

## Full Length Article



# Life satisfaction in coastal Kenya and Mozambique reflects culture, gendered relationships and security of basic needs: Implications for ecosystem services

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## ABSTRACT

Life satisfaction is both a desirable ‘end’ for sustainable development, and a means to understand the priorities, and behaviour of people towards local ecosystems. Ecosystem-services research on life satisfaction has focused on cultural services in wealthy, Western contexts, although ecosystem services are essential for poor people’s livelihoods in the Global South. We examined reported life satisfaction from a survey of over 2000 people in rural and urban settings of coastal Kenya and Mozambique. We coded respondents’ open-ended reasons for their reported satisfaction, and used multiple correspondence analysis to explore the characteristics of people who mentioned different reasons. We tested associations between satisfaction and the meeting of basic needs and income, with binary logistic regression, accounting for site and gender.

Life satisfaction was lower in Kenya, for men, and in the most urbanised site. Respondents explained high, and low, satisfaction in terms of social relationships, basic needs, money and employment. They rarely mentioned the ecosystem services and related livelihoods that underpin those, suggesting an instrumental relation to nature. Meeting basic needs, including economic security better predicted satisfaction than household income. Life satisfaction reflected material differences in people’s lives but also different evaluative criteria and national cultures. For example, family reasons more commonly explained women’s satisfaction, while money was more important for urban-dwelling men. We propose that the holistic perspective offered by life-satisfaction research can inform environmental management alongside more focused ecosystem-service research. For example, our results suggest that a) interventions should recognise immediate needs and social relationships, b) the role of ecosystem services for subjective wellbeing varies by local culture and individual identities and c) secure and fair access to ecosystem services may support life satisfaction better than high incomes that are insecure or inequitably distributed.

## 1. Introduction

Sustainable development aims to maintain ecosystems while improving people’s quality of life. But policies and interventions developed without an understanding of how people evaluate the quality

of their own lives, may fail to address people’s priorities, and fail to anticipate how they will respond to initiatives. Thus subjective assessments of life satisfaction, which give a voice to peoples’ own priorities and motivations, are increasingly recognised as important for assessing social change and progress (Diener and Seligman, 2004).

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Extensive evidence show that benefits from local ecosystems are particularly important in helping poor people in the Global South to meet their basic human needs (Angelsen et al 2014, Belton and Thilsted 2014). However, the role of ecosystem services in *subjective* life satisfaction tends to fall in a gap between two fields of literature. One body of literature has explored patterns and predictors of life satisfaction in the global south (e.g. Camfield et al 2010), but these rarely explicitly consider the role of nature. Another, research on nature's contribution to wellbeing is dominated by either objective measures of harvests and income from nature-based livelihoods, or focussed on the aesthetic or cultural benefits of exposure to nature, primarily in wealthier societies (Blythe et al 2020). For poor people in the Global South, where direct material reliance on nature is highest, the role of ecosystem services in life satisfaction remains rarely studied (for exceptions see Adams et al., 2020; Rasolofoson et al., 2018).

Understanding the effects of ecosystem services on life satisfaction can inform environmental policies in three ways. Firstly, life satisfaction offers a person-centred, holistic perspective on quality of life, which can show the role of nature in relation to other factors (such as social relations, income and access to public services) that may be indirectly related, or even independent of ecosystem services. This may help to navigate trade-offs between different human- and environmentally-focussed policy goals, such as by identifying policies that can improve people's lives while meeting environmental goals. Secondly, life satisfaction can help to understand human behaviour in relation to the environment. People are heavily invested in strategies and behaviours that aim to secure wellbeing for themselves and their families in response to their own values and priorities. Thus, better understandings of life satisfaction can guide strategies to promote sustainable behaviour and improve the effectiveness of environmental governance (Masterson et al 2019). Thirdly, a better understanding of factors affecting life satisfaction can help to understand how people's quality of life is affected by processes of environmental and social change and conservation initiatives, and support policies that address vulnerabilities and adapt to these challenges (Milner-Gulland et al 2014).

This paper contributes to understanding the role of ecosystem services in the subjective wellbeing of people in low-income countries, by viewing them in the broader context of factors affecting their lives. Such a holistic approach is necessary to capture the direct and indirect effects of ecosystem services on wellbeing (Summers et al 2012; Oldekop et al., 2021). We aim to bridge the literature on life satisfaction with the literature on ecosystem services and human wellbeing. In so doing we also contribute to the growing understanding of life satisfaction in developing countries.

Specifically, we explore life satisfaction in communities on the East African coast, ranging from remote rural villages to urban areas. Nature-based livelihoods such as fishing, farming and harvesting from local forests are common across these sites but are challenged by resource overexploitation, large-scale infrastructure development and conservation initiatives that restrict access. Meanwhile high levels of material poverty, strict gender roles, and fluctuating economic and political contexts are a challenge for people trying to pursue a quality of life, and management actions or initiatives often imply difficult tradeoffs (Daw et al 2015). We examine patterns of life satisfaction in men and women across these sites, the reasons for their satisfaction or dissatisfaction, to explore the role of nature in their subjective wellbeing and within the broader context of their lives.

We examined the question: what role do ecosystem services play in the life satisfaction of communities in coastal Kenya and Mozambique? In order to contextualise contributions from ecosystem services alongside other factors, we approach this question by first examining the general patterns of life satisfaction in our sites, before exploring the reasons for its variation and the role of ecosystem services.

Although embedded in a larger project about coastal ecosystem services, this study takes life satisfaction as a starting point in order to examine the role of nature in people's own lived experiences. We did not

directly ask how ecosystem services contribute to wellbeing. This differs from the majority of ecosystem services literature, which emphasises ecosystem services themselves, rather than the multidimensional life experiences that they contribute to (Bennett et al., 2015). For example empirical research on coastal ecosystem services and wellbeing, tends to directly ask people about their relationship to nature (E.g. Aguado et al 2018; Chaigneau et al., 2019a; Chaigneau et al., 2019b; Lapointe et al 2021) restricting people to talk about wellbeing within an ecosystem-service framing. This study is also based on a gender-balanced survey of over two thousand randomly-selected people across eight sites, which contrasts with most ecosystem service studies that focus on groups who are directly linked to a natural resource, based on their livelihoods (Abunge et al., 2013) and miss how other people in society benefit from ecosystem services (Blythe et al 2020).

The survey included a life satisfaction indicator, an open ended question about people's own reasons for their level of satisfaction, indicators of whether basic needs are met, and details of household incomes (only in the Kenyan dataset  $n = 1600$ ). Unlike qualitative studies with purposively selected respondents, our random sample of respondents also allowed us to explore generalizable patterns across eight sites, and supplement people's own reasons for life satisfaction with cross-sectional statistical analysis of associations of life satisfaction with basic needs, income and demographics.

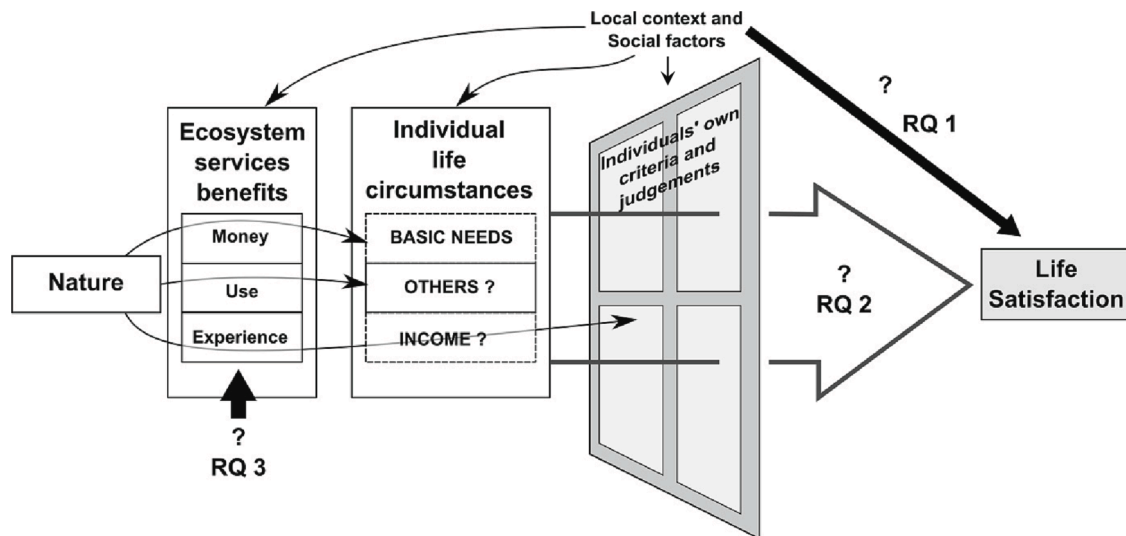
### 1.1. Paper outline

In the next two sections we briefly review the theoretical background for our study from the fields of life satisfaction and ecosystem services, and outline our approach and specific methods. In results, we first present descriptive results of patterns in life satisfaction, then how people explain their own satisfaction or dissatisfaction, including any mentions of ecosystem services. We then present a statistical analysis to evaluate which reasons were cited by which respondents, and which cross-sectional variables predict life satisfaction. The discussion embeds our findings in the wider life satisfaction and ecosystem services literature and discusses the implications for environmental management. Finally, we reflect on our methodological approach and its contribution to understanding and managing ecosystem services.

## 2. Theoretical background and approach

### 2.1. Ecosystem services and subjective wellbeing

Ecosystem-services assessments reflect broad definitions of wellbeing that include subjective dimensions. For example, the Millennium Assessment framed ecosystem services as contributing to "freedom of choice and action", while the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) adopted a broadly defined concept of 'Quality of Life' (Pascual and Howe, 2018). These broader understandings of wellbeing have given rise to a plethora of ways of conceptualising how nature contributes to it (Coulthard et al 2018). At one extreme Schleicher et al (2018) consider nature as a core constituent of wellbeing. Other frameworks distinguish wellbeing from the ecosystem services that support them. For example, Polishchuk and Rauschmayer (2012) draw on Sen's capability approach to define wellbeing as freedom of choice and action, and distinguish it from the resources (including ecosystem services) that support those choices. Similarly, Summers et al (2012) present ecosystem services as contributing rather than constituting wellbeing, and include subjective wellbeing as one component of wellbeing alongside basic needs and economic needs. Chaigneau et al (2018) conceptualised ecosystem services as contributing to meeting basic needs through multiple mechanisms that they summarised (based on focus groups in the same sites as this study) as: 1) creating opportunities to earn money, 2) providing resources for direct use, and 3) benefiting through the experience of engaging in ecosystem-based activities (as reflected in Fig. 1).



**Fig. 1.** Conceptual framework for this study showing the relationship of life satisfaction to individual life circumstances, refracted through the window of individual judgement. The hypothesised roles of ecosystem services is depicted according to Chaigneau et al 2019, and the influence of context and social factors. RQ1-3 refer to the three research questions of this paper.

Meanwhile, there is growing evidence and policy interest for how connection to nature supports mental health (Bratman et al 2019) and a growing field of environmental psychology that addresses environmental impacts on life satisfaction (Biedenweg et al 2017). However, much of the research on nature and life satisfaction has been in relatively wealthy regions (Bratman et al 2019). Although poor people in the rural Global South have the greatest direct dependency on nature for their wellbeing (Ten Brink, 2011), the subjective dimensions of this are poorly explored. Some examples from the Global South have shown the importance of nature experiences for subjective wellbeing, for example of South African rural–urban migrants (Njwambe et al., 2019). In a rare example of studying both material and non-material benefits from ecosystems, Adams et al (2020) found that lack of access to ecosystem service-based livelihoods were statistically associated with material poverty and life dissatisfaction, and that dissatisfaction was related to certain social-ecological contexts. A key emerging insight is that individual identities influence how ecosystem services contribute to wellbeing (Fisher et al., 2014), as well as social factors from community to societal scales such as gender norms, national and ethnic cultural identity (Oldekop et al., 2021).

## 2.2. Life satisfaction and basic needs as subjective and objective measures of wellbeing

The concept of human wellbeing gives a more multidimensional understanding of social progress than notions of economic welfare and income poverty, which have dominated development narratives throughout the 20th century (McGregor et al 2015). For example, wellbeing consists of both material and non-material life domains (Doyal and Gough 1991, Gough and McGregor 2007), and includes subjective wellbeing, defined as ‘an overall evaluation of the quality of a person’s life from his or her own perspective’ (Diener et al 2018). An evolving consensus agrees on the need for both objective measures of quality of life, alongside subjective measures that give voice to peoples’ own priorities and motivations (Diener and Seligman, 2004).

This study uses the ‘Satisfaction with Life Scale’ as a measure of subjective wellbeing, which has been extensively used over the last 30 years. It captures a conscious judgement of a person on their satisfaction with life according to their own criteria (Pavot and Diener, 2009) reported on an ordinal scale. Such scales have facilitated large-scale research to explore patterns in life satisfaction, and identified a complex mix of personal identity, social and demographic factors (Diener

et al., 2009; Camfield et al 2009), rather than a straightforward effect of material conditions such as fulfilment of basic needs (Camfield et al 2010) and wealth (Posel and Rogan 2016). These personal and contextual factors are thought to influence the experience, evaluation and expression of life satisfaction. For example men and women may use different criteria or scales when evaluating life satisfaction, leading to gendered differences (Montgomery 2022). Meanwhile, the standards people use to assess their own lives may differ according to comparisons with others, their own recent past, or the expectations they have for themselves. At one extreme, life satisfaction might be unresponsive to material deprivation for marginalised individuals with ‘adaptive preferences’, in which “the underdog learns to bear the burden so well that he or she overlooks the burden itself” Sen (1984:309). At the other extreme of the ‘hedonic treadmill’, life satisfaction is determined only by comparison with others and thus is not improved by rising absolute consumption (Davis and Wu, 2020). Thus evaluation of life satisfaction, and the way in which ecosystems contribute to it are influenced by personal identity and demographics such as age and gender as well as context such as landscape (Adams et al 2020), urbanisation and experiences of migration (Mulcahy and Kollamparambil 2016).

To capture people’s material circumstances and explore their role in life satisfaction, we use objective indicators of whether people or households are fulfilling a range of basic human needs (Chaigneau et al 2018). These indicators draw on the Theory of Human Needs (Doyal and Gough 1991), which provides a list of needs that need to be met to avoid suffering. These needs are assumed to be universal, although the means of meeting these needs vary by context.

## 2.3. Our approach

Fig. 1 summarises how we draw on these theoretical perspectives to examine what influences life satisfaction and identify three research questions (RQs). RQ1 explores how context and social identity are associated with life satisfaction through a descriptive analysis of patterns of satisfaction. Fig. 1 shows that such associations can have multiple explanations, because context and social factors may affect access to ES, people’s life situation directly, or the lens and criteria through which people assess their lives.

RQ2 asks what aspects of people’s lives seem to influence and explain life satisfaction, based on respondents own reasoning as well as cross-sectional statistical analysis. We focus on the impact of meeting basic human needs (Doyal and Gough 1991), as well as income, given the

disputed role of income in life satisfaction (Jebb et al 2018), and abundance of monetary mechanisms for ecosystem services to contribute to multidimensional wellbeing in these settings (Chaigneau 2019). We also explore whether the reasons given vary by context and identity exploiting the gender-balanced survey data not typically available from surveys conducted only with household heads (e.g. Adams et al., 2020).

RQ3 asks how ecosystem services feed into life satisfaction based on how people refer to nature or nature-based livelihoods (primarily fishing and farming). We also reflect on how the aspects of life identified in RQ2, can inform management of ecosystem services to support life satisfaction.

### 3. Methods

#### 3.1. Study sites

The data were collected in 2014 and 2015 as part of a larger project exploring the relationship between ecosystem services, poverty and human wellbeing in eight coastal sites in southern Kenya and northern Mozambique (ANONYMISED PROJECT REFERENCE, Fig. 2). Sites were selected to span rural and *peri*-urban contexts (Table 1) while having associations with nearby coral reef and/or mangrove ecosystems, as reflected in the presence of related livelihoods in each site (Table 1).

Kenya and Mozambique, former British and Portuguese colonies, were ranked 145 (medium) and 180 (low) respectively in the world for human development index in 2014 (<https://hdr.undp.org>). Having emerged from a civil war and communist past, Mozambique has one of the lowest human development index (0.433) in sub-Saharan Africa, in contrast, Kenya is classified as a medium human development (0.558) and has consistently higher GDP per capita than Mozambique. Despite Kenya's relative wealth, national average life satisfaction was higher in Mozambique in 2014 (4.4 and 5.0 out of 10) according to global surveys of life satisfaction (Helliwell et al., 2015).

The difference in development status between the countries is amplified by the sites featured in this study. Kenyan sites were located near the large coastal city of Mombasa, Kenya's main port and second city, and the coastline stretching south towards Tanzania including coastal and island villages and towns with a range of livelihoods including fishing, tourism and agriculture (Table 1). In contrast, our Mozambican sites lie in the extreme of north of Mozambique, far from the capital in a region that has historically suffered from conflict<sup>1</sup>, instability and lower levels of development than Mozambique as a whole. Offshore gas discoveries in the early 2010s led to a wave of rapid investment and development, centred on the Provincial city of Pemba, although tangible benefits to local populations were not apparent at the time of the research.

In the northern district of Palma, close to the Tanzanian border, Vamizi Island and Lalane village on the nearby mainland are the most remote of our sites (Fig. 2). Livelihoods on Vamizi were dominated by fishing and many residents were migrants attracted to the fishing opportunities there. In contrast, Lalane had less productive fisheries and was more agricultural (Table 1). An exclusive eco-tourism lodge operated on Vamizi Island providing limited local employment, while Lalane, with poor infrastructure, no electricity and very poor road connections had no tourism-based livelihoods.

Our other two Mozambican sites are adjacent to the regional capital of Pemba city, which was experiencing a rapid economic transformation due to anticipated gas production, an influx of foreign workers and a related local tourist industry. Maringanha is a coastal suburb of Pemba,

which retains fishing livelihoods but with limited agriculture. Mize is set back from the coast, along a major road with good access to Pemba city. However, few in our study sites benefitted directly from employment from Pemba's gas-based growth (Table 1). Mize is known as a productive agriculture town, producing crops for Pemba and with access to an extensive mangrove forest.

Our Kenyan sites varied in their remoteness from Mombasa, livelihood opportunities and exposure to the international and domestic coastal tourism industry (Fig. 2, Table 1). Vanga has access to extensive fishing grounds and agricultural lands and was embedded in a large mangrove forest, but was unaffected by coastal tourism. In contrast, Mkwiro on Wasini island was adjacent to the Kisite-Mpunguti Marine National Park with limited access to land for agriculture. Although close to Mombasa, Tzunza remained a rural site due to very poor connections to the city where most houses benefitted from mangrove- and fisheries-based livelihoods, and agriculture. Kongowea, a large suburb of Mombasa was a fully urban site with a diversity of livelihoods linked to the economy of Mombasa. Its coastal location allowed some access to fishing grounds and engagement in the vibrant coastal tourism industry. Further site descriptions are available in Fortnam et al (Fortnam et al., 2019) and [www.espa-spaces.org](http://www.espa-spaces.org).

#### 3.2. Data collection and survey design

This study was based on the SPACES household survey asking the question "All things considered, how satisfied are you with your life as a whole these days?" The question first provided an ordinal response from (1) very satisfied, (2) satisfied, (3) dissatisfied or (4) very dissatisfied. A follow-up question, "What makes you to say that?" provided an open-ended response clarifying the reason for the life satisfaction score. Such qualitative, unstructured responses help to contextualise people's responses to a quantitative life satisfaction question (Camfield et al., 2009).

Household surveys were conducted by locally trained enumerators during March-July 2014. The survey instrument was translated and back translated, piloted and administered in local languages (Swahili in Kenya, Kimwani and Macua in Mozambique). Importantly for the study of individual life satisfaction, responses by the 'household head' were accompanied by up to two other people including a spouse and a randomly chosen third person older than 16 years to provide within-household variation. Respondents were interviewed individually. The survey included interviews of 2417 people from 1130 randomly selected households, with twice as large sample in Kenya (Table 1) and a gender balance in both countries.

The survey also included indicators of the achievement of eight basic needs at the household level following the method described in (Chaigneau et al., 2019b) and detailed in Table 2. For each basic need, we applied a locally defined threshold of harm to allocate each household a binary value of whether or not that need was met.

In Kenya, the survey captured detailed information on cash income and harvests throughout the year, from which we calculated the total gross household income, using per-unit prices from the survey or from local median prices to convert non-cash income. This value was converted to a per adult equivalent value (using the square root of household size method; Buhmann et al., 1988).

The fieldwork was approved in advance by the University of East Anglia International Development Research Ethics Committee (Decision date: 17th February 2014). All respondents gave free, prior informed consent (see Supplementary Materials).

#### 3.3. Analysis

We first summarised the relative frequency of satisfaction scores by gender, age and site using descriptive mosaic plots.

<sup>1</sup> Since 2017 a violent insurgency has plagued the area (Morier-Genoud, 2019) including devastating attacks on our site of Lalane by insurgents. These events have occurred subsequent to our research and thus are not reflected in this paper.

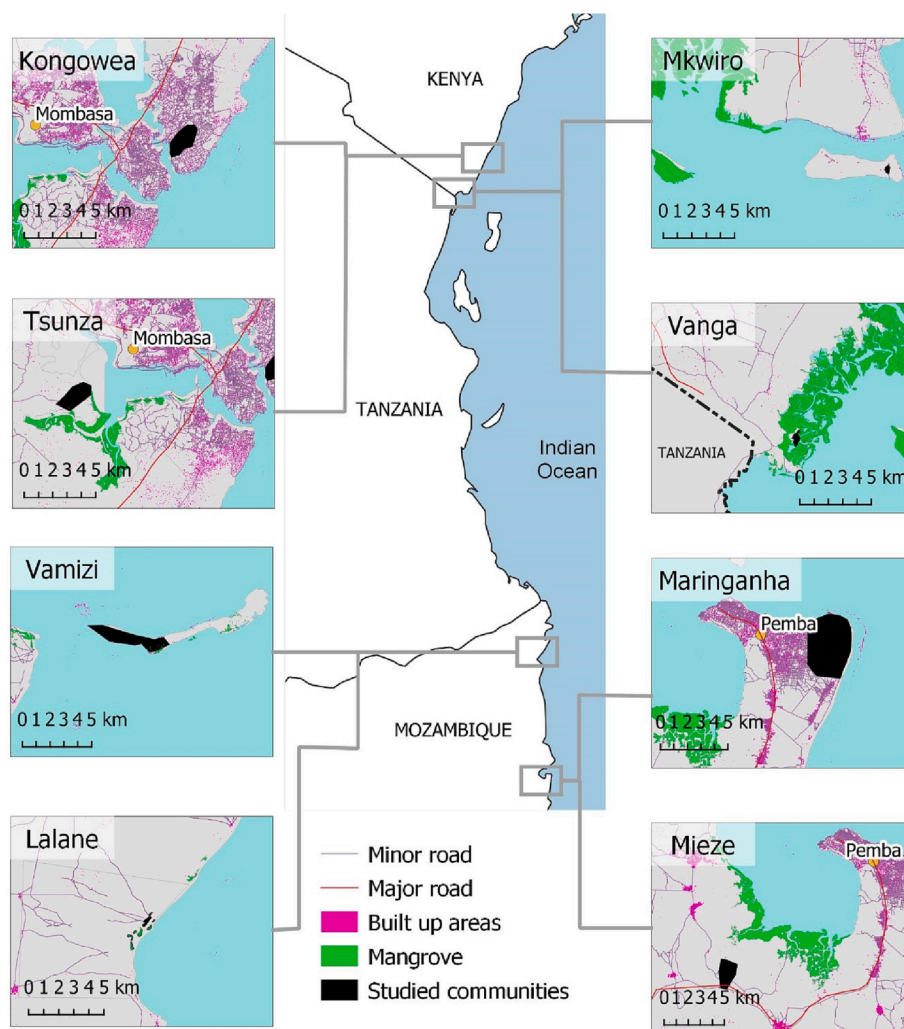


Fig. 2. Study sites in Mozambique and Kenya. Data layers from CIESEN 2016, Gong et al. 2019, RCMRD 2019a, RCMRD 2019b, OSM 2021.

### 3.4. Coding of qualitative statements of reasons for life satisfaction level

We inductively tagged responses from the open-ended question, ‘What makes you to say that?’ with ‘reason codes’, based on keywords and phrases in the responses. We combined deductive codes for mentions of ecosystem services and for each of the basic needs with inductive codes based on an initial scan of the responses. We refined this list of codes by discussing between the first authors and fieldworkers from the SPACES team, and developed a ‘coding manual’ to define 28 different ‘reason codes’ (Supplementary materials). Several codes could be allocated to a single response, so for example, the response “She has good health, dress well, can educate her children, eat well and has a loving husband” was coded for *material needs, family, personal development and health*. The code ecosystem services refers to an explicit mention of the ecosystem or benefits from it. Thus aspects of life such as such as job, money, water, housing and social relations that could be supported by ecosystem services were not included if there was no reference to the ecosystem. Six team members then read the coding manual before independently coding a random sample of 100 responses to assess the clarity and applicability of the codes, given their familiarity with the sites and original data. We assessed ‘hamming distance’ to quantify the coding differences between coders for each response, and across responses between different codes, in order to identify ambiguous code definitions and refine the coding manual. The second author then coded the full sample of responses, without seeing the site or the life satisfaction score, to avoid bias.

For analysis, we reduced the list of 28 reason codes to 15 (Table 3), by grouping similar codes, and removing the codes for respect, participation, security and sanitation, which were not mentioned in any response. We also removed the code ‘vague’ from our analysis as uninformative. All coded data are attached as [supplementary materials](#).

### 3.5. Statistical association between reason codes and demographics

For statistical analysis we converted life satisfaction scores to a binary value that distinguished respondents who reported being *very satisfied* and *satisfied* separately from those reporting being *dissatisfied* and *very dissatisfied*.

To explore which kinds of people mentioned which reason codes, we used multiple correspondence analysis (MCA) to evaluate the similarity of each respondent based on binary satisfaction, the reasons given for satisfaction, site and social-demographic variables of age class, gender and immigrant status. Age and gender are commonly used to disaggregate people’s experience and relationship to life satisfaction (e.g. Fortin et al., 2015), while migration is relevant at these sites both driven by and linked to life satisfaction through changed reference groups, the results of migration relative to expectations and disruption to sense of place (Mulcahy and Kollamparambil, 2016). Respondents who had spent <75% of their life (for respondents under 20) or <15 years (for over 20 s) were classed as ‘immigrant’. We ran the MCA separately for each country. We selected social-demographic variables and satisfaction as ‘active variables’ and projected the reason codes as ‘supplementary

**Table 1**

Characteristics of study sites including proportions of households engaged in natural resource-based livelihoods according to the SPACES household survey. Natural-resource based livelihoods assessed based on whether survey respondents mentioned food or income from a natural resource based livelihood, each house could have multiple natural resource based livelihoods. Tourism was included due to the dominance of coastal-based tourism in the regions. <sup>1</sup>Data from a sub-sample of villages in Kongowea near the coast.

Country	Site	Setting	Context	Population in 2014	% households deprived of selected basic needs				% households with natural-resource based livelihoods			
					Food security	Economic security	Sanitation	Clean water	Fisheries	Tourism	Mangrove products	Farming
Mozambique	Ilha Vamizi n = 120	Remote Island villages	Productive fisheries, settled migrant fishers, exclusive eco-tourism lodge provides limited employment	533	62	65	95	86	65	4	1	3
	Lalane n = 168	V. remote village	Very poor infrastructure and road connection, no electricity	1,150	80	73	100	77	61	0	11	66
	Mieze n = 124	Peri-urban	Agricultural community, by major road, large mangrove forest	32,000	45	45	2	0	12	0	2	88
	Maringanha n = 358	Peri-urban	Coastal suburb of Pemba city, near to tourist beach.	4,000	66	83	55	35	23	4	0	9
Kenya	Vanga n = 291	Rural town	Near Tanzanian border, vibrant fisheries, surrounded by large mangrove forest	6,500	44	59	40	31	49	5	14	52
	Mkwiro n = 257	Island village	Adjacent Marine National Park attracting overseas and domestic tourists.	1,900	44	39	56	0	69	15	33	18
	Tsunza n = 422	Remote village	Poor infrastructure and connection to nearby Mombasa no tourism	10,000	68	75	36	0	63	2	75	92
	Kongowea n = 677	Large urban suburb	Diverse livelihoods linked to economy of Mombasa include fisheries and tourism	100,000	47	73	0	0	17 <sup>1</sup>	6 <sup>1</sup>	8 <sup>1</sup>	15 <sup>1</sup>

variables' a posteriori on these to show which reasons were associated with which demographic and satisfaction variables. To perceive clear patterns better than possible in a cluttered, two dimensional principal coordinate plot, we combined MCA with a hierarchical cluster analysis thus, correcting some of the distortions projected on a two-dimensional plot (Lebart,1998). The hierarchical cluster analysis used the Ward's method with K-means clustering to cluster respondents together based on their satisfaction, age, site, immigration status. The number of clusters was informed by a large the jump in the index in going from n to n + 1 clusters (Lebart 1998). The largest jump in chi-square distance was when forming three clusters in Kenya and two in Mozambique, but there was still a large jump in index when forming four clusters, and we judged the four clusters to be more interpretable and interesting based

on the set of significant variables that characterised them (see Table S4). We then tested which reason codes were significantly associated with each cluster by comparing the relative frequency of each code in the different clusters (through a t.test) to the overall relative frequency. Thus, this analysis reveals how groups of respondents with similar sociodemographic characteristics and life satisfaction tend to use particular reasons to explain life satisfaction.

Given the frequency of codes relating to social relations (spouse, caring for, being cared for, relations, family), we opted to explore the alternative interpretations of 1) social relations as intrinsic ends, or 2) as means to meet material ends. We thus tested, *post-hoc*, the independence of these relationship codes from codes related to material resources (job, money, supplies of basic needs, responsibility for, and being cared for)

**Table 2**

Criteria for identifying whether a survey respondent met their basic needs, based on local focus groups to identify locally perceived threshold of harm in each of the basic needs (Following ANONIMISED AUTHOR REFERENCE).

Basic need	Assessed as unmet if household members report:
<b>Economic security</b>	No savings, and cannot borrow money in a moment of need
<b>Sanitation</b>	No access to toilet facilities
<b>Water</b>	Cannot treat water and gets water from unprotected well, river or lake.
<b>Food</b>	Eating only once because of lack of food 2–3 times or more per year
<b>Health</b>	A person was ill or injured and not able to access sufficient healthcare
<b>Education</b>	Children miss school once a week or more or if the children leave school before finishing primary education
<b>Physical Security</b>	Not feeling secure in their home or village
<b>Social relations</b>	Not feeling they can turn to people when in need
<b>Autonomy</b>	Household members over 18 years of age not involved in community, and place of work and household decisions
<b>Shelter</b>	Floor is made of mud OR if walls are made of mud OR if roof is made of palm thatch

using a Chi-squared test of independence for each country.

### 3.6. Regression analysis of effects of basic needs and income on life satisfaction

As the reason-codes analysis highlighted the importance of money, jobs and basic needs we fitted regression models to evaluate the association of income and basic needs satisfiers from the household survey with the probability of life satisfaction. Two binary logistic-regression models evaluated how binary life satisfaction was associated with gender, site and each basic need indicator. Shelter was not included because nearly all households met this basic need. Model 1 included income and therefore was only applied to the 822 households in Kenya for which we had income data. Income was log transformed to reflect the marginal utility of income, such that increments of income had more weight at the lowest levels of income. Gender and site were included as fixed effects, to account for observed gendered differences, and so that income effects were not driven by mean income differences between sites. Model 2 expanded the analysis, to include 1063 households from across both Kenya and Mozambique but without income as an explanatory variable. We assessed (multi)collinearity amongst all explanatory variables using bivariate correlations and variance inflation factor estimates, and evaluated model fit using simulation-based quantile–quantile and residual plots suitable for logistic regression (SOM). To further illustrate the importance (or lack thereof) of different combinations of explanatory factors on life satisfaction, we report a multi-model inference analysis for both models using the Akaike information criterion (AIC) to show which combination of variables have the best fit to the data (Burnham et al 2011).

Analyses were conducted in the R statistical software environment, using the packages base R; factormineR (Husson et al 2017) and FactoClass (Campo et al 2018) for the MCA and HCA; and car (Fox and Weisberg, 2019), MuMIn (Barton 2020) and DHARMA (Hartig 2020) for regression.

## 4. Results

### 4.1. Overall patterns in life satisfaction, by gender, site and age

Respondents in Mozambique reported higher satisfaction than those in Kenya (Fig. 3) particularly than the urban Kenyan site, Kongowea where over a quarter of people were very dissatisfied. Remote Vamizi island had the lowest proportion of respondents reporting any level of dissatisfaction while, approximately one third of respondents in Mizee

**Table 3**

The ‘reason codes’ used to tag the respondents’ answers to the follow up question “why do you say that?” after respondents reported their life satisfaction. \*only used in Mozambique. For example responses for satisfied and unsatisfied respondents see Tables S1 and S2.

Codes	Explanation /description
Material Needs	General mentions of basic needs or specific mentions of need for, lack of or provision of food, water, clothes, shelter.
Family (Spouse, Children, Parent and Family)	Social relations within the family directly mentioning spouse, children, parent or family.
Personal development (Education and autonomy)	To be autonomous is the having the ability to formulate aims and make informed choices what should be done. The mentioning of specific or general goals, if achieved or not. Education is learning, gaining knowledge or taking courses/studies. The cost/fees associated with learning
Ecosystem Services (including mentions of fish, farm, tourism, cultural)	Benefits for work or pleasure the respondents receive from the ecosystem, mentions income derived from natural resources, or personal enjoyment from ecosystem. Note that mentions of basic needs (e.g. foods or shelter which MAY relate to local ecosystem services) were not coded as ecosystem services unless an ecosystem component, farm, fish, sea etc was explicitly mentioned.
Lack of Spouse (Widow, Divorce, Single)	Mention of loss of spouse due to bereavement or divorce or lack of spouse including single parenthood
Neighbors/Friends	Interactions with the community, friends or neighbor, mentioning positive or negative interactions.
Being cared for by someone	Receiving support or care from someone
Care for or having the responsibility for someone	Refers to their ability/inability to support, provide for or take care of someone
Job/Work	Statement on job, work, activities, or business which can be general or specific, earning an income, including duration of work
Acceptance/Fatalism	Generally mentioning of contentment and acceptance of life’s plan, life satisfaction and adapting to life
Religion/Living Virtuously	Mentioning religion, God or living a proper life referring to morals.
Health	Statement on the condition of a person’s body or mind, either good or bad/poor. Also including facilities giving treatment.
Living Well	Generally referring to material needs or welfare, can be positive or negative. Also including social relations. Does not include the statement “is well”
Money/Expenses/Income	Statements about the economic situation (stable or unstable, positive or negative) including prices of items, cost of living, earnings
Infrastructure*	The development of the village/community regarding communication, energy and transportation and community economy. Only public infrastructure

reported being ‘very satisfied’, much higher than all other sites.

Compared to women, higher proportions of men reported dissatisfaction in all sites in both countries, except Maringanha in Mozambique. In Kenya, the proportion of women who reported being very satisfied, was also higher than men (although still a small minority) (Fig. 3). No overall trend of men and women’s life satisfaction by age was evident across the data (Supplementary materials, Figure S1).

### 4.2. Reasons cited to explain satisfaction scores

Fig. 4 shows the proportion of men and women, separated by country and satisfaction, whose response was allocated to each reason code.

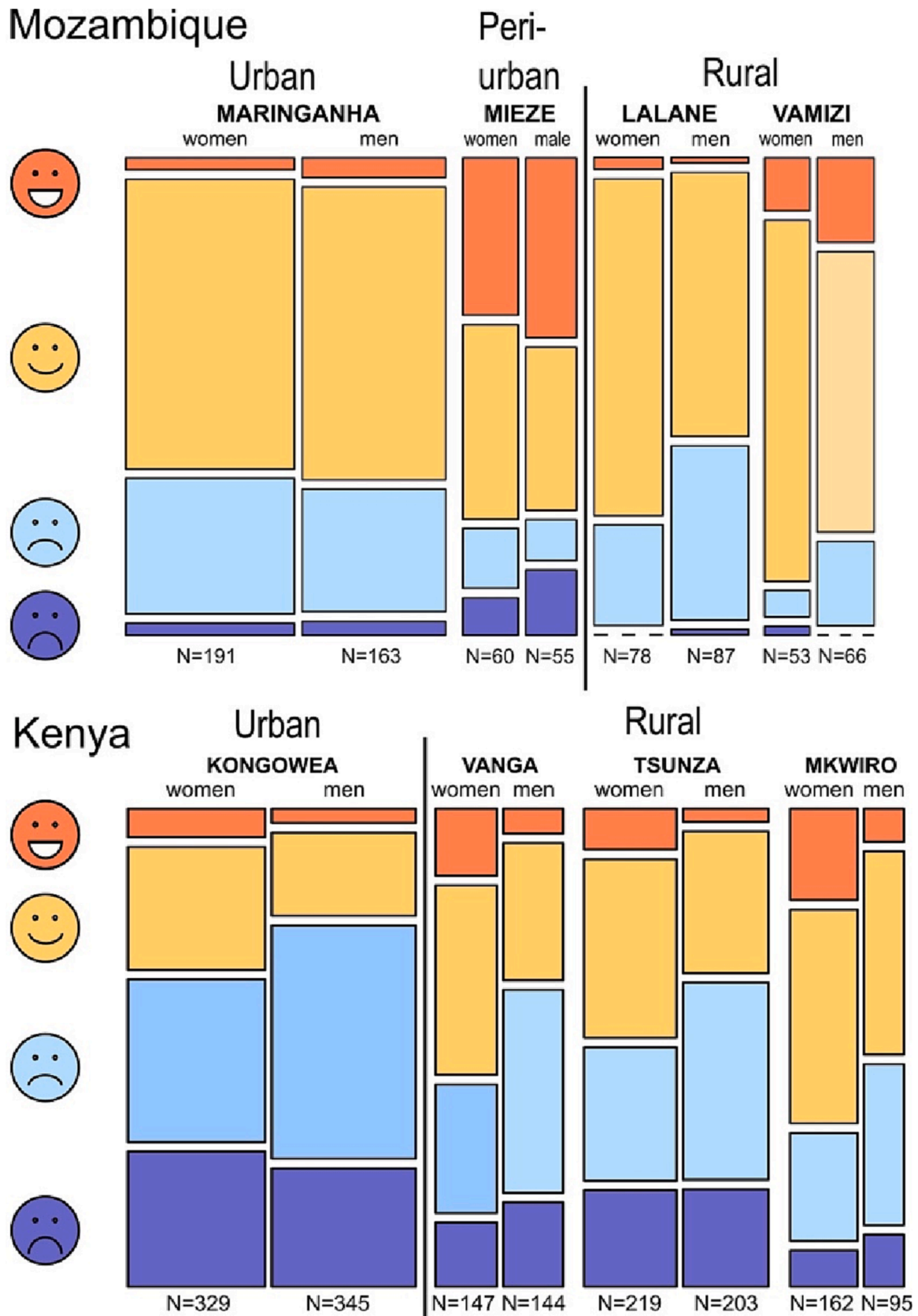
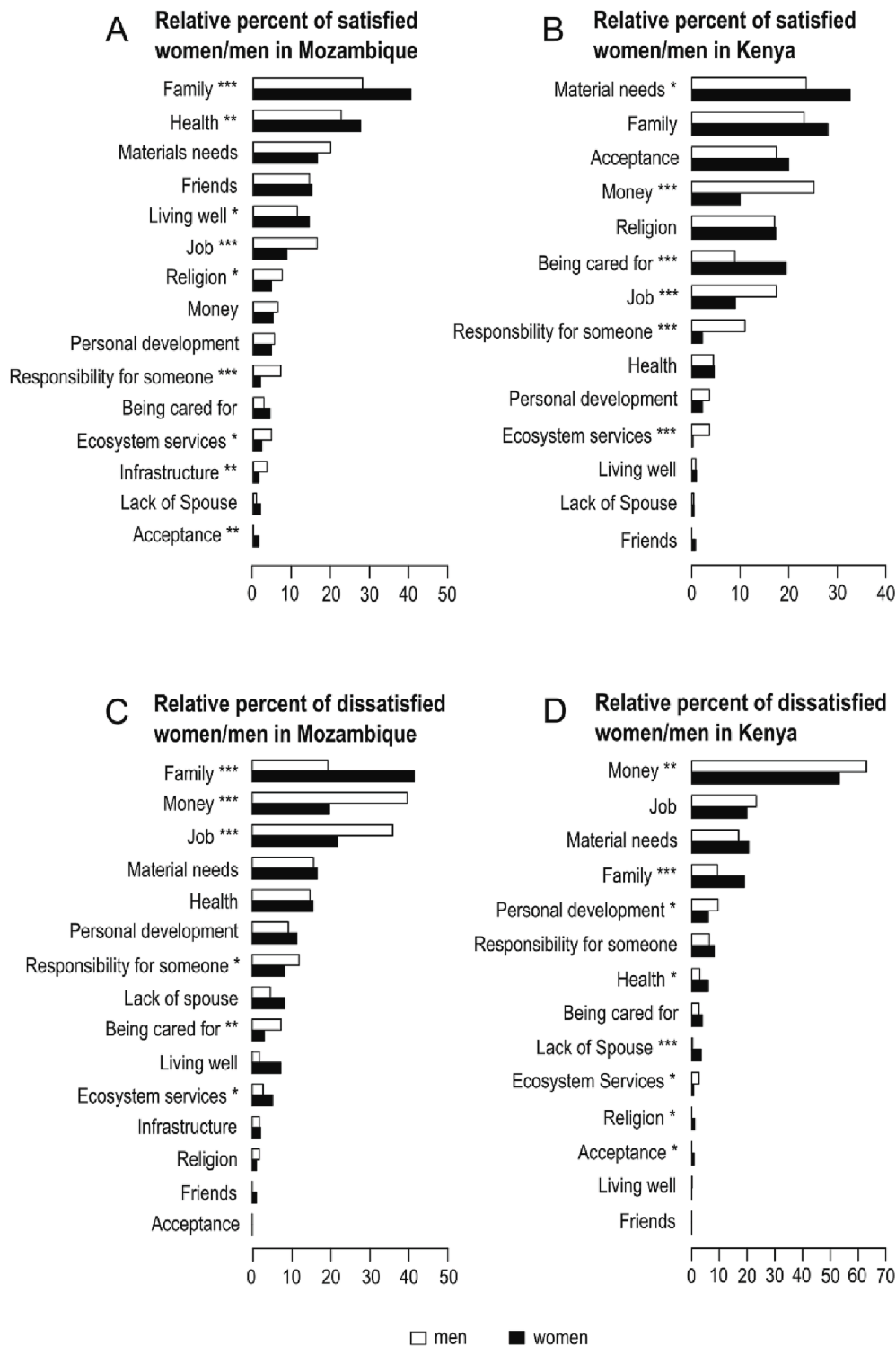


Fig. 3. Relative frequency of men and women who reported that they were very satisfied, satisfied, dissatisfied and very dissatisfied (as indicated by ‘smiley’s) with their “life as a whole these days” at each site. “N” denotes total number of individuals for each category which is also reflected in box widths.





**Fig. 4.** Relative frequency (%) of satisfied and dissatisfied respondents tagged by each reason code. Reason codes are ordered in each plot by the total frequency in each country but bars are shaded to indicate respondent gender. Significant difference (Spearman rank correlation) between the genders for each reason code are indicated by \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Tables S1 and S2 report typical answers from satisfied and dissatisfied respondents for each code.

Satisfied and very satisfied respondents in both countries often mentioned family (particularly women) as well as satisfaction of material needs (Fig. 4). Health was mentioned less frequently in Kenya, where access to health facilities such as dispensaries is more widespread. Meanwhile the third most common reason code for satisfaction in Kenya

was acceptance, but this code was rarely allocated to Mozambican responses.

As reasons for dissatisfaction, aspects of material wellbeing, including job, money and material needs were reported for the majority of dissatisfied Kenyans and nearly half of dissatisfied Mozambicans. Two-thirds of dissatisfied Kenyans mentioned money directly, while dissatisfied men in Mozambique most frequently cited money and jobs.

Family issues were also commonly mentioned as reasons for dissatisfaction, particularly amongst women; nearly half of dissatisfied Mozambican women and nearly a quarter of dissatisfied Kenyan women.

One quarter of all responses were tagged with codes that related to social relations (primarily family members). Social relation codes were more frequently allocated to satisfied respondents, but were also given as reasons for a fifth of dissatisfied respondents (Fig. 4). Spousal relations were given as reasons for life satisfaction more by women than men, and more in Mozambique. 21% and 15% of satisfied women in Mozambique and Kenya respectively mentioned spouse compared to 10% and 0% of satisfied men. Meanwhile 21% and 8% of Mozambican and Kenyan dissatisfied women mentioned husbands compared to 3% and 0% of dissatisfied men mentioning their wives.

Of the responses coded for any type of social relations across both countries, 60% (392 of 654) were also allocated codes that related to material resources (job, money, meeting material basic needs, and being cared for). In Kenya, 80% (260 of 323) of social-relation-coded responses were also coded for material resources and there was a statistical association between the codes for material resources and social relations ( $X^2 = 16.84, p < 0,001$ ). In contrast, for Mozambican dissatisfied respondents, only 40% (37 of 70) of responses coded for social relations were also coded for material resources, and for satisfied respondents only one third (90 of 261). Codes thus give stronger evidence for social relations being economic or material in Kenya, whereas in Mozambique, social relation-coded responses were less frequently linked to material resources, especially for satisfied respondents.

#### 4.3. Mentions of ecosystem services in reasons for life satisfaction

Few respondents explicitly mentioned ecosystem services or related activities as reasons for satisfaction or dissatisfaction. The few mentions were clustered in particular sites where respondents mentioned farming (Mieze, 10%) or fishing (10% of men in Lalane and 6% in Vanga) only three respondents were coded for cultural ecosystem services due to mentions of tourism or enjoying the sea (Supplementary material Table S5). Responses from satisfied respondents related to the possibility to farm or fish and the livelihood benefits that resulted, while unsatisfied respondents mentioned the inability to farm or fish, and low or seasonal incomes (Table 4). The seasonality and unreliability of fishing incomes was mentioned by fishers themselves as well as their spouses.

**Table 4**  
Typical example of responses linked to ecosystem services (fishing and farming) by satisfied and dissatisfied respondents.

Codes	Satisfied Responses	Dissatisfied Responses
farming	<ul style="list-style-type: none"> <li>Is satisfied because farming is going well</li> <li>is thankful because is well in life and can get what to eat and do farming with her husband</li> </ul>	<ul style="list-style-type: none"> <li>is not well, lost her farm and now does not do anything. she depend on her son and cannot help him in expenses</li> <li>Because last years raining ruined their corn harvest while she lives from farming</li> </ul>
fishing	<ul style="list-style-type: none"> <li>Does fishing. can get many fish to eat with his family, that is why lives well</li> <li>Because of his work(fishing) he gets enough income</li> <li>because is healthy. can go fishing. sustain his family and is thankful</li> </ul>	<ul style="list-style-type: none"> <li>is not satisfied with his life those days. is tired of going to fish but can not stop because is fishing that he get bread for every day</li> <li>our lives are endangered as fishermen and we have nothing to hold to</li> <li>because my husband has no stable job but just depend on fishing</li> <li>He says he suffers greatly to support his family, his life is only fishing, when not fishing will not eat</li> </ul>

#### 4.4. Relationships between satisfaction, sociodemographic variables and reason codes

Respondents in each country were grouped in four classes based on MCA and HCA on sociodemographic variables and satisfaction (Tables S3 and S4). In Mozambique, these included two classes characterised by satisfaction with life and one by dissatisfaction. Both classes characterised by satisfaction (M1 and M2) were also characterised by the rural sites. The small class M1 characterised by satisfied residents of the remote site Lalane was significantly associated with reason codes of acceptance and religion. The largest of the classes, M2, was characterised by satisfaction, women, residents of Vamizi Island and Mieze, immigrants, and was significantly associated with reason codes of friends, health and living well.

The second largest class in Mozambique (M4) was characterised by youth, dissatisfaction, men, peri-urban site Maringanha, and was associated with reason codes connected to economic opportunities (job, money, material needs), personal development and the pressures of, constraints on, or dependencies on social relations (lack of spouse, responsibilities for someone, family, being cared for) (Table S3).

Two of the Kenyan classes were associated with life satisfaction and two with dissatisfaction. The satisfied classes (K3 and K4) were associated with women and the dissatisfied (K1 and K2) with men. The largest class (K1) strongly mirrored class M4 in Mozambique, being characterised by dissatisfaction, men, the urban site, and with associations to reason codes of money, job and material needs (Table S4). In contrast, the two classes (K3 and K4) associated with satisfaction were characterised by women and rural sites. K3 was additionally associated with codes linked to social relations (family, being cared for, having responsibility for someone), while K4 was linked to non-material sources of satisfaction (religion and acceptance) and the island site of Mkwiro. 'Lack of spouse' associated with class K3 referred to satisfaction despite the loss of a spouse rather than satisfaction due to lack of spouse.

#### 4.5. Statistical predictors of life satisfaction in cross-sectional data.

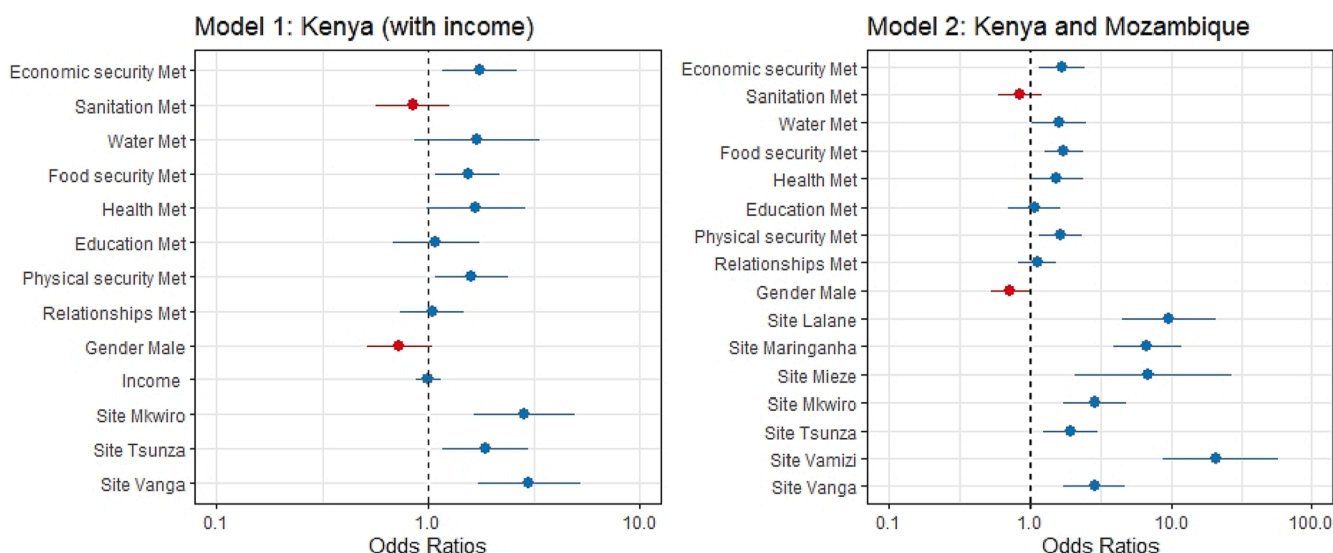
The regression models of cross-sectional data (Fig. 5) confirm the results of the clustering with regard to the importance of site and gender, with satisfaction being much higher in Mozambican sites, and amongst women. Amongst basic needs, economic security, physical security and food security were most associate with satisfaction, followed by health and water. In contrast to the reasons given by respondents, relational basic needs were not significant in the regression. Personal security - reflecting whether a respondent felt safe in the village, home or had experienced violence - was a significant predictor of life satisfaction in Kenya, and second only to site and food security for importance in the global model, although this had not been mentioned in open-ended reason responses.

While a bivariate relationship existed between income and life satisfaction in Kenya, when other explanatory variables were accounted for, income had no effect (Fig. 5). Income was less important than all other variables, including all basic needs, site and gender, even despite the log transformation of income which should amplify the effect of income amongst poorer households. Generally, the regressions indicate that life satisfaction is more closely linked to basic needs - including a minimum level of economic security - than income.

These results are further supported by the multi-model inference results in Table 5. In both cases the best model included gender, site and basic needs, and for the sites with income (Model 1), inclusion of income made no improvement to the model (no difference in log-likelihood between the model with and without income).

## 5. Discussion

The role of nature in life satisfaction has been little explored in the Global South. Despite the inclusion of subjective aspects of wellbeing in



**Fig. 5.** Coefficient plots for the full regression models (all predictor variables included). The Kenyan urban site of Kongowea is not shown and acts as the baseline (reference category) for the effects of all other sites. Dots show the coefficient point estimate, while whiskers show 95% confidence intervals.

**Table 5**

Multi-model inference to evaluate the relative fit of models with different combinations of explanatory variables to the data using Aikike’s Information Criterion (AIC). Basic needs are included as combined set of variables. Lower AICc values and higher weights indicate a better fit to the data, and all models within ~ 2 AIC units of the ‘best’ model merit consideration (see Burnham et al 2011 for further explanation).

Model 1: Kenya only, with income					
	Df	Log Lik	AICc	ΔAIC	Weight
Gender, Site, Basic needs	13.0	-468.7	963.8	0.0	28.38%
Gender, Site, Income, Basic needs	14.0	-468.7	965.8	2.1	25.60%
Gender, Basic needs	10.0	-479.1	978.4	14.6	13.65%
Gender, Site	5.0	-487.4	985.0	21.2	9.85%
Gender, Site, Income	6.0	-486.5	985.0	21.3	9.81%
Site	4.0	-489.1	986.3	22.5	9.22%
Gender	2.0	-510.9	1025.8	62.0	1.28%
Gender, Income	3.0	-510.5	1027.0	63.2	1.20%
Null model	1.0	-514.3	1030.5	66.8	1.01%

Model 2: Kenya and Mozambique					
	Df	Log Lik	AICc	ΔAIC	Weight
Gender, Site, Basic needs	17.0	-611.8	1258.2	0.0	74.14%
Gender, Site	9.0	-638.0	1294.2	36.1	12.21%
Site	8.0	-639.8	1295.7	37.6	11.34%
Gender, Basic needs	10.0	-653.8	1327.8	69.6	2.28%
Gender	2.0	-714.1	1432.2	174.0	0.01%
Null model	1.0	-715.7	1433.5	175.3	0.01%

ecosystem-service frameworks, ecosystem-services research has made limited connection to the many studies on life satisfaction across populations in relationship to different aspects of people’s lives. We contribute to the empirical evidence on life satisfaction, and probe how this informs our understanding of ecosystem services.

Ecosystem service’s contributions to wellbeing are known to be context dependent, complex, and sometimes indirect (Agarwala et al., 2014; Daw et al., 2016; Fisher et al., 2014). Overall, our respondents rarely cited aspects of nature as a salient factor in their life satisfaction, even at rural sites where ecosystem services are known to contribute to income, basic needs and social relations (Chaigneau et al 2019a). We

begin this discussion by reviewing what we found *did* impact life satisfaction and relating this to existing literature. We then focus in on how ecosystem services fit into that picture. Finally, we explore what our life-satisfaction findings can say about governance of ecosystem services to support people’s quality of life, then reflect on the methodological contribution of life-satisfaction methods to ecosystem-services research.

5.1. Patterns of life -satisfaction and what affects it across sites and gender

The strongest differences in life satisfaction was between locations and gender. Respondents from Mozambique were more likely to express life satisfaction, mirroring reported national differences in average life satisfaction between the countries (Helliwell et al., 2015). Differences in life satisfaction across nations, cultures and genders are not only indicative of material circumstances, they can also be affected by cultural differences in affect (tendency to experience happiness), expectations, or measurement differences due to culturally variable responses to survey questions (Bolle and Kemp, 2009).

For example, the impact of wealth and inequality on life satisfaction can vary according to national cultural norms. Davis and Wu (2020) draw on international dimensions of culture (see Hofstede et al 2010), and find that relative status is more important for life satisfaction in cultures that are more individualistic and less hierarchical, and becomes more important as countries get richer. Reflecting on these insights for our results, we observe that Kenya is demonstrably richer, and thought to be more individualistic and less hierarchical than Mozambique<sup>2</sup>, where recent history of communism and socialism is thought to have shaped a less entrepreneurial culture (Mvulirwenande and Wehn, 2020). According to Davis and Wu (2020)’s framework this would predict more tolerance of inequality, and help explain the higher life satisfaction of Mozambican respondents, despite lower material wealth and development. This is particularly illuminative of the urban sites where our respondents live alongside wealthier internationals and national urban elites.

<sup>2</sup> No verified surveys exist for Kenya or Mozambique for Hofstede’s cultural dimensions, but educated guesses by Gert Hofstede (https://geerthofstede.com/country-comparison-graphs/) suggest that scores (out of 100) for Kenya and Mozambique would differ for the dimensions of Individualism (25, 15 respectively) and hierarchy (power-distance) (70, 85).

The more recently proposed cultural dimensions of indulgence-vs-restraint relates to how people value the free gratification of desires, “enjoying life and having fun” (Hofstede et al 2010, p281), and could directly affect measurement of life satisfaction. A higher cultural tendency towards indulgence in Mozambique than Kenya could contribute to the national differences that we observe<sup>3</sup>. How such cultural differences affect people’s relation to and use of nature is a future research question that could support conservation or development initiatives that are better adapted to different cultural contexts.

With regards to urbanisation, urban locations offer higher income opportunities, access to services such as healthcare and education (especially at low levels of economic development) and thus might be expected to increase life satisfaction, and explain rural to urban migration (Easterlin et al 2011). However, our results suggest highest satisfaction in *rural* sites and lowest in the Kenyan urban site. This echoes international findings of higher life satisfaction in rural settings from China and Peru (Knight and Gunatilaka 2010, and Guillen-Royo and Velazco, 2012, respectively), Solomon Islands (Lapointe et al 2021) and in Europe (Sørensen 2014).

Several reasons could explain lower satisfaction in urban settings, despite higher access to services and income opportunities. Costs of living and expectations are higher in urbanised settings (Knight and Gunatilaka, 2010; Mulcahy and Kollamparambil, 2016) perhaps contributing to the high proportion of survey respondents lacking economic security in the urban site (Table 1). Meanwhile higher levels of inequality mean that urban dwellers evaluate their own material conditions in comparison to more wealthy reference groups (Guillen-Royo and Velazco, 2012). From an ecosystem services perspective, urban environments may be dislocated from cultural landscapes and social networks (see Mulcahy and Kollamparambil 2016; Njwambe et al 2019 for examples from South Africa).

The social and cultural and ecological resources needed to satisfy needs also differ between rural and urban contexts (McGregor et al 2007). Urban environments may foster a more competitive, and consumerist ethic (Guillen-Royo and Velazco, 2012) and less connection to nature (Aguado et al 2018, Lapointe et al 2021). Our cluster analysis of reason codes did identify urban–rural differences in the criteria used to judge satisfaction. For example, in both countries, clusters characterised by dissatisfied, young, urban men were associated with concerns about income, money and basic material needs. Lower access to ecosystem services in urban sites may contribute to this trend. For example, the suburbs of Mombasa have no opportunities for farming, while fishing grounds are limited and crowded compared to more remote locations. Meanwhile rural, satisfied clusters were associated either with social relations (e.g. family, friends, being cared for) and other non-material factors (religion). Acceptance was also a more frequent reason code in rural settings, providing some evidence for ‘adaptive preferences’ (Sen 1984).

After site, gender was the next strongest predictor of life satisfaction. Women expressed higher life satisfaction than men, despite the constrained opportunities, incomes and representation women experience in East African fishing communities, due to intra-household relations, social norms, and limited capital (de la Torre-Castro et al 2017). Higher life satisfaction amongst women has also been shown globally (although in Kenya women were not significantly more satisfied with life; Fortin et al., 2015, p46). Along with the significantly different codes used by men and women (Fig. 4), these results emphasise highly-gendered experiences and evaluations of life satisfaction. Men and women use different scales and criteria to evaluate and report life satisfaction (Montgomery 2022).

The reasons people gave for their satisfaction offer insights into the

<sup>3</sup> Hofstede’s estimates suggest Mozambique would score considerably higher on indulgence-vs-restraint (80) than Kenya (40) (<https://geerthofstede.com/country-comparison-graphs/>).

role of gendered identities and multiple effects of social institutions. Institutions directly affect women’s and men’s opportunities, resources, and thus lived experience. Additionally, gendered norms influence people’s ambitions and sense of what a ‘good life’ would be for them (Jha and White 2016). Norms of gendered household responsibilities can be seen in the reason codes. Many satisfied women cited being cared for, while the responsibility, and (in)ability to care for family was commonly cited by both genders, but particularly men, who more readily expressed frustration with lack of employment, reflecting global results that work is more important for men’s social status and life satisfaction (Joshi and Jovanović, 2020).

A higher proportion of women than men mentioned spousal relations when explaining satisfaction and especially dissatisfaction. Men, rarely mentioned their wives, instead tending to mention ‘family’ more generally, in the context of being able to provide for them. This emphasises that gendered relations and roles affect how individuals approach life-satisfaction questions, and warns against a simplistic contrast of satisfaction levels between genders or other social identities.

### 5.2. Income, basic needs and social relations are important and interrelated reasons for life satisfaction

As a life-satisfaction study, our starting point is in the subjective domain of wellbeing, but our results clearly reflected the material and relational domains, from the 3-dimensional wellbeing framing that has become popular in ecosystem service research (Coulthard et al 2018). Materially, ‘job’ and ‘money’ dominated people’s explanations of dissatisfaction. This result is unsurprising given the low material attainment across these sites, and the potential for additional financial resources to improve life satisfaction (Diener et al 1995). Relational dimensions were also apparent in frequent references to family, spouse, friends and inter-reliance in reasons for both satisfaction and dissatisfaction.

These relational dimensions of wellbeing interrelate with the material and subjective (Camfield et al., 2009; Wood, 2003; Gough and McGregor, 2007). While some responses appeared to refer to the intrinsic value of social relations (e.g. “He has a good friendships and he never argued with his neighbours”), many others referred to instrumental value of relations to meet material needs (e.g. “has children who are providing all her basic needs”), particularly in our Kenyan data. Social relations also generate demands on material wealth through the responsibilities they demand, as illustrated by explanations for satisfaction such as “Because he can get money to sustain himself and his family”. Thus social relations are entangled with material needs, rather than distinct from them, and we find support for considering the social relations as both a means and an end for wellbeing.

### 5.3. Economic security and meeting basic needs is more important to life satisfaction than income

An important finding was that the perceived importance of ‘job’ and ‘money’ was not reflected in a strong statistical relationship between income and life satisfaction, when meeting of basic needs (particularly food, physical and economic security) were considered. This echoes findings that household income has *only a small effect* on subjective wellbeing (Diener and Biswas-Diener 2002). This contributes to ongoing debates based on larger inter-country comparisons (Jebb et al 2018) that do not account for locally relevant co-variants such as our basic needs indicators. We propose three reasons why income may have limited effect on people’s satisfaction.

Firstly a ‘threshold’ theory (Camfield et al., 2009) proposes that income only contributes to wellbeing until basic needs are met. Our regression results suggest that income only influenced life satisfaction in so far as it helped respondents to meet their basic needs (especially food, economic and physical security and to some extent health and access to water), based on a threshold of harm as judged by local focus groups

(Chaigneau et al., 2019a; Chaigneau et al., 2019b). This emphasises the importance of meeting basic needs, of money as a means rather than an end, and of the potential to improve life satisfaction by targeting the most severe forms of deprivation. In so doing it supports the relevance of indicators designed to detect multiple acute deprivations, such as the multidimensional poverty index (MPI, Alkire and Santos 2014), rather than income poverty.

Secondly, our findings support calls to explicitly study 'economic security' (Wyn et al., 2015a; Wyn et al., 2015b) which has been empirically shown to be more important than income for subjective wellbeing (Camfield et al., 2009). Similarly, emergent concepts such as 'economic dignity' (Brown 2020) highlight the expansive ways in which economic security can translate into wellbeing, through enabling a 'dignified life'. As a measure, gross annual income sheds no light on seasonal economic insecurity or precarious income sources. Many ecosystem-based livelihoods depend upon uncertain access to changeable ecosystem services and are vulnerable to weather, economic and security shocks. For example, high annual earnings from fishing can hide economic vulnerability (Bene 2009), due to uncertain and seasonally variable catches. This is illustrated in our data by mentions of the insecurity of fishing by those respondents who did mention fisheries in explaining dissatisfaction.

Thirdly, not all income makes the same contribution to wellbeing. For example, cash transfer programs are commonly targeted towards women based on theory and some empirical evidence that women's income contributes more to household expenditure and children's needs (Armand et al 2020). In contrast, fishing is a masculine activity, especially when linked to demanding and sometimes dangerous activities (Fabinyi 2007) with unpredictable returns, and episodic surpluses of cash income. This context in which fishing income is received can encourage expenditure on immediate consumption rather than savings or investment in personal and household wellbeing. For example alcohol abuse has been shown to be widespread in fisheries (see Coulthard et al. (2020) for a review and Geheb et al (2008) for a detailed example from Lake Victoria). Echoing this global literature, community dialogues to discuss our project findings in both countries frequently mentioned the lack of a savings culture and savings facilities for fishers. Thus, where seasonal or variable ecosystem-based livelihoods - like fishing - are important, comparing annual household incomes to a poverty line might miss economic insecurity (Wood 2003), and should be supported by direct estimates of economic security and meeting of basic needs.

Our rather straightforward indicator of economic security – whether household members could access cash in the event of a sudden need – was more predictive of life satisfaction than gross income, and much more straightforward to collect than income data. Survey-based calculations of annual income are prone to biases, uncertainties and sensitivities due to a reliance on recall and assumptions about quantities and prices. Particularly where livelihood resources are dynamic and variable, financial aspects of material wellbeing may be better reflected by questions about economic security than attempting to measure total income.

#### 5.4. Ecosystem services, one step removed from life satisfaction

Although ecosystem services and natural resource-based livelihoods, including agriculture, were rarely mentioned as reasons for life (dis)satisfaction, complimentary evidence shows how ecosystem services support the factors such as livelihoods (Table 1), material needs and social relations (Chaigneau et al., 2019a; Chaigneau et al., 2019b, Table 1) that were reported as affecting life satisfaction. Unlike Adams et al (2020), we did not test the effect of ecosystem-service based livelihoods on life satisfaction in our cross-sectional analysis, but the importance of economic security for life satisfaction points towards the importance of the livelihood functions of ES. Regardless of a household's main livelihoods, direct uses of ecosystem services can also help meet basic needs such as through wild foods, natural water sources and

traditional medicines where formal healthcare is inaccessible or unaffordable.

Ecosystem services can also indirectly support the social relations that were so prominent in our reason codes for life satisfaction, by underpinning the situations, activities or resources that nourish these social relations (Chaigneau et al., 2019). For example, fishing together can reinforce social bonds, while material benefits from ecosystems support social relations through exchange networks such as gifting of fish, which is particularly common in our rural sites (Mäkelä 2016). Reason codes of 'being cared for', and 'having responsibility for someone' illustrate the relevance of such networks of care for life satisfaction, along with the frequency of relationship codes co-occurrence with material-resource-related codes. In a natural-resource dominated economy, such relations are often underpinned by ecosystem services.

Our survey method asked people to assess their life satisfaction, and report the reasons for their assessment. It did not prompt respondents to discuss processes or resources underlying their quality of life. In terms of the capability approach's conceptual framework, many reason codes we recorded such as jobs, money, food and social relations, related to capabilities and functionings (that are constitutive of wellbeing), or conversion factors, that allow people to draw on resources to increase their capabilities. Given interpretations of ecosystem services as resources that are drawn on to achieve capabilities and functionings (Polishchuk and Rauschmayer, 2012; Ballet et al., 2018) the lack of reference to ecosystem services in our reason codes are unsurprising. As we discuss above, these resources can be directly or indirectly linked to ecosystem services, especially in rural sites. However, in contrast with Schleicher et al (2018)'s argument that relationship to nature is constituent of wellbeing, our data reflect ecosystem services as a *means* to wellbeing rather than a wellbeing *end* in themselves. Rasolofson et al (2018) similarly found few links between conservation and priority wellbeing domains, and that such links only emerged through direct discussions about the effects of conservation. Thus the paucity of direct mentions of nature in this study does not contradict the manifold links between nature and wellbeing that have been shown in complimentary research (e.g. Chaigneau et al., 2019a; Chaigneau et al., 2019b). Rather it but shows ecosystem services' role to be indirect and enmeshed within 'non-ES' factors and processes such as social relations, and economic security.

#### 5.5. Open-ended quality of life methods help to understand how ecosystem services fit into people's lives

What therefore, does *not* asking directly about ecosystem services contribute to understanding people's relationship to nature, Compared to a more directed approach within the same sites? (see Chaigneau et al., 2019a; Chaigneau et al., 2019b). Such an open and inductive approach also allows people to set their own agendas, which can offer novel and relevant insights for environmental governance. For example, Coulthard et al (2020), through open-ended studies of subjective wellbeing, uncovered alcoholism as a critical dynamic in the relationship between fisheries and wellbeing, an insight unlikely to have emerged from a more bounded 'fisheries and wellbeing' investigation. Similarly, Barratt and Allison (2014) illustrated how the pressures and risks in fishers' lives, beyond fisheries, had critical implications for governance of the natural resources on which they depend.

Our results highlight the importance of gender, urbanisation, social relations, material security and deprivation for satisfaction. All of these have implications for the role of ecosystem services in supporting quality of life, not least because ecosystem service benefits are also moderated by these same factors. To illustrate, our findings on income and basic needs have several implications for management of provisioning ecosystem services.

First, managing natural-resources for life satisfaction would imply maintaining access and broad distribution of benefits, rather than driving specialisation to support higher incomes for fewer beneficiaries. Echoing debates in the fisheries literature (Béné et al 2010), our research

suggests that a ‘welfare-based approach’, to natural resource governance will be more supportive of life satisfaction than a ‘wealth-based approach’, which prioritises financial gain, distributed to fewer people. This also emphasises the importance of equity, environmental justice and social differentiation (e.g. by gender) in the design and planning of natural resource governance (Schreckenberg et al 2018). Secondly, ecosystem service valuations that rely on aggregate, market values may overemphasise the importance of ecosystem services with high but variable incomes, and underestimate the importance of stable, regular income that is widely accessible, and which may be more important for life satisfaction of more people. Thirdly, as a method for evaluating economic wellbeing and informing conservation and development initiatives, relatively straightforward indicators of economic security, may be more appropriate than attempts to measure income.

5.6. Reflections on the use of a life satisfaction scale

We include some methodological reflections in this section to inform future uptake of life satisfaction measures in ecosystem-services research. A well-documented critique of life-satisfaction scales is that they do not differentiate between different life domains, such as employment, income, or social relations. Instead, respondents weigh up their own relevant domains, assign different weightings to them, and integrate them in their own ‘unique set of criteria’ (Shin and Johnson 1978). In this study, we attempted to capture those individually varying criteria and use them as data in our analysis of reason codes to understand the different priorities of different people.

We recognise the merit in capturing life satisfaction for specific domains, because people might be very satisfied with one domain, such as friends and income, but dissatisfied with health, or marital relations. The Global Person Generated Index is a method that allows people to nominate domains that they feel are important for wellbeing, and then assess satisfaction in relation to these (e.g. Rasolofoson et al 2018). Such an approach allows for different life domains with different levels of satisfaction, but this level of detail requires a longer interview and a greater proportion of survey resources.

We have also discussed differences in how people score their life satisfaction, warning against simplistic cross-sectional analysis. For

example we cannot definitively say whether higher life satisfaction reported by women and Mozambicans reflects greater satisfaction, or different cultural and gendered differences in people’s readiness to express satisfaction or dissatisfaction in a survey situation.

6. Conclusion

Inspired by our results, Fig. 6 synthesises the wide range of factors that emerge from our results as influencing life satisfaction, including the (largely indirect) role of ecosystem services. Life satisfaction for these inhabitants of coastal Kenya and Mozambique was linked to meeting basic needs through economic security and social relations. While these needs may be underpinned by ecosystem services, life satisfaction seems directly determined by other factors that may be indirectly related, or even independent of ecosystem services. The role of ecosystems in people’s lives needs to be understood in the context of these other factors. Non-ES factors are relevant for environmental management even if they do not relate to ES, because they affect how people will respond to tradeoffs e.g. between infrastructure and natural ecosystems. For example, our findings depict an instrumental relationship between nature and life satisfaction, and caution against assumptions of intrinsic motivations to conserve nature. Despite common dependence on natural resources, our respondents connected their satisfaction to immediate factors such as jobs, money and social relations, which can be affected by shifting social-ecological contexts alongside changes in ecosystem condition or access.

We detected varying satisfaction by site and gender, but to say that women or rural people, are happier is an oversimplification because respondents also differed in the reasons for (dis)satisfaction. Urban men focussed more on money and employment, and women on family and spousal relations. Further research could explore the role of expectations, adaptive preferences and reference groups in urban areas as well as access to ecosystem services and social relations in rural areas. We conclude that the experience, evaluation and expression of life satisfaction is moderated by social identities, local cultures and comparison with others. The influence of ecosystem services on subjective wellbeing is therefore dependent on local context and identity (e.g. gender) as much as ecological status and flows of ecosystem services.

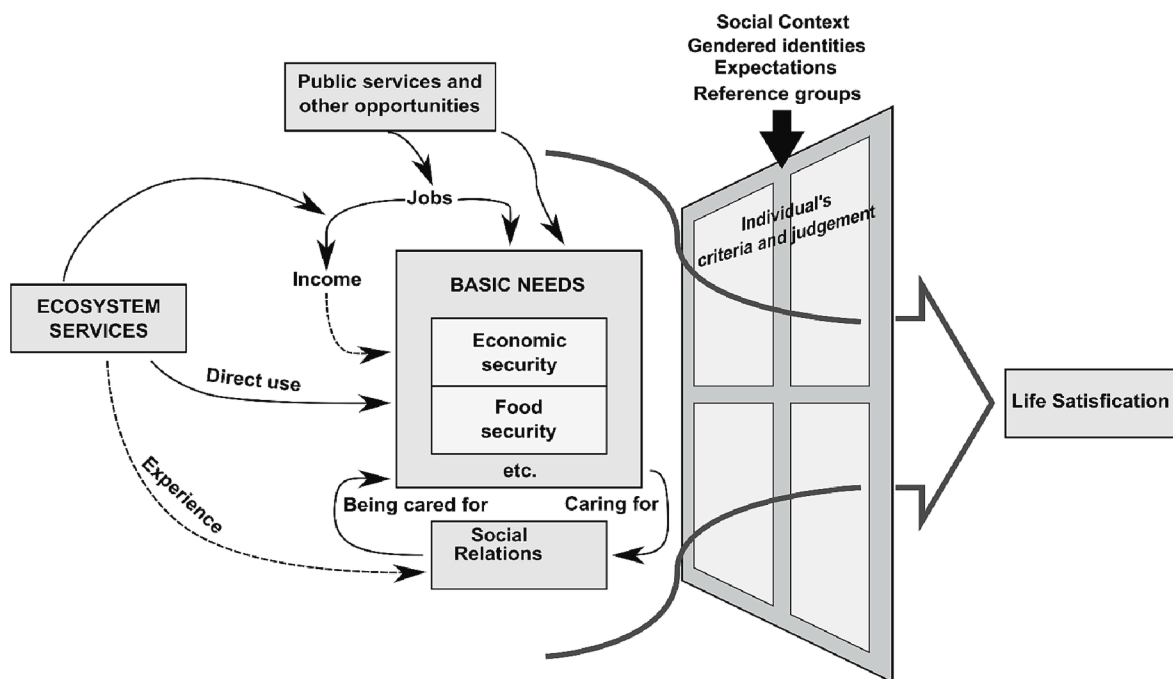


Fig. 6. Summary conceptual figure characterising the main factors influencing life satisfaction of our respondents, and their relation to one another and to ecosystem services.

Understanding how different people frame and understand their life satisfaction can help to understand their goals and behaviours and contribute towards the design of sustainable governance of natural resources (Masterson et al 2019).

For example, our results suggest that total income was less important for life satisfaction than economic security and meeting basic needs. This supports ecosystem-service governance approaches that pay more attention to equitable and stable livelihood support than maximising aggregate economic benefits.

Life satisfaction research as described here may generate few data about ecosystem services, even (as in this case) when they underpin people's livelihoods. However, they can help to understand how ecosystem services fit into the broader context of people's lives, in a way that research that directly asks about ecosystem services cannot. We thus propose that both approaches are necessary to evolve a rounded picture of *how* nature contributes to wellbeing.

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#### Data archiving.

Data for this project are archived in Schulte-Herbrüggen et al. (2022) and calculated household incomes in Wells et al (2022).

#### CRedit authorship contribution statement

**Tim M. Daw:** Conceptualization, Methodology, Visualization, Funding acquisition, Investigation, Project administration, Supervision, Writing - original draft, Writing - review & editing. **Nicole Reid:** Formal analysis, Investigation, Conceptualization, Methodology, Visualization, Data curation, Writing - original draft. **Sarah Coulthard:** Methodology, Conceptualization, Funding acquisition, Writing - review & editing. **Tomas Chaigneau:** Methodology, Conceptualization, Investigation, Writing - review & editing. **Vilma Machava:** Investigation, Methodology, Validation, Writing - review & editing. **Chris Cheupe:** Investigation, Methodology, Validation, Writing - review & editing. **Geoff Wells:** Visualization, Formal analysis, Writing - review & editing. **Edgar Bueno:** Formal analysis, Writing - review & editing.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Data availability

Data are published in <https://reshare.ukdataservice.ac.uk>

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ecoser.2023.101532>.

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