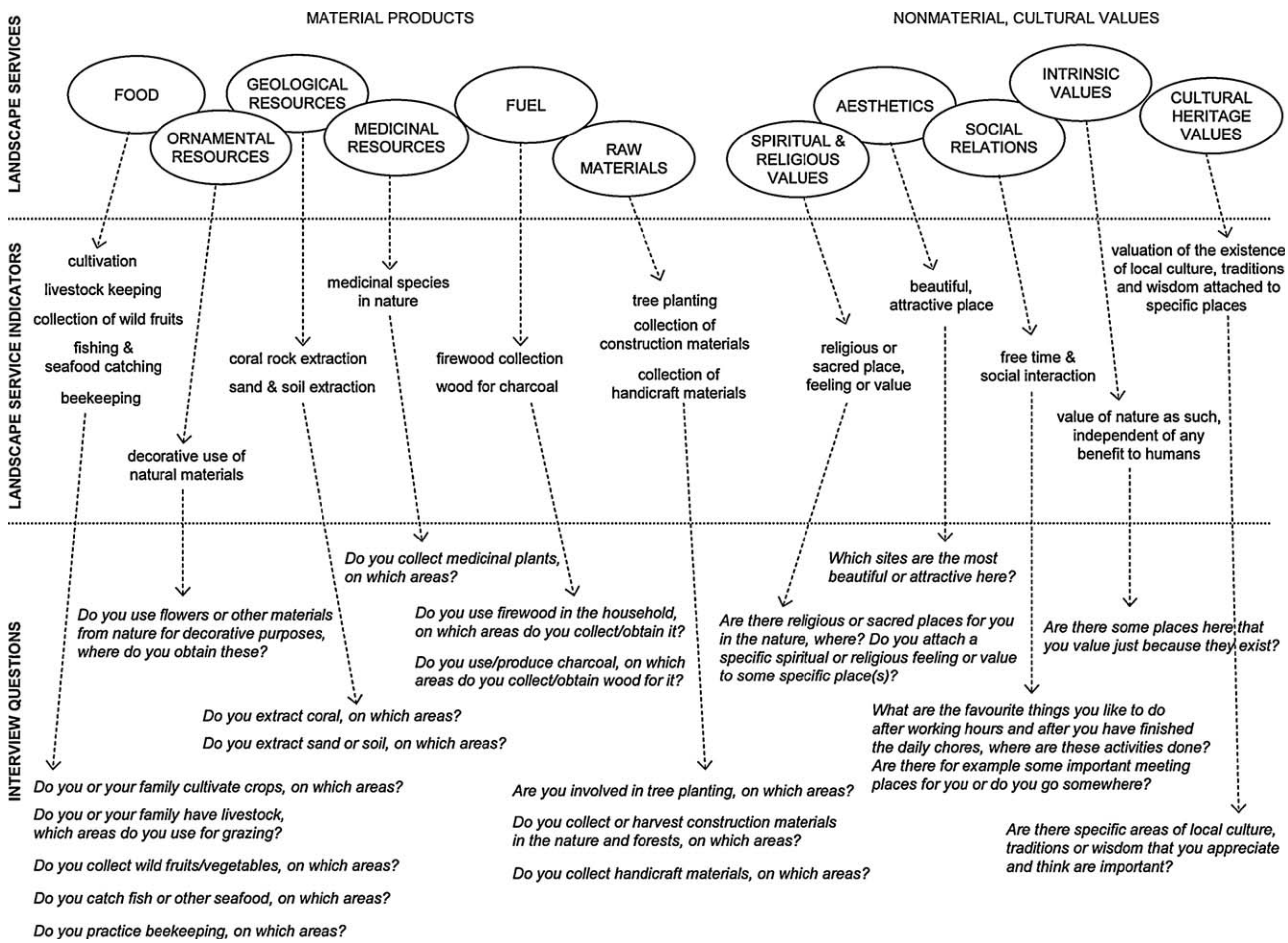

Fig. 2. Typology for landscape services, their respective indicators, and interview questions to locate the indicators in the context of rural Zanzibarian communities.

and Käyhkö, 2009). Secondly, the spatial arrangement of the indicator points was studied with the nearest neighbour statistics to see if the points are randomly distributed in the landscape. NN-statistics measures the Euclidian distance of each point and its nearest neighbours and divides this with the distance in a hypothetical randomly distributed point layer (Ebdon, 1985). A spatially clustered distribution gives as a result a ratio less than 1 with significant *Z* scores, indicating how many standard deviations from the mean the ratio value is. The area in analysis was set as the area of a rectangular polygon covering the extent of all the mapped points.

Thirdly, to describe the spatial intensity of the landscape service indicators, density surfaces were generated from the point data layers using a quadratic Kernel function (Silverman, 1986). It calculates a smoothly curved circular surface of point density for each point summing the values in a raster grid cell. This method was selected after a comparison to previously applied methods for creating density and abundance surfaces of landscape value points (Alessa et al., 2008; Brown, 2005; Bryan et al., 2010; Sherrouse et al., 2011). The Kernel density output cell size was set to 200 m to reflect the local scale in which the data was originally collected. The selection of the threshold distance in the analysis was based on the mapping scale (1:12,000) and an estimated respondent error of 120–240 m (size of the beads) and testing threshold distances (Alessa et al., 2008; Brown and Pullar, in press).

In addition, to examine the spatial relationship between the 19 landscape service indicators, a bivariate correlation analysis was performed. To conduct the analysis, a polygon grid layer with a 200 m cell size, indicating the total amount of all mapped points per indicator in each cell was created. The Pearson correlation coefficient (r) was calculated between all the indicators in the 3060 cell cases in SPSS. It was also expected that certain landscape indicators associate with specific land cover and land use areas. Each landscape service indicator was overlaid with a digitised land cover and land use classification (based on the visual interpretation of a 2004 aerial photograph) of the study area to analyse the dominant LC/LU. The land use classes consist of: (1) permanent/semipermanent agricultural land (rice, crops, etc.), (2) shifting agricultural land (various crops), (3) grassland/scrubland, (4) permanent/semipermanent agricultural land/agrofarming, (5) forest with low stands or scrubland, (6) forest with high stands, and (7) settlement (Fig. 1).

The final analyses examined the broader landscape level patterns of the indicators using a cell size of 600 m. Indicator point data layers were merged and each 600 m cell included information on the amount of mapped points per indicator, intensity as the total amount of all mapped points per indicator and binary information (1/0) of the presence of each service indicator. Three spatial analyses were calculated on the basis of these data. Firstly, the intensity was calculated with a Kernel density analysis using a threshold distance of 600 m. Secondly, the richness of landscape service indicators, i.e. the total number of different indicators present in each 600 m cell (max. 19) was summed up. And, thirdly, a Shannon diversity index (H') was used to analyse the diversity and occurrence of the 19 landscape service indicators on the landscape scale (Bryan et al., 2010; Fagerholm and Käyhkö, 2009; Krebs, 1989, Brown and Reed, in press). The diversity index was calculated based on the relative amount of points for each indicator in the 600 m cell. An H' value 0 indicates that only a single indicator is present in the cell.

The maximum values for H′ are reached when all the indicators are represented by the same number of points in a specific cell.

3. Results

3.1. Community profile

Of the total 218 community members interviewed, the majority are married (61%) or single (26.1%), 11% divorced and a few widowed (1.8%). The households are large, with a mean size of 6 persons (min 1, max 15), and with more than three children on average (max 10). The majority of the informants have completed elementary (21.2%) or secondary education (49.3%) and three informants high school. However, about a fourth (26.7%) do not have any formal, finished education. Over half (56%) of the informants have moved from other parts of Zanzibar or from mainland Tanzania. The main livelihoods are subsistence farming (practiced by 95.4% of the informants), cultivation for selling (55.3%), livestock keeping, typically poultry, cows and goats (54.8%), and small scale business (27.2%). 13% of the informants, mainly men, are working for salary as teachers, car drivers, construction workers or as government employees. The other main livelihoods are cutting wood for sale, preparing and selling handicrafts, fishing, and tree planting.

Men are notably more active than women in visiting and moving around in the village on a daily and weekly basis (men 80.9%, women 48.1%), and most of them (74.5%) also travel to Zanzibar Town regularly. Women in general stay in the vicinity of their homes. The informants hardly ever visit other parts of Unguja Island. The self-perceived familiarity and knowledge of the landscape is rather high (scale score mean 3.9), and men rank it generally more often higher than women (highest score 5 pinpointed by 46.4% of men compared to 22.2% of women). Low perceived knowledge is typical to those who have migrated less than 10 years ago.

3.2. Landscape service indicators and associated activities

A total of 4046 points were mapped on the aerial photograph during the interviews (Table 1), and the attributes of an additional 173 places were noted down for places located outside the aerial image map. The highest response rate (*n*%) was established for food (cultivation, livestock keeping and the collection of wild fruits) and fuel (firewood collection) of the material products and aesthetics, social relations and intrinsic values of the cultural services. Most of the informants marked one to two places per landscape service indicator, but the men had a tendency to map slightly more points than women (53.0% of all points), especially for cultural services (free time, religious and spiritual, and intrinsic values) and the collection of wild fruits. The majority (88.8%) of the informants who mapped more points than average have been living 10 or more years in the village, and they also have a tendency to evaluate the self-perceived knowledge with the highest scores (4 or 5).

The most common landscape service is food, which consists of five indicators and represents 31.4% of all the mapped points (Table 1). Cultivation and livestock keeping are practiced by the majority (90.4–99.1%) of the informants and ranked as the two most important material indicators (Fig. 3). Fishing and seafood catching is practiced by a few (8.7%), and some (5.9%) go fishing to the sea coast some kilometres south of the study area. Beekeeping is also practiced only by a few informants (3.7%). The highest amount of locations (528) is pinpointed for cultivation (2–3 fields/informant). More than half (52.7%) of the informants cultivate rice, mainly the villagers in Cheju. Six out of ten rice farmers (60.9%) self-produce most of their household consumption (scale score 4 or 5), whilst farmers of other crops are less self-subsistent (37.0%). On the contrary to cultivated crops and fruits, wild fruits are collected widely across the landscape, especially by the men.

Firewood collection is ranked as the third most important of all the material services (Fig. 3). Almost all the informants (97.7%) collect firewood and more than half (56.0%) wood for charcoal production (Table 1). The mapped points for fuel in total represent 11.3% of all the points. The majority of the informants (86.6%) state that they collect all their consumed firewood (scale score 5). Charcoal is mainly collected or produced for selling to create monetary income (69.0%) and, to a lesser extent, for home consumption (24.5%), and it is practiced especially in Unguja Ukuu Kaebona. Tree planting is rather common (39.9%, Table 1), and the collection of construction and handicraft materials and medicinal species are also favoured. Whilst handicrafts are more of the activity of the women, the extraction of geological resources is typical to men. The decorative use of natural materials, such as flowers or shells, is a rather rare activity.

Most of the non-material, cultural landscape values were identified and located by the majority of the informants (80.3–98.6%, Table 1). However, the cultural heritage values were mapped only by 22.0% of the informants. The five different cultural services correspond to 34.1% of all allocated locations. Spiritual and religious values, attached typically to graveyards (71.7%), sacred places (25.5%) and visiting a sorcerer (1.6%), are the most important cultural services (Fig. 3). The majority (90.0%) consider religious or sacred sites to be protected from cultivation and tree cutting. Some of these religious places (5.3%) are found outside the study area.

Aesthetic places are the most frequently identified and heterogeneous cultural services (Table 1), and associate to areas where infrastructures, services and possibilities for shopping (26.5%) exist. Many of these places (9.3%) link to social interaction. A fifth (20.2%) of the aesthetic places are characterised by high forest areas, beautiful trees, or places where the possibility to spot wild animals exist. Fields and suitable soils characterised are 12.6%, fresh air, breeze, beach and possibilities for relaxation 10.6% and beautiful scenery 1.3% of the mapped places. Aesthetics is also related to the soccer grounds by the men (3.2%), and to the home, mainly by the women (14.1. %). Some of the aesthetic places, such as beaches and the sea shore (14.1%) are located outside the study area.

During free time, social interaction is the most important activity and over half (51.8%) of the allocated sites point out these meeting places. For women, such sites are either at home or in the vicinity where many prepare handicrafts, but men gather in central places in the villages or play soccer. Intrinsic values are mostly related to high forest areas and various forest plantations (42.5% of the points). Other natural features and good soil characterised in total 21.1% of the points. 7.9% of intrinsic places were attached to the sea and beach south of the study area, and 5.9% to the home. Built environment and road infrastructure were valued in 15.3% of the intrinsic value points. The places for the valuation of local culture were related to traditional singing, story telling, celebration, and coral caves used for worshipping.

3.3. Spatial patterns, arrangement and intensity of landscape service indicators

Landscape service indicators are located on average at 1130 m distance, and 12 out of 19 indicators within 1 km distance from the informant's home (Table 1). Livestock keeping, the collection of medicinal species, decorative use of natural materials, and free time and social interaction seem to locate closest to homes (around 500 m). On the other hand, aesthetics, intrinsic values, collection of handicraft materials, and fishing and seafood catching are found furthest from the home (over 1500 m). In general, the distance of the indicators from the informant's home is higher for men than for women. Altogether, for the informants living in the sub-villages

Table 1
Summary of descriptive statistics on landscape service indicator points mapped on an aerial image map (number of informants, relative proportion of all informants, number of mapped points, relative proportion of all points, points per informant mean and maximum, average distance from informant's home (m), average nearest neighbour statistics as distance between points (m), nearest neighbour ratio and *Z* score, dominant land cover/land use class(es), intensity grids (Kernel density) statistics as number cells, area (km^2), density minimum, maximum, mean and standard deviation. The Kernel density analysis is calculated as points/ha with a cell size and search radius of 200 m.

Landscape service		Landscape service indicator	*n*	*n*% (218)	No. of points	Points% (4046)	Points/inform.		Ave dist. from home (m)	Nearest neighbour statistics			Dominant LC/LU class(es)	Intensity (Kernel density) grids statistics					
							Mean	Max		Ave NN dist. (m)	NN ratio	*Z* score		No. of cells	Area (km^2)	Min	Max	Mean	Std. dev.
Food	1	Cultivation	216	99.1	528	13	2.4	6	987	113	0.47	−23.34	1	600	24	8.50E−06	1.41	0.22	0.24
	2	Livestock keeping	197	90.4	296	7.3	1.5	4	423	127	0.4	−19.91	7	346	13.8	4.30E−06	2.13	0.21	0.3
	3	Collection of wild fruits	200	91.7	421	10.4	2.1	6	900	128	0.47	−20.6	1	508	20.3	5.10E−06	2.05	0.21	0.24
	4	Fishing & seafood catching	19	8.7	19	0.5	1	1	3455	338	0.27	−6.12	–	23	0.9	7.00E−04	0.76	0.2	0.24
	5	Beekeeping	8	3.7	9	0.2	1.1	2	1632	1554	0.84	−0.91	7	28	1.1	1.60E−04	0.23	0.08	0.08
Raw materials	6	Tree planting	87	39.9	90	2.2	1	2	727	266	0.46	−9.87	5.7	205	8.2	2.70E−06	0.43	0.11	0.1
	7	Collection of construction materials	176	80.7	231	5.7	1.3	3	835	178	0.49	−14.88	4	347	13.9	4.60E−07	2.19	0.17	0.23
	8	Collection of handicraft materials	64	29.4	74	1.8	1.2	2	1981	314	0.49	−8.42	3.6	182	7.3	6.80E−05	0.46	0.1	0.09
Geological resources	9	Coral rock extraction	116	53.2	138	3.4	1.9	3	661	215	0.46	−12.24	5	256	10.2	1.70E−06	0.76	0.13	0.13
	10	Sand & soil extraction	132	60.6	149	3.7	1.3	3	667	138	0.3	−16.21	1	225	9	1.70E−06	1.14	0.16	0.17
Fuel	11	Firewood collection	213	97.7	275	6.8	1.3	3	1271	177	0.53	−14.89	5	495	19.8	2.70E−06	1.53	0.14	0.15
	12	Wood for charcoal	122	56	181	4.5	1.5	3	1217	197	0.48	−13.4	5	349	14	4.30E−06	0.7	0.13	0.12
Medicinal resources	13	Medicinal species in nature	170	78	230	5.7	1.4	3	564	152	0.41	−16.97	7	330	13.2	1.00E−06	1.62	0.17	0.24
Ornamental resources	14	Decorative use of natural materials	24	11	25	0.6	1	2	430	405	0.37	−6.07	7	52	2.1	2.90E−04	0.63	0.12	0.13
Aesthetics	15	Beautiful, attractive place	207	95	463	11.4	2.2	4	1476	109	0.42	−23.69	7	502	20.1	1.60E−06	2.94	0.23	0.44
Social relations	16	Free time & social interaction	215	98.6	312	7.7	1.5	3	394	57	0.18	−27.64	7	195	7.8	3.70E−10	6.37	0.4	0.8
Spiritual and religious values	17	Religious or sacred place, feeling or value	180	82.6	234	5.8	1.3	3	942	71	0.2	−23.54	4	156	6.2	2.70E−06	4.12	0.37	0.65
Cultural heritage values	18	Valuation of local culture	48	22	55	1.4	1.2	3	876	283	0.38	−8.81	7	95	3.8	1.40E−05	1.62	0.14	0.23
Intrinsic values	19	Value of nature as such	175	80.3	316	7.8	1.8	3	1955	171	0.55	−15.33	7.1	513	20.5	2.50E−06	1.68	0.15	0.21

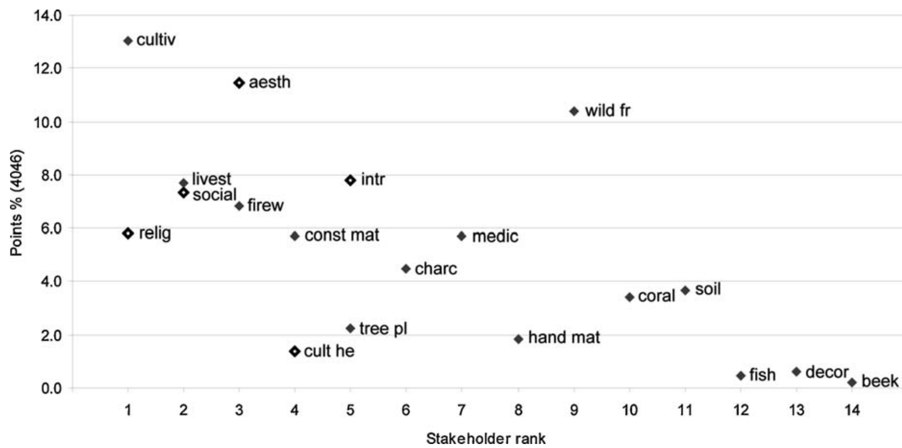

Fig. 3. Stakeholder rank value for material (1–14) and non-material, cultural (1–5) landscape service indicators and relative amount of mapped points.

along the main roads, distances to various landscape services are the highest, for all but one indicator. Only for free time and social interaction the distance is lower, indicating the tendency of people to gather in the main sub-villages from the more peripheral locations.

Landscape service indicators are significantly spatially clustered, with the only exception being the beekeeping, which is likely to result from the low number of points (Table 1, examples in Fig. 4). In general, cultural services have a higher spatial intensity (max 1.62–6.37 points/ha, Table 1) than the material services (max 0.23–2.19 points/ha). The scattered pattern (NN 0.47, Z score −23.34) for cultivation (Fig. 4A) is similar to other important food services in the landscape, resulting in moderate intensities (max 1.41/2.13/2.05 points/ha for cultivation, livestock keeping and the collection of wild fruits, respectively, Table 1). Cultivation and livestock keeping have also high spatial extent in the landscape (24.0 and 20.3 km^2, respectively). Firewood collection is among the indicators having the most dispersed, although a statistically clustered, pattern (NN ratio 0.53, Z score −14.89). This spatial pattern shows a zone with a north-south direction through the study area, with the spatial intensity rising the highest to 1.53 points/ha (Fig. 4B). In general, fuel resources cover a significant spatial extent (19.8 and 14.0 km^2 for firewood and charcoal, respectively, Table 1).

The most clustered and spatially intensive indicators are those of free time and social interaction (NN ratio 0.18, Z score −27.64, max 6.37 points/ha), and spiritual and religious values (NN ratio 0.20, Z score −23.54, max 4.12 points/ha), especially pointing out the shared meeting places and graveyard sites (Table 1, Fig. 4C). This clustering is also indicated by the highest NN statistics Z scores and standard deviations in the intensity values. Free time and social interaction together with spiritual and religious values also have a rather small extent (7.8 and 6.2 km^2, respectively). The intrinsic values are spatially the most dispersed (NN ratio 0.55, Z score −15.33, max 1.68 points/ha) and cover an area of more than 20 km^2 (Table 1, Fig. 4D). For comparison, also aesthetics is rather dispersed and has a significant spatial extent (NN ratio 0.42, Z score −23.69, 20.1 km^2).

3.4. Spatial relationship between landscape service indicators, land cover and land use

Spatial patterns of cultivation, livestock keeping and the collection of wild fruits show a tendency for spatial co-occurrence (r = 0.45–0.52, Table 2). These activities are found on permanent and semipermanent agricultural land and agrofarming is practiced on settlement areas and in the vicinity. Wild fruits are often collected nearby or along the way to fields and livestock is kept freely around the home and in vicinity (dominant LC/LU classes 1/7, Table 1). Livestock keeping areas have a strong spatial relationship also with the indicators for the collection of construction materials and medicinal species, decorative use of natural materials, and aesthetic and social interaction.

The places for the collection of handicraft materials, concentrated in high forest areas in Mapopwe and the neighbouring lowland grasslands (classes 3/6, Table 1), show a weak or moderate spatial association with other indicators (Table 2). The indicator has also the highest relative amount (44.6%) of mapped points falling inside the JCBNP. The use of forest resources is seen also in the pattern of construction materials, a fifth of the points (20.1%) located inside the national park. Fuel resources are primarily found in low stand forests and on scrubland (class 5). The points for firewood and wood for charcoal collection have a moderate spatial relationship (0.40) and are strongly oriented towards the use of the resources in the national park, where approximately a third of the mapped points (38.2% firewood, 30.4% charcoal) are scattered.

Between the five non-materials, cultural landscape values the spatial relationships show strong or moderate association except for religious and sacred places (Table 2). Places for free time cover the central meeting places in all sub-villages (class 7, Table 1), and correlate strongly with beautiful places (0.70) and the valuation of local culture (0.50). A strong correlation is also found between aesthetic and intrinsic values (0.61). A significant number of mapped places for aesthetic and intrinsic values can be found in the deep soil rice cultivation area and scattered in the forest areas (classes 1/5/6). 40.2% of intrinsic value points fall within the JCBNP, and 18.1% of the aesthetic points. However, both of the values can also be found in the settlement areas where the highest intensities occur and which the dominant LC/LU class is. Religious and sacred places differ from these and are located outside but close to settlement areas (class 4).

Interestingly, the material and non-material landscape service indicators show a rather low spatial relationship. A strong correlation is found only between livestock keeping and beautiful places and free time (r = 0.68/0.64), co-existing mainly in the settlement areas.

3.5. Intensity, richness and the diversity of indicators at the landscape level

When studying the spatial patterns of all the mapped services together at the landscape level, sub-villages located along the main roads, both in the northern and southern parts of the study area, show the highest intensities of different landscape services (Fig. 5A). For example, at the maximum, 178 landscape service

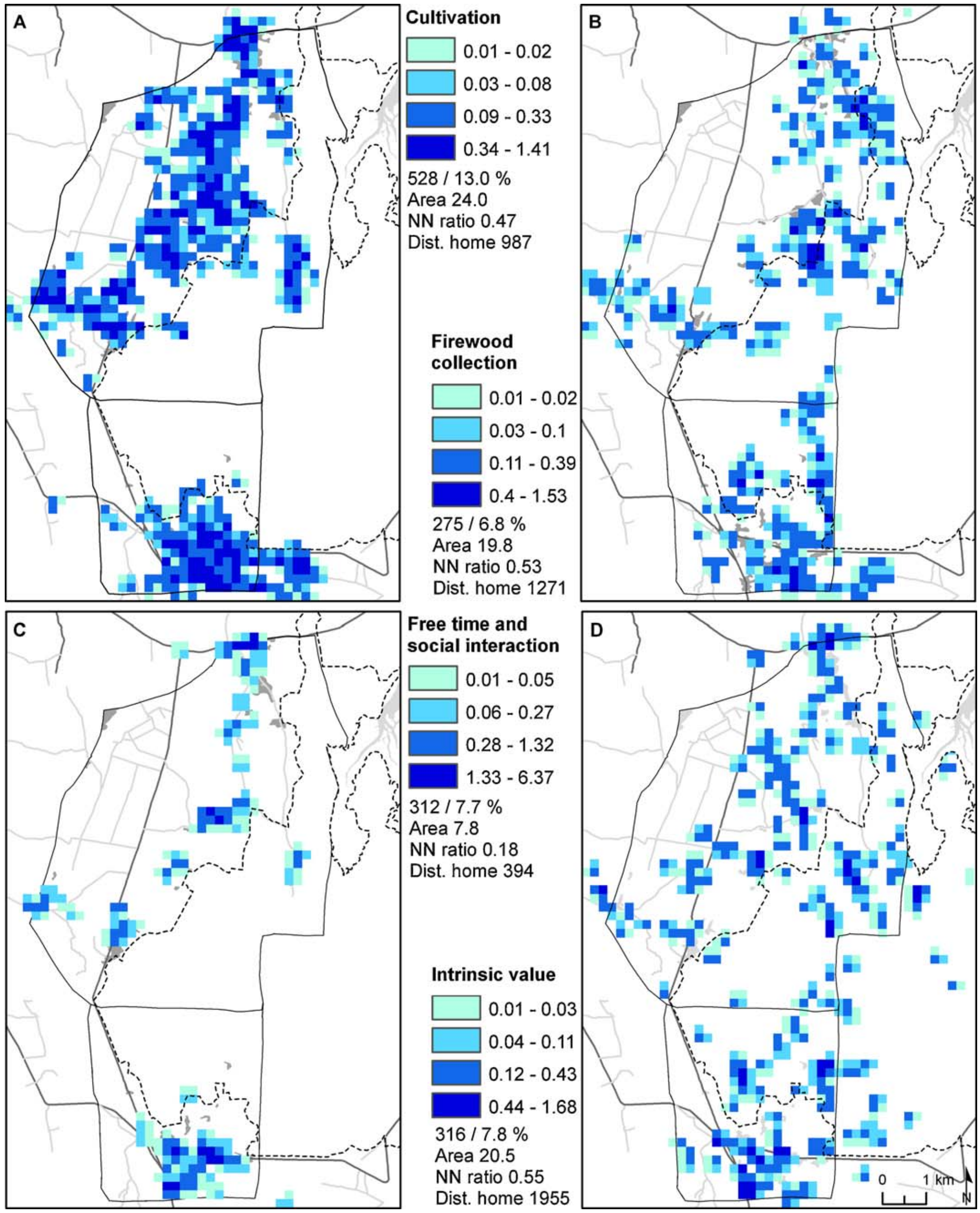

Fig. 4. Spatial intensity (points/ha) for four landscape service indicators of cultivation (A), firewood collection (B), free time and social interaction (C), and valuation of nature as such (D) calculated as Kernel density surface with 200 m cell size and search radius. Descriptive data indicate the number of mapped points and relative proportion of all mapped points per indicator, nearest neighbour ratio, and average distance (m) from informant home to mapped point locations.

indicator points are located in the area of one 600 m cell in the southern Kwaboti sub-village. The very same areas express also the highest co-existence of different types of landscape services, reaching up to a richness of 18 services in the northern Uwandani settlement along the main road (Fig. 5B). Additional single cell areas of high richness are located in and in the vicinity of some of the sub-villages. When looking at the diversity of landscape service indicators (Fig. 5C), the cells with the highest diversity index values can be found in almost all settlement areas and in the surrounding forested land covers, scrubland and agrofarming areas (LC/LU classes 3/4/5/6). These are the areas where more than 10 different material and non-material landscape services with a rather even occurrence of different indicator points are present. The point intensity varies significantly between the high diversity areas.

4. Discussion

4.1. Landscape service indicators reflecting multiple benefits from the environment

This case study has demonstrated how local stakeholders' knowledge can be used in the spatial assessment of landscape services. We have shown that community stakeholders are able to express their multiple values and perceptions of the land using the concept of landscape services, and that these services and their patterns can be spatially analysed and generalised. The indicated benefits from nature demonstrate spatial clustering and the co-existence of various services, but simultaneously also a tendency for spatial dispersion, and suggest that there is far more

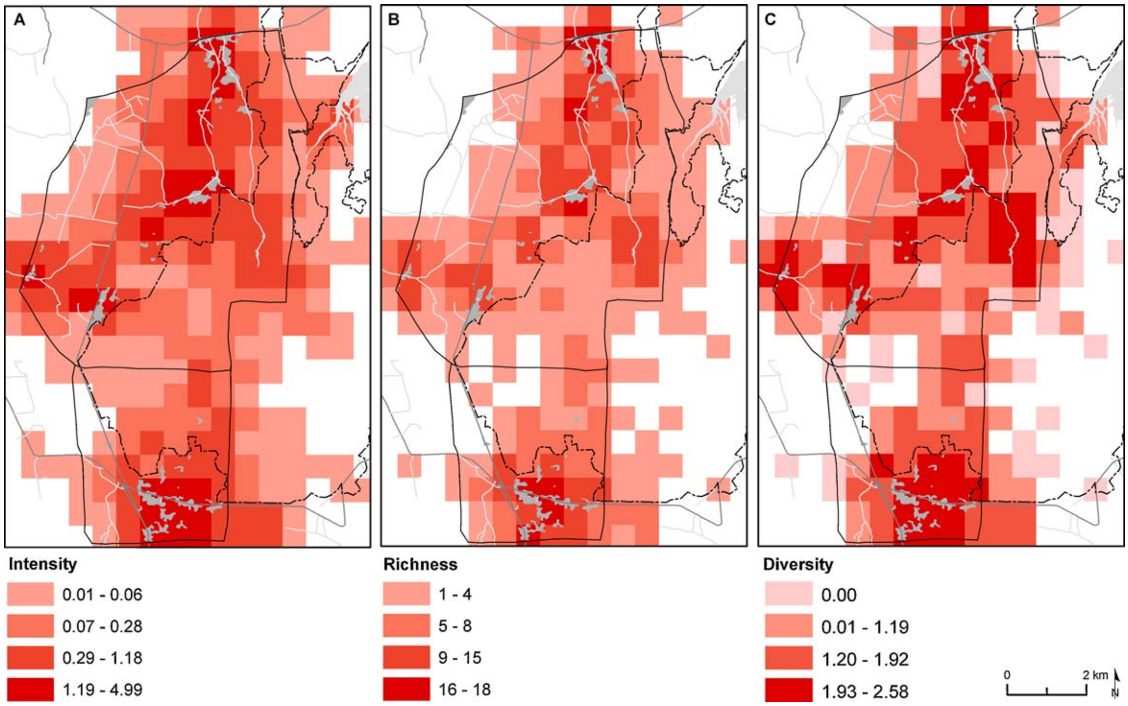

Fig. 5. Landscape level patterns of material and non-material, cultural indicators as intensity ((A) Kernel density surface, points/ha, 600 m search radius), richness (B) and diversity ((C) Shannon diversity index) for all 4046 landscape service indicator points in 600 m cell.

heterogeneity and sensitivity in the ways these benefits are distributed in relation to actual land resources.

Subsistence-related, and most frequently addressed material service indicators are individually based and spatially scattered in the landscape, suggesting that only through mapping their spatial clusters and distance patterns, it is possible to indicate which areas are of fundamental resource value for the communities. Furthermore, as many of them co-exist spatially, it means that landscape services are rather inclusive than exclusive in character. In other words, subsistence economies are a showcase of multiple land values sensitive to spaces and places. As material services are primarily indicators of family strategies of subsistence, it is sensitive to draw too harsh generalisations of their collective meaning. However, in the studied landscape, one can identify crucial material assets for the communities as a whole, and these relate to the remaining forests and scrubland areas in the vicinities of the villages, and the rice farming area in the northeastern part of the area. The scattered pattern of the use of natural resources, service intensities and diversities nearby the settlements, create land use pressures and trigger conflicts. Even inside the protected forests, resources are under pressure and biodiversity threatened, since for many of the communities those gazetted forests are temptingly close to their homes. Forests are not truly protected anywhere. On the contrary, gazetting forces pressures elsewhere and simultaneously is too weak in itself to sustain from pressures. On the other hand, the unique appreciation of natural features is revealed by aesthetic and intrinsic values scattered in the forests. Furthermore, religious and sacred sites show a tendency for conservation arising from the community. Hence, the community members' high appreciation of the forests as sources of many material and non-material values creates a paradoxical situation, which may need new types of approaches for the long-term viability of natural resources.

The well-being of the communities is also significantly dependent on non-material services, pointing out shared places of social interaction and cultural traditions, as indicated with the highest intensity and spatial clustering of landscape service indicators in and nearby settlement areas. One could interpret such places in the landscape as key areas, which play a vital role in the sustainability of the services and overall well-being of the communities. Cultural landscape service indicators show co-existence with the material ones, mainly in the settlement areas, indicating that for the most part the tangible and intangible benefits relate to different areas and places in the landscape. Both material and non-material benefits are preferred closest to (1 km) settlements, where also the highest intensity, richness and diversity are found, meaning that geographical distance plays an important role in the assessment of landscape services. This may suggest that both settlement-related and geographical distance-dependent functions should be incorporated into the efforts of modelling landscape service potential in any human-modified and settled landscapes. Given the contextual nature of many especially cultural services, their patterns are, however, challenging to generalise.

The study indicates also the tendency for cumulative place relationship, as those informants who mapped more than the average amount of points also were the ones who had the longest dwelling experience and evaluated the self-perceived knowledge the highest as well. It can be suggested that these informants have developed a deepened understanding of the landscape and the abstract space in the landscape have become multiple places with attached values and practices (Tuan, 1977). In addition, our study strengthens the understanding of a relationship between frequency of mapped attributes and their high perceived importance. In this study, as well as in three studies by Brown and Reed (2009), the most frequently mapped landscape values were also ranked as the most important by the informants.

4.2. Local stakeholders as experts in landscape service mapping

From a methodological point of view, participatory mapping of indicators for landscape services proved to be a valuable tool to describe and spatially capture community perceptions on and use of these services. We suggest that the presented conceptualisation

Table 2
Spatial relationship between landscape service indicators calculated as a Pearson correlation coefficient in 200 m cell. All correlations are significant at level 0.01 (except the correlation between religious and sacred place and firewood collection at the level 0.05).

Landscape service		Landscape service indicator	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Food	1	Cultivation	1																		
	2	Livestock keeping	0.52	1																	
	3	Collection of wild fruits	0.45	0.46	1																
	4	Fishing & seafod catching	NS	NS	NS	1															
	5	Beekeeping	NS	0.10	0.05	NS	1														
Raw materials	6	Tree planting	0.33	0.31	0.20	NS	NS	1													
	7	Collection of construction materials	0.32	0.50	0.43	NS	0.05	0.16	1												
	8	Collection of handicraft materials	0.20	0.17	0.12	NS	NS	0.12	0.18	1											
Geological resources	9	Coral rock extraction	0.29	0.38	0.28	NS	NS	0.20	0.28	0.18	1										
	10	Sand & soil extraction	0.37	0.41	0.39	NS	NS	0.14	0.37	0.07	0.25	1									
Fuel	11	Firewood collection	0.23	0.09	0.18	NS	NS	0.25	0.17	0.05	0.11	0.06	1								
	12	Wood for charcoal	0.29	0.32	0.25	NS	NS	0.25	0.25	0.16	0.23	0.22	0.40	1							
Medicinal resources	13	Medicinal species in nature	0.44	0.70	0.44	NS	NS	0.29	0.47	0.18	0.35	0.40	0.13	0.33	1						
Ornamental resources	14	Decorative use of natural materials	0.31	0.52	0.42	0.07	NS	0.25	0.43	0.07	0.25	0.31	0.05	0.17	0.49	1					
Aesthetics	15	Beautiful, attractive place	0.40	0.68	0.35	0.08	0.10	0.14	0.41	0.13	0.27	0.28	0.06	0.26	0.57	0.45	1				
Social relations	16	Free time & social interaction	0.43	0.64	0.33	NS	NS	0.15	0.42	0.14	0.25	0.30	NS	0.26	0.62	0.39	0.70	1			
Spiritual and religious values	17	Religious or sacred place	0.19	0.27	0.20	NS	0.13	0.08	0.30	0.16	0.23	0.08	0.04	0.15	0.24	0.16	0.28	0.27	1		
Cultural heritage values	18	Valuation of local culture	0.19	0.38	0.14	NS	NS	0.07	0.26	0.09	0.15	0.10	NS	0.21	0.46	0.19	0.42	0.50	0.25	1	
Intrinsic values	19	Value of nature as such	0.25	0.36	0.21	0.18	NS	0.14	0.22	0.11	0.18	0.13	0.11	0.21	0.32	0.28	0.61	0.37	0.22	0.24	1

The correlation coefficient is categorised as a strong correlation when $r \geq 0.5$ (dark grey), moderate correlation $0.3 \leq r < 0.5$ (light grey) and weak correlation $0.1 \leq r < 0.3$ (no fill). Not significant spatial relationships are indicated with NS.

and typology of landscape services together with the participatory mapping methodology could be applied in and adjusted to different study contexts. This kind of real knowledge of the multiple landscape benefits can only be captured when local expertise is involved at a local level where individuals and resources meet (Luz, 2000), and is an essential part of landscape service assessments, which combine local and disciplinary expertise. As we have seen, the community stakeholders possess knowledge created through cumulative place experience. One main advantage of the approach is that the non-utilitarian and intangible value of landscapes and sensitivity to cultural landscape services, which many disciplinary expert evaluations of landscape or ecosystem services fail to do justice, was also captured with the participatory approach and applied service typology. This is valuable, as the management decisions on land should not only be based on the existing material benefits from nature's services, but also to consider the total well-being of the community. Interestingly, the intangible benefits may in some cases even exceed the tangible ones, as suggested by Vejre et al. (2010) in a Danish peri-urban context. Also, in these subsistence communities they have a significant role for community well-being.

There always exists the risk that the typologies and categorisation of values and perceptions attached to the landscape, such as ecosystem and landscape service typologies developed in western societies, may lack some essential aspects when applied in a different cultural context. We modified the typology and indicators for landscape services together with the local members of the research team, based on previous experience on mapping social landscape values (Fagerholm and Käyhkö, 2009), and also tested the interview questionnaire *in situ*. As our findings indicate co-existence and contextual interpretation of landscape services, it would also be worth exploring the conceptualisation of new typologies rising from the context of non-western societies. Furthermore, to find a combination of services, which together establish the essential contribution to community well-being, would be useful, as mapping several services is rather laborious.

A particular challenge for participatory mapping methods is the representation of the spatial dimensions of the mapped attributes. In this study, the beads placed on the aerial image map are considered to represent the centroids of the spatial occurrence of landscape service indicators. In the analysis, their extent is indeterminate, although some may represent spot like features (e.g. a beautiful house), and other wider areas (e.g. a field or area for collecting handicraft materials). Data analysis relied on the spatial aggregation of points (Brown, 2005; Brown and Reed, 2009; Brown and Pullar, in press). Inherently, the collected data includes ambiguity and especially many of the cultural landscape services are indirect and abstract in nature. However, the same applies to the real world and it may be questioned whether participatory mapping approaches necessarily need to aim for exact accuracy to be regarded as scientific (McCall, 2006). Eventually, the interest is in the broader spatial patterns of the services and their indicators in the landscape.

Aerial photographs have been found to be useful and reliable in location-specific tasks in participatory mapping exercises delivering visually attractive information of the landscape and are not too abstract (Bernard et al., 2011; Fagerholm and Käyhkö, 2009). The use of the aerial photograph as a background map was successful as, in general, the informants were able to identify places and areas with little support and some were very enthusiastic about reading the map. However, on some occasions, the interviewees were guiding informants who had difficulties in reading the image map. It was observed during the fieldwork that mapping is simpler when it is done close to the informant's home. When the here applied point mapping method is compared with our previous polygon mapping study (Fagerholm and Käyhkö, 2009), the spatial patterns and also the distances between the home and mapped values are consistent with each other.

This case study shows that the integration of participatory mapping methods with landscape service assessments is crucial for true collaborative, bottom-up landscape management aiming to community empowerment. It is also necessary in order to capture the non-material benefits of the land and resources. However, as Stephenson (2008) has pointed out, community members' views are not necessarily more 'right' than those of discipline-based experts: "the crucial issue is that both forms of knowledge contribute to understanding landscape values-as-a-whole". Agreeing with previous, practical management of multifunctional cultural landscapes needs explicit spatial data, maps and visual representations that integrate socio-cultural, bio-physical and economic values at relevant scales (Alessa et al., 2008; Burkhard and Müller, 2008; Black and Liljeblad, 2006; Brown et al., 2004). It can be concluded that landscape assessment cannot be truly integrated as long as there exists an imbalance in the representation of material and cultural landscape services.

4.3. Implications for local level management processes

This study has addressed many of the challenges listed by De Groot et al. (2010, Box 1) about the integration of ecosystem and landscape services into landscape planning and management. Certainly community involvement and participatory mapping enhance the assessment of landscape services. This is relevant especially at local scales and could be widely adopted in community forest management processes (Pagdee et al., 2006) and, also, among others in agricultural management, the designation of nature protection or conservation areas, and the allocation of tourism. For the practical management of multifunctional cultural landscapes, two arguments discussed in the following paragraphs can be made.

Firstly, landscape service assessment should be sensitive to space and place and include a local scale. Stakeholder involvement can enhance the assessment of landscape services, as it brings the multiple landscape benefits, rising from the local scale everyday experience, into spatial context. Thus, needed information on the socio-cultural values is created and it can be represented in legitimate spatial form and integrated with other government and expert data sets in GIS. Engaging local communities in environmental decision-making has proven to be valuable (Fraser et al., 2006). In the particular case of Zanzibar, however, participation has remained modest, although village conservation committees exist in the villages, and resources use management agreements have been drawn with local stakeholders (DCCFF, 2008; ZFDP, 1997). We have suggested that the proposed methodology is feasible for, and should be adopted in, existing community forest management (CoFM) processes via the inclusion of spatially explicit stakeholder knowledge.

Secondly, participatory mapping enhances capacity-building and the empowerment of the stakeholders involved. The suggested procedure has the potential to integrate and institutionalise place-based local knowledge in planning, and to promote the currently weak stakeholder collaboration and capacity-building within and between community stakeholders and administrative levels. On a more positive side, the local level administration in Zanzibar appreciated that not only those community members who regularly are engaged in environmental issues were participating, but also the informants represented the whole community, creating extensive information sharing. Furthermore, maps are powerful modes of representation and, as observed during the community meetings, facilitate the stakeholders understanding of what kind of benefits landscape services provide for the communities, how these are distributed and where these are under threat, in order to identify priority areas for landscape management.

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