

Ecosystem services, well-being benefits and urbanization associations in a Small Island Developing State

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Abstract

1. Urbanization is a key driver of social and environmental change world-wide. However, our understanding of its impacts on the multidimensional well-being benefits that people obtain from ecosystems remains limited.
2. We explored how the well-being contributions from land- and seascapes varied with urbanization level in the Solomon Islands, a fast-urbanizing Small Island Developing State. Drawing on the social well-being framework, we compared perceived well-being benefits derived from ecosystem services in paired urban and rural sites.
3. Our analysis of 200 semi-structured interviews revealed complex associations between provisioning, regulating and cultural services and well-being benefits, with all ecosystem services contributing to material, relational and subjective well-being dimensions.
4. Although patterns of associations between ecosystem services and well-being benefits were similar between urban and rural dwellers, urban dwellers reported significantly fewer material, relational and subjective well-being benefits. The most important differences between urban and rural dwellers were in terms of meeting basic material needs (e.g. income and material comfort), feeling connected to nature and feeling happy and satisfied.
5. With urbanization, livelihood activities transition from being subsistence-based to income-generating, which is also associated with increased wealth in urban areas. Similar to the relationship between ecosystem service well-being benefits and urbanization, material wealth was negatively associated with perceptions of well-being benefits. People with less material wealth appeared more reliant on nature for their multidimensional well-being.
6. Our findings demonstrate that the altered human–nature relationships in urban areas are associated with decreases in multidimensional well-being that people derive from nature. Improving access to particular ecosystem services, which make clear contributions to multidimensional well-being, could be a focus for urban planners and environmental management where enhanced human–nature relationships and poverty alleviation are central goals.

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KEYWORDS

cities, ecosystem services, Melanesia, poverty, rural, social well-being framework, Solomon Islands, urbanization

1 | INTRODUCTION

Urbanization transforms rural and natural environments to highly built urban environments, which results in a decrease in the supply of several ecosystem services (Seto et al., 2017; United Nations, 2019). In the process, people's livelihoods transition from a direct reliance on nature, through agriculture or fisheries for example, to a more indirect one, through employment in the industrial or service sectors of the economy (Cumming et al., 2014). Cities contribute to improving human well-being by offering employment opportunities and access to social and non-ecosystem services such as education, waste disposal and health care (United Nations, 2019). However, living mostly disconnected from nature, in predominantly human-made environments that often experience air and water pollution, can be detrimental for urban dwellers' physical and psychological health (e.g. Harlan & Ruddell, 2011; Hartig & Kahn, 2016). Now that more than half of the world's population lives in cities, it is timely to understand better how living in cities and urbanization affect the well-being benefits that people derive from nature, especially in the Global South where most future urbanization will occur (United Nations, 2019).

Since the mid-20th century, rapid urbanization, population growth and industrialization have not only been associated with increased human well-being according to various indicators (e.g. DGP, health, literacy rates), but also with extensive environmental degradation (Millennium Ecosystem Assessment, 2005). The fact that human well-being could increase while environmental quality had been deteriorating has been referred to as the Environmentalist's Paradox (Raudsepp-Hearne et al., 2010). In fact, because humans depend on nature, as shown notably by the ecosystem service or Nature's Contributions to People (Pascual et al., 2017) approaches, it seems paradoxical that trends in human well-being and natural capital could be decoupled.

Three interlinked knowledge gaps in ecosystem service research might obscure the relationships between environmental change and well-being. First, unidimensional indicators such as monetary-based values do not address multiple dimensions of well-being that could be affected by environmental change (Agarwala et al., 2014; Daw et al., 2016). In fact, the need to employ a multidimensional human well-being lens to measure social progress or development rather than relying on reductionist economic measures (e.g. GDP) is increasingly recognized (e.g. Costanza et al., 2014; Stiglitz et al., 2009). Multidimensional well-being assessments should include both objective and subjective components, as well as indicators covering aspects such as wealth, health and education, but also security, social relationships, life satisfaction and ecosystems' quality (Stiglitz et al., 2009).

Second, while ecosystem services are defined as 'the contributions that ecosystems make to human well-being' (Haines-Young & Potschin, 2018), most ecosystem service research since the ground-breaking Millennium Ecosystem Assessment (Millennium Ecosystem Assessment, 2005) has focused on the ecosystem-side of the equation and assumed that ecosystem services provided well-being benefits to people (Daw et al., 2016). Moreover, research into the relationships between ecosystem services and well-being has focused especially on provisioning services, consequently, the contributions of regulating and cultural services to multidimensional well-being are poorly understood (Bennett et al., 2015; Daw et al., 2016; Guerry et al., 2015).

Third, most studies have used aggregate measures of well-being benefits derived from ecosystem services, which hinders assessment of whether impacts of environmental change can differ between people within a society, creating winners and losers of environmental change (Daw et al., 2011; Fisher et al., 2013). This information is relevant to manage the environment equitably in the perspective of maintaining or improving the well-being of different social groups (Coulthard et al., 2011; Daw et al., 2011; Gurney et al., 2015). Disaggregated analyses might be especially relevant in urban areas where social inequalities can be high (e.g. Østby, 2016; Smets & Salman, 2008).

Well-being research is represented by a diversity of theoretical frameworks and is considered to have reached a certain maturity in its conceptualization (Adler & Seligman, 2016). The contributions of ecosystems and their services to human well-being were first demonstrated by the pioneer work of the MA, which also proposed a framework to study the association of ecosystem services to five components of well-being, namely material needs, health, social relations, security, and freedom of choice and action (Millennium Ecosystem Assessment, 2005). The use of well-being within the MA framework has helped to promote the understanding of how ecosystem services relate to multiple dimensions of well-being, and has stimulated the adoption of multidimensional assessments of human-environment relationships (see e.g. the Ecosystem Services for Poverty Alleviation programme, ESPA, 2018). Nevertheless, the MA framework has also been criticized for being insufficiently complete to fully address well-being, notably because of its aggregated scale (Lele, 2013; Summers et al., 2012). To deepen the understanding of well-being provided by the MA, the social well-being framework (Gough & McGregor, 2007) is gaining traction, and has been applied to investigate the relationship between ecosystem services and well-being (Agarwala et al., 2014; Chaigneau et al., 2019; King et al., 2014). According to this framework, well-being can be conceptualized and measured in three dimensions: a material dimension addressing income, health and

education for example; a relational dimension including relationships that influence what can be achieved with given components of the material dimension; and a subjective dimension relating to a person's evaluation of their own well-being (McGregor, 2007). All three dimensions must be taken into account to provide a complete understanding of a person's well-being in the social context in which they live (McGregor, 2007).

Research into well-being benefits derived from urban ecosystem services has focused mainly on urban green areas in the Global North and regulating (e.g. air and water quality) and cultural services (mainly recreation; e.g. Coutts & Hahn, 2015; Harlan & Ruddell, 2011) having positive impacts on physical and mental health (Bratman et al., 2019; Coutts & Hahn, 2015). Conversely, environmental degradation and the lack of nature exposure in cities has been shown to impact health negatively (Cox et al., 2018; Harlan & Ruddell, 2011). A few comparative case studies of urban versus rural communities have addressed differences in ecosystem services and well-being (Aguado et al., 2018; Song et al., 2018; Yang et al., 2019), which could help to shed light on the effect of urbanization on the well-being benefits derived from ecosystem services. However, these studies either assessed well-being independently of ecosystem services (Aguado et al., 2018; Yang et al., 2019) or assumed that ecosystem services produced certain well-being benefits without measuring them (Song et al., 2018). Therefore, the contributions of ecosystems services to multidimensional well-being in relation to urbanization and living in cities remain unclear.

To explore how urbanization and living in cities is associated with people's perceptions of multidimensional well-being benefits derived from provisioning, regulating and cultural ecosystem services, we compared two paired urban and rural sites in a Small Island Developing State. We used the social well-being framework to investigate locally relevant well-being benefits derived from ecosystem services (Coulthard et al., 2014; Gough & McGregor, 2007). We selected the Solomon Islands because of their rapid urban population growth (4.7% annually, UN-Habitat, 2012) and because Solomon Islanders' well-being is highly dependent on ecosystems (Coulthard et al., 2017; McCarter et al., 2018). Furthermore, coastal and island ecosystems have received less research attention in studies related to ecosystem services and poverty (Suich et al., 2015). We focused on the following four questions: (a) How do Solomon Islanders in urban and rural areas conceive well-being? (b) How do ecosystem services contribute to the well-being of Solomon Islanders? (c) How do the well-being benefits derived from ecosystem services differ between urban and rural dwellers? and (d) How are socio-demographic characteristics associated with perceived well-being benefits derived from ecosystem services? Furthermore, for question (c), we tested the hypothesis that urban dwellers would report benefiting less from provisioning, regulating and cultural services than rural dwellers because of the physical and emotional disconnect between people and nature caused by environmental and lifestyle changes associated with urbanization. Alternatively, living in an urban environment might not influence perceived benefits derived from nature or urban dwellers could

perceive even more benefits (perhaps due to higher levels of formal education).

2 | METHODS

We assessed perceptions of well-being benefits associated with nine ecosystem services in paired urban and rural communities of the Solomon Islands. We used the Common International Classification of Ecosystem Services (CICES, Haines-Young & Potschin, 2018) definition of final ecosystem services or 'what ecosystems do for people'. These ecosystem services in turn contribute to multidimensional well-being depending on a person's interactions (use and non-use values) with these services. We selected a total of four sites in two provinces where we conducted focus group discussions ($N = 8$) and household interviews ($N = 200$) in September–December 2018.

2.1 | Study sites and sampling design

Twenty percent of people in the Solomon Islands live in urban areas, as defined by the government in terms of population density and diversity of economic activities (Solomon Islands National Statistics Office, 2015). We paired two urban to rural coastal sites in two provinces of the Solomon Islands. In Guadalcanal province, we paired the capital, Honiara, to Tamboko village. In the Western province we paired the industrial town of Noro to Nusa Hope village. Each site within a pair had similar environmental characteristics, such as ecosystem types, distance from the coast and location on the same island (for further details, see Lapointe et al., 2020a).

We used mixed methods to investigate the relationship between ecosystem services and well-being. The goal of the qualitative component was to understand which well-being aspects were considered important in each community. We held eight focus group discussions: one with men and one with women in each of the four sites. Participants in villages were mostly suggested by the village leaders. In urban locations, we recruited people in public areas. Discussions were held in churches or in community halls.

For the quantitative component, we conducted 50 semi-structured interviews in each of the four sites to assess the relationship between ecosystem services and well-being benefits ($N = 200$). Respondents were selected using systematic random sampling, whereby every second household was selected. We interviewed only one person per household, preferentially the head of the household (this includes the head's spouse if the head was male). We maintained a gender balance in each site (respondents were 49% male and 51% female) and we collected other key socio-demographic characteristics that were likely to be related to the perceptions of ecosystem services and their benefits (Table 1).

Focus group discussion and interviews were conducted in 2018 by trained Solomon Islander research assistants in Solomon Islands Pijin (except in Nusa Hope, where the interview was translated into Roviana). This sampling protocol was reviewed and approved by

TABLE 1 Socio-demographic characteristics elicited in household interviews

Variable	Justification	Description	Variable type
Age	Related to differences in ecosystem service valuation (e.g. Maestre-Andrés et al., 2016) and between urban and rural areas (e.g. Martín-López et al., 2012)	Recorded in years	Continuous
Education level	Related to differences in ecosystem service valuation (Aguado et al., 2018) and between urban and rural areas (e.g. Martín-López et al., 2012)	Level of formal education: (a) None to elementary; (b) junior secondary and professional, for example, carpentry; (c) senior secondary; and (d) tertiary	Ordinal (four levels)
Main livelihood	An indicator of occupation and reliance on provisioning services associated with differences in ecosystem service valuation (Paudyal et al., 2015; Plieninger et al., 2013)	(a) Food production; (b) Food production and home production to generate income; (c) Food production and paid work; (d) Wages are most important, but some food production; (e) Wages only	Categorical (five categories)
Material style of life (MSL)	An indicator of wealth. Wealth is related to differences in ecosystem service valuation (Dawson & Martin, 2015; Horcea-Milcu et al., 2016)	A material assets index constructed using a principal component analysis (Table A.3)	Continuous
Time living in the community	Urban areas are destinations for migrants (United Nations, 2019)	Number of years living in the community divided by the person's age	Continuous

the Human Research Ethics Committee of James Cook University. Written consent to participate in the interviews and focus group discussions was given by all respondents. The study was conducted with permission from the Solomon Islands government.

2.2 | Ecosystem service identification

We used the CICES to define ecosystem services at the class level (version 5.1; Haines-Young & Potschin, 2018). The final nine ecosystem services (Table A.1) were selected through a process of expert interviews and focus group discussions conducted in urban and rural areas of the Solomon Islands (Lapointe et al., 2020a). These ecosystem services were derived from a diversity of ecosystems, ranging from the open ocean to home gardens.

2.3 | Well-being benefits identification

To identify the important well-being elements in each study site, we asked focus group discussion participants to describe someone who was doing well in their community and someone who was not (e.g. Coulthard et al., 2015). Then, to assess the relationship of well-being elements and ecosystem services, we asked household interview participants to describe in open-ended questions all the ways each ecosystem service contributed to their household's well-being. We analysed the answers written in full from 50 pilot interviews to identify the main well-being benefits reported according to the social well-being framework (White, 2008). In the final interviews, the research assistants classified answers into these pre-determined categories (Table A.2). Well-being benefits that represented <1% of potential answers or that were reported by 5% or less people per ecosystem service were removed from the analyses.

2.4 | Statistical analyses

2.4.1 | Urban–rural comparisons

To test our hypothesis that urban dwellers would report fewer well-being benefits associated with ecosystem services than rural dwellers, we used GLMMs for each of the 15 well-being benefits. These models were fitted with a binomial distribution (presence–absence of each benefit) with the `LME4` package (Bates et al., 2015). The response variable was the presence of a well-being benefit per household. Urbanization level (urban vs. rural), ecosystem services and the interaction between the two variables were the fixed effects. In all cases, we added household as random factor to control for the non-independence of multiple responses per respondent. We did not include the study site in the random structure because it has only four levels; we would have included it as a fixed effect, but it was not possible in our case because each site is nested within an urbanization level. We tested whether the fixed effects contributed significantly to the models with an analysis of deviance using the ANOVA function of the `CAR` package (Fox & Weisberg, 2019). In the case of a significant interaction between urbanization level and ecosystem services, we performed post hoc multiple comparisons with the `EMMEANS` package (Lenth, 2019) with a Tukey's correction for multiple testing. Assumptions of dispersion, linearity and uniformity of the residuals were tested with the `DHARMA` package (Hartig, 2019).

2.4.2 | Disaggregation by socio-demographic characteristics

To understand how socio-demographic characteristics were related to differences in perceptions of well-being benefits derived from ecosystem services and their association with urbanization level,

we first investigated how the different socio-demographic characteristics measured differed between urban and rural areas with chi-squared test or Student-*t* test. We then assessed the association of the different socio-demographic characteristics among themselves and with urbanization using either Pearson's correlation coefficient, multiple correlation coefficient or Cramer's V depending on the type of variable (i.e. numeric or categorical). Finally, we used GLMMs for each of the 15 well-being benefits as above, but replacing urbanization level by socio-demographic characteristics. Again, we could not include the study site as a fixed effect because it was strongly associated with MSL and moderately associated with both livelihood and time living in the community (0.75, 0.51, 0.54 respectively; Figure A.1). Because MSL and livelihood activities were moderately associated (0.66; Figure a.1), we analysed them separately. All of the remaining socio-demographic characteristics were checked for multicollinearity using variance inflation factors. All analyses were undertaken in R (R Core Team, 2019).

3 | RESULTS

3.1 | Important well-being elements in the study sites

When asked to describe people in the community who were doing well and those who were not, several elements of well-being were identified in the focus groups undertaken with men and women at all of the study sites (Table 2). We classified well-being elements in the three dimensions of the social well-being framework, although some elements could have belonged to more than one dimension.

In fact, the social well-being framework acknowledges that the three dimensions are related and overlap; the interpretation of a given well-being element therefore depends on how it affects a person (White, 2010). We classified elements that could belong to different well-being dimensions into the one that appeared to capture the principal signifier of the well-being element. In the material dimension, these elements were meeting basic household material needs and providing for children, having income-generating activities, good food and a home. In the relational dimension, the most universally recognized elements were participating in community activities as well as sharing and helping others. Rules and religion were mentioned in seven of the eight focus group discussions. In relation to the subjective dimension of well-being, being happy and satisfied with life was also mentioned in seven of the eight discussions.

Other aspects were perceived differently among urbanization levels and/or study sites. The importance of education was only mentioned in urban areas. The importance of fishing and gardening was mainly mentioned in rural sites (and in Noro town by men). The importance of the natural environment was not directly mentioned, although four groups mentioned the importance of maintaining clean surroundings (mostly in urban settings).

3.2 | Association between ecosystem services and well-being benefits

Each ecosystem service was associated with multiple well-being benefits and *vice versa* (Figure 1). For example, health benefits were more or less strongly associated with all ecosystem services.

TABLE 2 Important well-being elements derived from focus group discussions (FGD, N = 8) conducted in urban and rural study sites. The benefits presented were mentioned by at least 50% of the focus groups

Well-being dimensions	Well-being elements	Number of FGD mentions		
		Urban	Rural	Total
Material	Meeting household material needs (e.g. school fees, clothing, transportation)	4	4	8
	Income-generating activities	4	4	8
	Fishing and gardening activities	3	4	7
	Good and permanent house	4	3	7
	Education	4	0	4
	Health	2	2	4
Relational	Participating in community activities	4	4	8
	Helping others and sharing	4	4	8
	Following laws, religion, traditions	4	3	7
	Being kind to people	3	2	5
	Caring for the land and surroundings	3	1	4
Subjective	Satisfaction and happiness	4	3	7
	Being hard-working	3	3	6
	Being humble	4	1	5
	Having life objectives	2	2	4

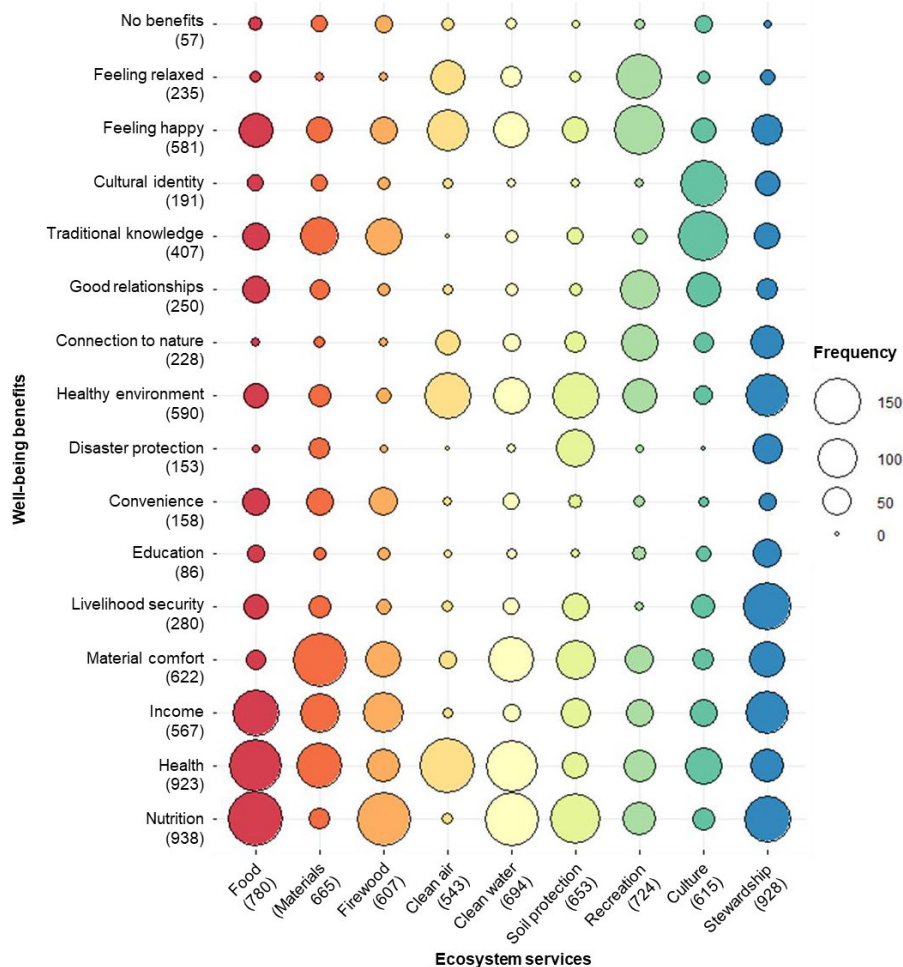


FIGURE 1 Bubble plot illustrating the frequency of well-being benefits associated with ecosystem services obtained from household interviews for both rural and urban dwellers

Stewardship was the ecosystem service with the most different benefits associated with it; and clean air, the least. The most widely recognized well-being benefits were, in order of importance, nutrition, health, material comfort, income and feeling happy. Education was the least mentioned of the main 15 benefits kept in the analyses.

3.3 | Urban and rural comparisons in well-being benefits derived from ecosystem services

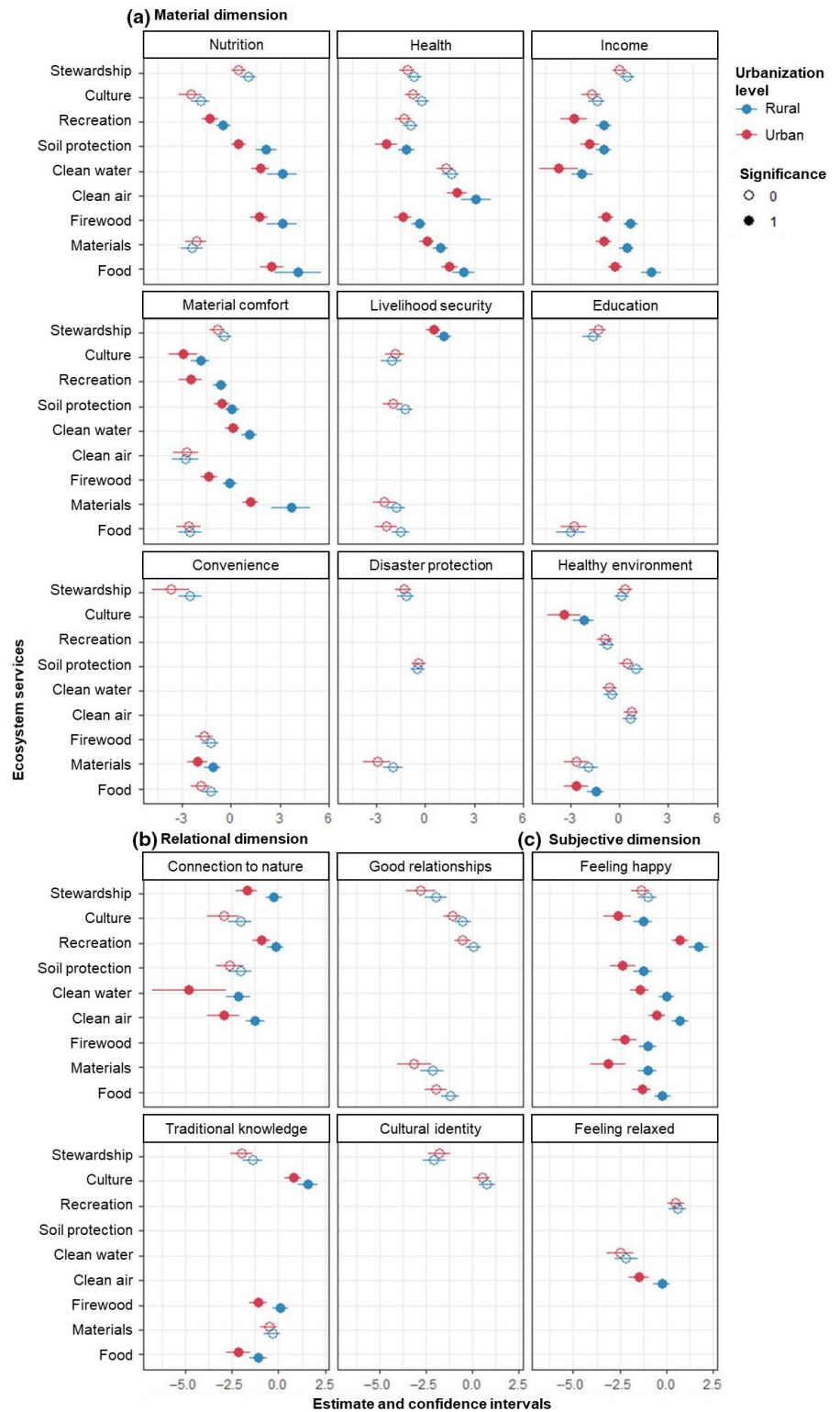
We predicted that urban dwellers would derive fewer well-being benefits from ecosystem services than rural dwellers. Overall, the patterns of associations between the different well-being benefits and ecosystem services were similar between urban and rural dwellers (Figure 2). However, for 11 of the 15 well-being benefits, across all dimensions of well-being, significantly fewer urban than rural dwellers reported deriving well-being benefits from at least one ecosystem service (Figure 2). Furthermore, some urban dwellers reported not benefiting at all from certain ecosystem services (7% for food, 14% for firewood, 10% for material, 5% for clean air and 10% for culture). Therefore, we rejected the null hypothesis of no differences in the perceived benefits that urban and rural dwellers derive from ecosystem services.

For the material well-being dimension, most differences between urban and rural dwellers were found in nutrition, health, income and material comfort benefits. For example, 70% of rural dwellers compared to 52% of urban dwellers associated health benefits with materials such as medicinal plants. Moreover, in terms of income, 86% of households in rural areas derived income from food (by selling mainly fresh root crops, vegetables and fruit) and 66% from firewood, whereas it was about half that number (44% and 32% respectively) in urban areas.

For relational well-being benefits, most differences were encountered for connection to nature and traditional knowledge. For example, 46% people in rural areas associated the ecosystem service recreation with feeling connected to nature compared to 30% in urban areas. Clean air also mediated the feeling of connectedness to nature for 24% of rural dwellers, but only 6% of urban dwellers. Traditional knowledge was associated mainly with the ecosystem service culture for 81% of rural dwellers and 67% of urban dwellers.

Finally, within the subjective well-being dimension, feeling happy was reported significantly less by urban than rural dwellers for all ecosystem services with the exception of stewardship. Feeling happy was mostly associated with recreation in nature for 83% of rural dwellers and 66% of urban dwellers. Having access to clean air also brought happiness to 66% of rural dwellers, but only 38% of urban dwellers.

FIGURE 2 Comparison between urban (in red) and rural dwellers (in blue) of the probability of identifying a well-being benefit obtained from a logistic regression according to urbanization level, ecosystem services and well-being benefits for (a) material, (b) relational and (c) subjective well-being dimensions. Full circles indicate a significant difference between urban and rural dwellers ($p \leq 0.05$)



3.4 | Disaggregation of well-being benefits reported per socio-demographic characteristics

Respondents from urban and rural areas differed in terms of age, education level, main livelihood activities, time living in community and wealth (Table 3). Compared to the average urban dweller, the average

rural dweller was older, had been living for a longer time on average in the study site, had fewer material assets and had lower educational attainment (fewer senior secondary and tertiary levels). Livelihoods were more based on cash economy in urban areas and on home production in rural areas. Livelihoods and wealth were strongly associated with urbanization level, and between themselves (Figure A.1).

Socio-demographic characteristics		Urban and rural comparison				
		Urbanization level		Test statistic	df	p-value
Variable	Category	Urban	Rural			
Age (years)	Mean	36.4	44.1	$t = 3.9419$	188.75	0.0001
	SD	12.1	15.2			
Education level ^a	1	26%	50%	$\chi^2 = 20.968$	3	0.0001
	2	17%	24%			
	3	32%	12%			
	4	25%	14%			
Main livelihood ^b	1	0%	8%	$\chi^2 = 147.35$	4	<0.0001
	2	0%	45%			
	3	3%	35%			
	4	78%	12%			
	5	19%	0%			
Time living in the community (years)	Mean	14.0	34.3	$t = 8.7524$	160.68	<0.0001
	SD	11.9	20.0			
Material style of life (MSL)	Mean	0.73	-0.73	$t = -15.269$	161.15	<0.0001
	SD	0.83	0.49			

^a(a) None to elementary; (b) Junior secondary and professional; (c) Senior secondary; (b) Tertiary.

^b (a) Food production; (b) Food production and home production to generate income; (c) Food production and wages; (d) Wages are most important, but some food production; (e) Wages only.

The logistic regression relating well-being benefits to socio-demographic characteristics (but without urbanization level; Figure 3) revealed that the reported benefits varied mainly according to wealth. In fact, wealth was associated with lower probabilities of identifying benefits derived from ecosystem services for 12 of the 15 well-being benefits. Similarly, as livelihoods transition from subsistence-based to wages, the probabilities of reporting well-being benefits derived from ecosystem services decreased for eight of the 15 benefits (Figure A.2). In the case of the other socio-demographic characteristics, education varied significantly for four well-being benefits, age and time living in the community for two benefits and gender for one benefit.

4 | DISCUSSION

People in both urban and rural areas of the Solomon Islands mentioned well-being elements pertaining to all dimensions of the social well-being framework when stating what was important to live well in their community. We found that each ecosystem service contributed to several of these well-being elements, especially to the material dimension. Our results demonstrate that, although ecosystem services contributed to urban and rural dwellers' well-being in similar ways, urban dwellers reported fewer well-being benefits than rural dwellers, which supports our hypothesis. In other words, increased urbanization was associated with decreased nature's contributions to multidimensional human well-being in the Solomon Islands. Furthermore, we found that increased material wealth and, to a lower degree, livelihood activities mainly based on wages rather than food production were

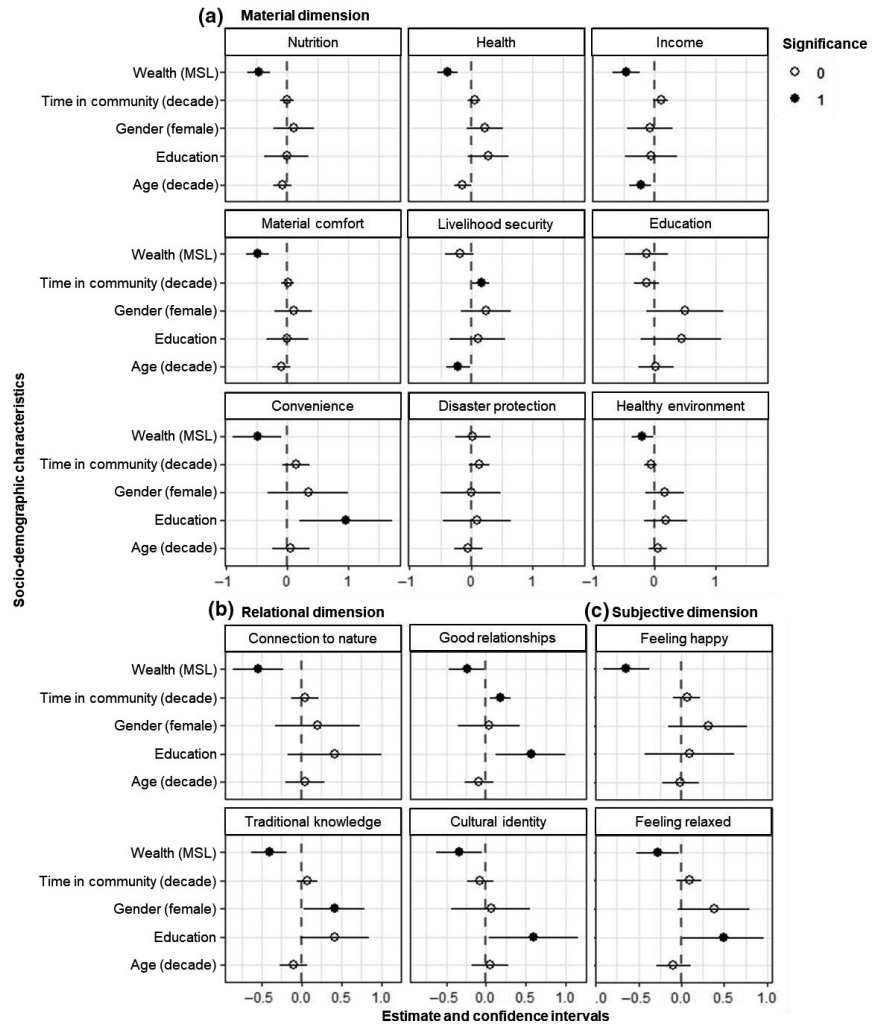
TABLE 3 Comparison of socio-demographic characteristics between urban and rural dwellers

also associated with lower probabilities of identifying well-being benefits derived from ecosystem services. Associations between urbanization and wealth and livelihood activities suggest potential mechanisms by which urbanization affects the well-being derived from nature.

4.1 | Important aspects of well-being in the Solomon Islands

Several of the locally relevant well-being elements identified in the focus group discussions were shared among study sites and genders. In all communities, people mentioned well-being elements from the three well-being dimensions. First, for the material dimension, men and women in urban and rural areas identified basic material needs, such as good food, income and shelter. Other material benefits, such as health, were not identified in all groups; and education was mentioned only in urban areas, maybe because of the limited access in rural areas. Second, relational well-being benefits arise from the relationship between people, society (White, 2010) and, in our case, nature. They include aspects such as social relations, culture, institutions and identity. This dimension of customary obligations is very important in Melanesian cultures (e.g. Coulthard et al., 2017; Lau et al., 2020; Malvatuma National Council of Chiefs, 2012), and community participation and sharing were mentioned by all focus groups. Third, with respect to the subjective well-being dimension, which also incorporates a person's values (Coulthard et al., 2017), focus group participants identified not only life satisfaction and happiness, but also desirable personality attributes or attitudes such as being hard-working and humble.

FIGURE 3 Probability of identifying a well-being benefit obtained from a logistic regression according to socio-demographic characteristics, the type ecosystem service (not shown on the graph) and well-being benefits for (a) material, (b) relational and (c) subjective dimensions of well-being. Full circles indicate a significant effect of socio-demographic characteristics ($p \leq 0.05$)



The well-being elements reported here are similar to those identified in other studies of well-being in the Global South (Abunge et al., 2013; Beauchamp et al., 2018; Dawson & Martin, 2015). For example, the importance of community and sharing with others appears in all studies. There were some unique elements in the conceptualization of well-being in the Solomon Islands, for example, in the importance of certain personal attributes (e.g. being hard-working and being nice to people). Furthermore, self-determination elements such as ‘freedom of action and choices’ identified in the Millennium Ecosystem Assessment (2005) were rarely mentioned in the discussions. This well-being constituent might depend on the fulfilment of other well-being elements, as portrayed in the Millennium Ecosystem Assessment (2005), such as health, education or income, which may be harder to achieve in the Solomon Islands context.

4.2 | Ecosystem service contributions to multidimensional well-being

The patterns of association between ecosystem services and well-being benefits that we found were complex; all ecosystem

services contributed to each of the three well-being dimensions. First, material well-being benefits derived from ecosystem services were most often identified, illustrating the importance of nature to meet basic needs (e.g. nutrition, health and shelter). Material benefits were derived mainly from provisioning and regulating services. In addition, we found that benefits associated with nature stewardship, which give insights into why people want to conserve nature, were also strongly related to the material dimension. Our results align with previous research conducted in countries of the Global South that shows the importance of ecosystem services, especially provisioning services, to meet basic material needs (e.g. Suich et al., 2015).

Second, we found that relational benefits were mainly derived from cultural, but also provisioning and regulating services. Good relationships were mediated through recreation as well as through culture that guides social behaviour, for example, in relation to taboo places. Furthermore, the sharing of food (and of money derived from food production) is essential to fulfil customary obligations in the Solomon Islands (Martin, 2007). Traditional knowledge was not only related to cultural services, but also to all provisioning services that represent traditional practices such as gardening and cooking with firewood. Therefore, our approach linking ecosystem services to

well-being benefits allowed us to highlight how culture permeates ecosystem services that are not classified as cultural; addressing a limitation of the ecosystem service approach reported in previous studies in which cultural services appeared undervalued (Dawson & Martin, 2015; Lau et al., 2019).

Third, while our evaluation of well-being benefits was subjective (given it was based on perception data), some benefits were especially related to how a person felt emotionally and were therefore classified as subjective (e.g. feeling happy and satisfied, and feeling relaxed and stress-free). To our knowledge, this well-being dimension has been little studied in ecosystem service research (although, see Britton & Coulthard, 2013; Coulthard et al., 2017).

While the MA distinguished well-being benefits from the ecosystem services providing them, a distinction that is also present in the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES, Díaz et al., 2015), most research has focused on ecosystem service valuation without addressing human well-being impacts. These studies have focused mainly on ecosystem service stocks, using unidimensional well-being indicators such as money, or conflating ecosystem services and well-being benefits (Bennett et al., 2015; Daw et al., 2016). Our findings reflect to a great extent the results from the Millennium Ecosystem Assessment (2005), obtained on a large, aggregated scale, in how the different categories of ecosystem services contribute to multiple dimensions or constituents of well-being. However, the social well-being framework helped us identify additional relationships between ecosystem services and well-being in the subjective and relational dimensions. We found that feeling of happiness in the subjective well-being dimension which could not be covered by the Millennium Ecosystem Assessment (2005) because of its scale of analysis, was among the five most cited benefits and associated with provisioning, regulating and cultural services. Lastly, the social well-being framework appears to be especially relevant to consider these relational values of nature that depart from the intrinsic/instrumental divide and that are now thought to be key in valuing nature (Chan et al., 2016).

4.3 | Urban and rural comparisons in well-being benefits derived from ecosystem services

Urban and rural dwellers associated similar well-being benefits with ecosystem services. However, significantly fewer urban dwellers derived benefits from 11 of the 15 benefits spanning all well-being dimensions. Therefore, increased urbanization was associated with decreased nature's contributions to multidimensional human well-being in the Solomon Islands. The most important differences were in terms of meeting basic material needs (e.g. income and material comfort), feeling connected to nature, and feeling happy and satisfied; these well-being benefits were reported 54%, 66%, 43% and 54%, respectively, less in urban compared to rural areas. Apart from connection to nature, basic material needs and feeling happy were identified as universally important well-being elements in the Solomon Islands.

The decreased contributions of ecosystem services to material well-being in urban areas might be at least partially replaced by non-ecosystem services. For example, urban areas offer options to purchase both fresh and processed food, employment opportunities, health care services, although they are often inadequate or too costly to be equitably accessed in the Solomon Islands (Mecartney & Connell, 2017).

In contrast to material well-being benefits, the relational well-being benefit, connectedness to nature, cannot be substituted as easily by non-ecosystem service alternatives, and might have detrimental impacts on overall well-being and pro-environmental behaviour. In fact, connectedness to nature has been shown to be associated with psychological and physical health benefits in the Global North (Russell et al., 2013; Shanahan et al., 2016; Zelenski & Nisbet, 2014). In addition, feeling connected to nature predicts pro-environmental behaviour (Zylstra et al., 2014).

Feeling happy and satisfied emerged as one of the main well-being benefits related to ecosystem services, but was mentioned 46% less in urban than in rural areas. Interestingly, overall individual subjective well-being was also higher in rural than in urban areas: rural dwellers stating being satisfied or very satisfied with their life more than urban dwellers (82% and 56% respectively). Similarly, a study conducted in the neighbouring country of Vanuatu reported that rural people had higher subjective well-being levels than urban dwellers (Malvatumauri National Council of Chiefs, 2012). The lower subjective well-being of urban dwellers could be due in part to the decreased satisfaction derived from nature, but also to decreases in other ecosystem service benefits associated with all well-being dimensions. For example, happiness in Melanesia has been shown to be linked to residing on customary land with which people have strong cultural ties and derive their livelihoods (Feeny et al., 2014). Furthermore, the link between mental health benefits and spending time in nature is also well-known (Bratman et al., 2019). However, we cannot attribute the lower subjective well-being in urban areas solely to transformed human-nature relationships. For example, social fabric, among other things, could also impact well-being, considering the importance of community in Melanesian conception of well-being, as well as shifting baselines in well-being conceptualization. Finally, by showing a decrease in all dimensions of well-being derived from nature in urban areas, our results might provide some evidence that the Environmentalist's Paradox (Raudsepp-Hearne et al., 2010) stems in part from the narrow definition of well-being in large scale, aggregated analyses focusing on the material dimension of well-being.

4.4 | Disaggregation of well-being benefits reported per socio-demographic characteristics

Among the socio-demographic characteristics considered, we found the strongest associations between material wealth and livelihood activities and perceived well-being benefits derived from ecosystem services. With urbanization, livelihood activities transitioned from being subsistence-based to income-generating, which is also associated with

increased wealth in urban areas. Other socio-demographic characteristics (age, education and time living in the community), which also differed between urban and rural dwellers, did not have significant associations with most well-being benefits derived from ecosystem services in the Solomon Islands. As wealth increased, we found a significant decrease in reports of most material well-being benefits, such as nutrition, health and income, and all relational and subjective benefits. Our findings show that poorer people appear to depend on ecosystem services for their well-being more than their wealthier counterparts, in accordance with the literature (Suich et al., 2015). The patterns observed for wealth and livelihood activities were similar to that related to urbanization. Although we suspect that changes in wealth and livelihood activities could partly be responsible for the patterns of association between urbanization and ecosystem service benefits, we cannot infer causality from our data.

Although the reliance on ecosystem services for the rural poor has been demonstrated, there is a lack of research into the importance of ecosystem services on the urban poor (Suich et al., 2015). We can speculate that, in terms of material well-being in the Solomon Islands, people with less material wealth might face more challenges in meeting their basic material needs in cities, as alternatives to ecosystem services benefits for nutrition and health require money to be accessed. Decreases in relational well-being benefits from ecosystem services might also be more detrimental to poorer urban dwellers. For example, good social relations are an essential well-being component in the Solomon Islands and the decreased contribution of ecosystem services to maintain these relationships for urban households could stem in part from an insufficient food production (and derived income) combined with a lack of paid employment and high costs of living in urban areas. While richer people can rely on other sources of income, these conditions can prevent poorer urban households from meeting social obligations of everyday sharing and reciprocity, and contributing to cultural traditions of Melanesia (e.g. associated with marriages and deaths; Maggio, 2017). In times of hardship, people facing scarcity in cities can even become reliant on their village relatives, what has been called 'reverse remittance' (Lindstrom & Jourdan, 2017; Rio, 2017). Thus, the decreased benefits from provisioning services in urban contexts not only impact material, but also relational well-being. Our findings show the importance of considering potential trade-offs between well-being benefits provided by ecosystem services as experienced by different social groups (Daw et al., 2011), in addition to trade-offs between ecosystem services (Howe et al., 2014; Lee & Lautenbach, 2016).

4.5 | Limitations and caveats

The main limitation of our study is that the well-being benefits that we measured were not weighted according to their relative contribution to overall well-being. Therefore, we do not know their cumulative impacts on overall well-being. Furthermore, as pointed out by Abunge et al. (2013), by asking an open question to identify well-being benefits, some potentially important benefits might

have been omitted because these were not thought about during the interviews and focus group discussions. Abunge and colleagues (2013) therefore warn against over-interpreting absent or infrequent well-being benefits. Finally, we used frameworks for ecosystem services and human well-being that were developed in the Global North. While we tried to adapt these to the Solomon Islands context, worldviews of well-being and nature held by Solomon Islanders are likely to be different. For example, collective well-being that is very important in Melanesian societies was not investigated here (Malvatumauri National Council of Chiefs, 2012). Further, western notions of human apart from nature (i.e. nature–culture dualism) are at odds with the relational value of humans as part of nature held by Melanesians (Jupiter, 2017).

4.6 | Future research directions

We showed that nature's contributions to human well-being decreased with urbanization in the Solomon Islands, but more research is needed to determine if this loss in well-being derived from nature is actually compensated by other non-ecosystem services in urban areas. To do so, we would need to know the relative importance of different well-being elements and the relative contribution of ecosystem services to these elements.

Furthermore, a next step would be to investigate the causal mechanisms responsible for the observed patterns in socio-cultural perceptions. Explanatory factors could range from needs, preferences or socio-economic status at an individual scale, to limitations in terms availability and access to ecosystem services at biophysical and social-institutional scales (refer to Lapointe et al., 2020b).

5 | CONCLUSIONS

Living in cities contributes to human well-being in several ways, but also alters human–nature relationships leading to a physical and emotional disconnect between people and nature. The impacts of this disconnect on multidimensional well-being of urban dwellers is not well-understood. We have shown that living in cities was associated with fewer perceived material, relational and subjective well-being benefits derived from ecosystem services. Similarly, the transition from subsistence to income-generating livelihoods and associated increased wealth that occurs with urbanization was also associated with decreased reports of ecosystem service well-being benefits. Our findings demonstrate that the altered human–nature relationships in urban areas were associated with decreases in multidimensional well-being that people derive from nature. The relationships between ecosystem services and multidimensional well-being are complex, and oversimplification of these relationships through an omission of locally relevant well-being elements in environmental management could lead to trade-offs between aspects of well-being and between people with different needs and preferences.

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CONFLICT OF INTERESTS

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.

AUTHORS' CONTRIBUTIONS

M.L., G.G.G. and G.S.C. conceived of the project idea; M.L. collected the data, performed the analyses and led the writing of the manuscript. All the authors contributed to design the methodology and critically to the drafts, and gave final approval for publication.

DATA AVAILABILITY STATEMENT

Data are available from the James Cook University data repository at <https://doi.org/10.25903/3s4e-t744> (Lapointe, 2020).

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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