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RESEARCH ARTICLE

Lost in transition? Capturing the impacts of conservation and development interventions on relational values and human wellbeing in the forested tropics

The comparative performance of land sharing, land sparing type interventions on place-based human well-being

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Abstract

1. Environment-facing interventions impact the distribution, use of and access of natural resources and have important implications for all dimensions (material, relational, quality of life) of human well-being (HWB). Yet conventional impact metrics routinely surpass the non-material impacts which may be particularly salient in rural contexts where small-scale farmers depend directly on the land and biodiversity. Furthermore, little is known about the comparative performance of distinct interventions along a land-sharing, versus land sparing gradient, on local definitions of HWB.
2. We address this knowledge gap, adopting a perception-based impact evaluation within communities across four intervention types representing the land sparing, sharing gradient: intensified industrial soy production (n = 60 HHs), a protected area (n = 70), an extractive reserve (n = 70) and a national forest (n = 70) in Pará in the Brazilian Amazon. We collected data using the Global Person Generated Index (GPGI) with household heads (n = 270) in eight communities (two per intervention type). Focus group discussions (n = 8) solicited residents' perceptions of impact pathways.
3. Our findings highlight the important contribution of relational and subjective dimensions to HWB and call in to question the dominance of material measures in standard impact appraisals.
4. Furthermore, we show that single sector and integrated approaches generate 'polarized impact footprints' in which integrated approaches achieve (a) more impact, which is (b) more often positive and (c) locally salient, the inverse is true for single-sector sparing style approaches.
5. Areas of well-being that matter locally (culture, health and social relations), but are not impacted by interventions are relational, and point towards the potential of rights-based conservation to empower rural smallholders to remain in their communities while flourishing.

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KEYWORDS
Brazilian Amazon, conservation, development, impact assessment, relational values, tropical forests

1 | INTRODUCTION

In recent years the international policy arena has shown deeper recognition of the relationship between the environment and human well-being (hereafter HWB). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) endeavour is documenting the diversity of relationships, including those non-instrumental relationships, between people and the natural world (Chan et al., 2016; Pascual et al., 2017, 2021), the planetary health community underscores the interlinkage between environmental and human health (Whitmee et al., 2015) and the UN Sustainable Development Goals emphasise the interdependent nature of development and environmental integrity (Schleicher, Schaafsma, & Vira, 2018). Indeed, the earlier formulation of the ecosystem services (ES) concept identified a typology of services on which humanity and HWB depend (Millennium Ecosystem Assessment, 2005). However, subsequent application of the ES framework has tended towards the dichotomy of instrumental and intrinsic values of nature, overshadowing those non-instrumental flows between nature and the multiple dimensions of HWB (Himes & Muraca, 2018; Russell et al., 2013). In addition, recent advances have helped to recognise, quantify and understand the disproportionate contribution of consumption and wealth to environmental collapse (Lenzen et al., 2012; Otero et al., 2020). Yet, despite this progress on the one hand of determining the interconnected nature of natural systems and the multiple dimensions of HWB, and the disproportionate role of (often geographically distant) wealth accumulation in biodiversity decline on the other, the geographic focus of many conservation interventions remains centred on site-level interventions in tropical forest landscapes working with the rural poor (McKinnon et al., 2016; Reed et al., 2020; Roe & Elliott, 2004). These interventions often attempt to achieve a combination of climate, conservation and development wins (Miller, 2014; Reed et al., 2020), which are pursued through distinct interventions ranging from protected areas (PAs) or agricultural intensification, to integrated landscape approaches.

The design of interventions depends on how the relationship between development and the environment is framed and understood (Adams et al., 2004; Otero et al., 2020). Single-sector interventions (e.g. those that promote agricultural intensification or PAs) stem from a fundamental separation of people and nature (Adams et al., 2004). PAs, a traditional model of conservation supported by influential conservation scientists (e.g. E. O. Wilson), may afford biodiversity gains but can result in injustices for residents, including eviction from intergenerational homelands (Cundill et al., 2017; Rai et al., 2019), and lost access to resources necessary for livelihoods and livelihood resilience (Agarwala et al., 2014; Shepherd et al., 2020; West et al., 2006). Agricultural intensification is often supported by governments (e.g. through subsidies and incentive schemes) concerned with development and growth (Dawson et al., 2016), and by some conservation scientists who contend that intensification (increased output per unit area of crop-land) can spare land for nature (recognised as 'land sparing' approaches; Green et al., 2005). However, intensification also generates social and environmental burdens that include infringements on HWB particularly for small-scale land managers peripheral to market economies (Dawson et al., 2016; Rasmussen et al., 2018; Santika et al., 2020). Furthermore, intensification is associated with land accumulation by an elite few in tandem with the disenfranchisement of a larger un-capitalised population (Rajão et al., 2020), and often results in commodity production and delivery to prioritised export markets, over local food security (Lenzen et al., 2012).

Conversely, when biodiversity conservation is understood to be central to development, more integrated initiatives tend to result, including sustainable use reserves and integrated landscape initiatives (Carmenta et al., 2020). Such approaches contrast land sparing actions, and instead represent 'land sharing' style solutions to conservation development challenges, within which people and nature co-exist, often practicing agroecological, low-input agriculture in diverse landscape mosaics (Perfecto & Vandermeer, 2010). Integrated approaches to conservation and development imperatives are increasingly promoted since they are perceived as capable of addressing system dynamics and delivering across social and ecological imperatives (Reed et al., 2016). Such initiatives involve bundles of actions (e.g. land zoning, health care and agroecological intensification) in integrated interventions, often in support of rights, and may outperform single-sector style approaches across the remits of conservation, agriculture and livelihoods (Carmenta et al., 2020). Many are notable because they often stem from grassroots mobilisation and achieve greater potential for inclusion of local stakeholders as initiative partners (Almeida, 2004). However, integrated approaches have been criticised largely due to implementation challenges that demand extended funding timelines, active engagement and coordination of diverse stakeholders in a continuing and dynamic process (Estrada-Carmona et al., 2014; Milder et al., 2014). Given the distinctions between land-use-facing interventions, from less to more integrated, or along a land sparing, land sharing spectrum, and the potential of each to impact people and nature, and the relationship between them, there is a crucial need to better understand their comparative performance.

The question of what intervention type performs best has been addressed by a number of impact studies, yet crucially such assessments have tended to focus on conservation outcomes (e.g. forest

loss, biodiversity impacts, hunting levels, fire extent; e.g. Carmenta et al., 2016; Geldmann et al., 2013; da Silva et al., 2018; Soares-Filho et al., 2010). Social indicators of performance are often missing entirely, or, when included, tend towards predefined and externally derived metrics focused on material gains and losses related to livelihoods (Agarwala et al., 2014; Brockington & Schmidt-Soltau, 2004; McKinnon et al., 2016). These omissions have resulted in calls to extend our understanding of the benefits and tradeoffs of sharing vs. sparing through inclusion of multi-dimensional HWB, including relational dimensions (Bennett, 2017; Phalan, 2018; Riechers et al., 2020). A related bias exists in the ES literature which has tended to assess the instrumental ES in economic valuation over the non-instrumental (be they intrinsic or relational; Chan et al., 2012; Himes & Muraca, 2018). The disproportionate focus on instrumental services and material constituents of human lives and livelihoods is explained by the general conviction that material measures are more tangible, easier to quantify and allow for systematised comparative analysis (Devereux & McGregor, 2014; McGregor et al., 2015; Vira & Kontoleon, 2012). As a result, the comparative impacts of interventions on the land sharing, sparing gradient on the multiple dimensions [i.e. quality of life (or subjective), material and relational] of HWB remain poorly understood (McKinnon et al., 2016; Rasmussen et al., 2018).

An expansion of HWB indicators to encompass not only material but also subjective and relational dimensions has taken place (e.g. Agarwala et al., 2014; Narayan, 2000; Pollnac & Poggie, 2008) and is recognised by the conservation community (e.g. see Special Issue Edisted by Biedenweg & Gross-Camp, 2018), although has yet to fully permeate the conservation and agricultural sectors (Büscher & Wolmer, 2007; McKinnon et al., 2016; Rasmussen et al., 2018). Notably, the relational values imbued within landscapes (Chan et al., 2016; Chan et al., 2018) have received little attention in conservation or agriculture impact assessment to date, with some notable exceptions (Cundill et al., 2017; Riechers et al., 2020). Similarly, ES literature on conservation and agriculture has made relevant advances in operationalising the assessment of cultural (including gendered) ES (Chan et al., 2012; Estrada-Carmona et al., 2020; Plieninger et al., 2013) but have been overshadowed by the dominance of instrumental services. Yet relational values are likely to contribute disproportionately to HWB in contexts where conservation and development initiatives are occurring (Agarwala et al., 2014; ESPA, 2018). Locations where the market economy is often peripheral, connection to land is more immediate and people depend heavily on affinity networks, moral and gift economies (Adams et al., 2008; Lima, 2009). Importantly, relationships and attachments to place may be eroded, recast or replaced as interactions with the landscape are reshaped to conform to new models of resource use and extraction introduced by land use-facing interventions (Cundill et al., 2017). Furthermore, cultural heritage and identities are defined by, and enabled through, connections to place and land rights struggles are anchored in a discourse of territory highlighting the centrality of relational values to place-based communities (Basso, 1996; Bolanos, 2011; Elk et al., 2008; Feld & Basso, 1996; Little, 2003).

Extending impact assessments to better account for the impacts of land use-facing interventions on locally salient, multi-dimensional HWB is essential for a number of reasons. The 'do no harm' principle of conservation or agriculture is only possible through understanding what matters locally, and thus requires meaningful engagement with diverse worldviews in favour of superimposing dominant models of development rooted in economic rationality (Pascual et al., 2021). Recognition of the salience of diverse values is particularly necessary as biodiversity conservation continues to situate itself with increasing proximity to cash poverty alleviation (Miller, 2014; Otero et al., 2020; Reed et al., 2020; Roe & Elliott, 2004). Perversely, the observed tendency to engage a material focus (either through intervention actions or impact assessments) may override, or be at odds with, alternative non-western models of human-nature interactions that exist in the rich biocultural landscapes that interventions target (Maffi & Woodley, 2012; Muradian et al., 2013). Plural valuation approaches are essential to ensure more just appraisal processes, and themselves can enhance the sustainability and equity of outcomes (Himes & Muraca, 2018; Zafra-Calvo et al., 2020). Furthermore, a biased focus on the material dimensions of well-being subverts new knowledge, norm and value creation related to the contribution of non-material and relational constituents of HWB and instead reinforces capitalist aspirations currently leading to environmental collapse (Jacobs et al., 2018; Steffen et al., 2015).

This study uses a perception-based impact assessment to understand how distinct land-use facing interventions along the sharing, sparing gradient, have impacted locally defined HWB. In doing so it makes a number of advances. These include contributing to closing the knowledge gap concerning the comparative performance of land use-facing interventions across the land sharing, land sparing gradient on multi-dimensional HWB, including relational values. We develop the concept of relational values in specific reference to HWB, enhancing links between well-being frameworks (McGregor et al., 2015) and contemporary understanding of relational values (Chan et al., 2016, 2018). Finally, we deliver to a methodological gap by combining perception-based impact assessment with a locally grounded approach to understanding HWB (Agarwala et al., 2014). We focus on the Brazilian Amazon, a landscape of rapid land use change where conservation and agriculture development are held in tension and a suite of land use-facing interventions have been introduced. Two research questions guided our work: (1) What are locally defined dimensions of HWB in the Brazilian Amazon and (2) What perceived impact do land sparing versus land sharing interventions have on locally salient HWB?

2 | METHODS

2.1 | Study context

The study took place in Pará, Brazil where one third of the state's territory is within some form of protection, either in strict use areas (containing five different types of conservation areas) or in sustainable use reserves. Meanwhile, since the early 2000s, Pará has invested in large-scale export infrastructure for soy bean combined

with agricultural development loans that have involved deforestation (Sauer, 2018). Municipalities around the city of Santarém have experienced agglomeration of small-scale farms by incoming capitalised soy farmers (Sauer, 2018). Since 2018, Amazonian forests, including in Pará, have come under increased pressure of deforestation due to a complexity of political-economic factors, including the continued expansion of cattle ranching and the agro-industrial frontier, illegal logging and fire, fuelled in part by the relaxing of environmental controls (Barlow et al., 2020; Carvalho et al., 2019; Escobar, 2020). Diverse rural communities are encountered in Pará including various indigenous groups, traditional *ribeirinho* or *caboclo* communities of mixed descent, and more recent arrivals of colonist farmers. These social groups have specific social histories and different degrees of market integration, though most organise production around traditional smallholder agriculture delivering subsistence needs and sell variable surplus at regional markets (Neves, 2007).

2.2 | Intervention types, participant communities and households

Field research was conducted over 6 months (June–November) in 2019 in four interventions that represent the land sparing, land sharing spectrum. The four interventions were: an area of industrial soy intensification (SOY) and a strict PA, both of which have parallels with land sparing strategies through the focus on intensification for increased yields, and sparing land for nature (Green et al., 2005). The two land sharing, more integrated approaches were a sustainable use reserve (RESEX) and a national forest (FLONA), which are designated multiple use areas, where local peoples are permitted to practice traditional small-scale, low-input farming and some forest use (Almeida, 2004; Spínola et al., 2020; Figure 1; Table 1). To avoid biasing results through data collection in 'outlier' communities, we selected two representative communities within each intervention type. For each pair, 'representativeness' was distinguished by the presence of average features along a range of attributes in relation to the environment (e.g. fire history), service availability (e.g. energy supply) and social characteristics (e.g. colonist or traditional farmers). These attributes were considered relevant for an appraisal of well-being due to their potential influence across well-being dimensions, and were identified based on the knowledge of the research team and local experts (Table 1). A short open-ended interview was conducted with the community president to triangulate the key attribute information. All study communities were home to smallholder family famers and included colonist and traditional peoples.

Within selected communities we held town hall meetings to present our research interests and possible outcomes of the work. These sought to seek the consent and participation of community

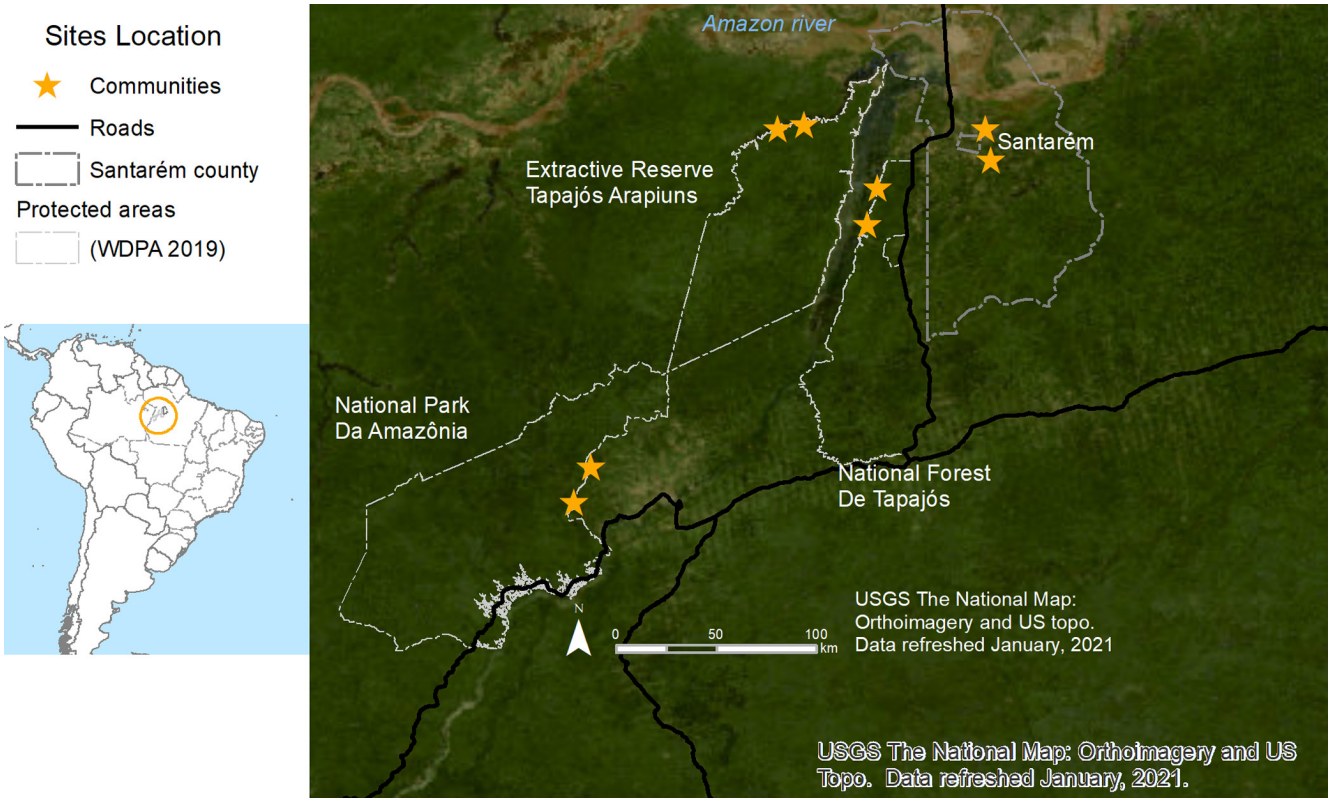

FIGURE 1 Location of the study region and interventions boundaries for the land sharing interventions: extractive reserve (RESEX, *Reserva extractivista Tapajos Arapíuns*), and the national forest (FLONA, *Floresta Nacional De Tapajos*) and the land sparing interventions: Protected area (PA, *Parque Nacional da Amazonia*) and the SOY intervention (SOY). For the latter we show the municipal boundary of Santarém. Community locations are indicative only.

TABLE 1 Summarised contextual characteristics and service provision within the pairs of study communities located in four distinct types of environment-facing intervention in the Brazilian State of Pará, Brazil. Sites include an Extractive reserve (RESEX), a national forest (FLONA), a protected area (PA) and a SOY intensification landscape (SOY)

Site	Land-use intervention approach, established date and area (ha)	Agri extension services	Tenure	Small farmer social group	Electric grid	Communication	Local school	Water	Access	# households
RESEX	Forest zoning, limited resource use; 1998; 677,513	Limited to training and some seedling varieties	Usufruct	Traditional peoples	No	Radio, public telephone	Primary	No	Fluvial	70
FLONA	Forest zoning, limited resource use, sustainable timber extraction; 1974; 527, 319	Yes, including training, some seedling varieties, fruit pulp extraction infrastructure	Usufruct	Traditional peoples	Yes	Radio, public telephone, cell phone	Primary	Wells and pump	Fluvial and road	70
PA	Strict forest protection, prohibited resource extraction; 1974; 1,084,896	Minimal extension to small scale farmers	Private	Colonists	Yes	Radio, public telephone, cell phone	Primary	Wells and pump	Road	70
SOY	No specific forest protection, soy intensification since 2005; municipality scale	High investment to intensified soy, minimal extension to small-scale farmers	Private	Colonists	Yes	Radio, public telephone, cell phone	Primary and Middle	Wells and pump	Road	60

members and therefore involved talking through discussion points and questions raised. Research permission was obtained through the Brazilian research authorisation system (Biodiversity Authorisation and Information System, SISBIO, approval number: 441949/2018-5) of the Chico Mendes Institute for Biodiversity and Conservation (ICMBio). Ethics approval was granted by the University of Cambridge ethics committee (Department of Geography, #715).

Community household lists, held by community presidents, enabled selection of a random sample of households. Communities varied in size yielding different proportions of households interviewed, while households were selected at random, the sample is therefore not fully representative of the larger communities. We interviewed either the male or female household heads and achieved a sample size of $n = 70$ households in the RESEX, FLONA and PA, and $n = 60$ households in the SOY intervention. We applied the Global Person Generated Index (GPGI) to solicit perceived and prioritised HWB constituents from participants, and a questionnaire to collect demographic household information including age, gender and main livelihood (Table S1). An overview of the project and intention of the survey formed part of the introduction in which there was re-emphasis of data anomynity, freedom to opt-out at any point, and request for verbal consent to proceed. Verbal consent was preferable to written consent because of the sensitivy of contract-like formalities.

2.3 | Global Person Generated Index: Gathering emic insights of place-based human well-being

The GPGI is a tool for soliciting the place-based plurality in what constitutes HWB. The GPGI was developed from the Patient Generated Index, which has been used extensively to capture subjective well-being related to health (Camfield & Ruta, 2007). The GPGI solicits data on locally percieved well-being constituents, the relative importance of the different constituents, and the level of satisfaction the respondent feels with each constituent. It does so through application of a standardised individual semi-structured interview. The GPGI responds to three necessities for measuring what matters to people for their well-being: (i) systematically identifying (i.e. distinct from participatory approaches) what is important for people to live well and in a way that is locally relevant and determined, yet universally comprehensible, (ii) assessing people's satisfaction regarding what matters most to them and (iii) understanding the relationships, trade-offs and weightings of the constituents of well-being that are locally salient (McGregor et al., 2015).

In practice, the GPGI method involves asking respondents to identify up to five constituents they regard as central to their well-being (Table S1). The respondent then gives a self-appraisal of their level of satisfaction within each constituent, ranging from 'the worse you can imagine' (−2 on the scale) to 'exactly as you would like it to be' (+2; OECD, 2013). Next, the relative importance (i.e. the weight) of each well-being constituent is indicated by distributing 20 tokens across the five constituents. The respondent has the option to leave

a constituent token-less or to load one with all 20. Complete satisfaction across all constituents of well-being results in a GPGI score of 100, whereas scores under 100 indicate the gap between total well-being satisfaction and the individuals actual experience.

Application of the GPGI is suggested as part of a proposed toolkit for perception-based assessment of how conservation interventions impact locally relevant well-being (Woodhouse et al., 2015). Therefore, following Rasolofoson et al. (2018), we introduced a final step to capture participants' perceptions of the impact of the land use-facing intervention across their well-being constituents (Rasolofoson et al., 2018), which was recorded on a scale of very negative (−2) to very positive (+2).

We were particularly interested in capturing subjective, material and relational dimensions of HWB some of which may be latent constituents – taken for granted and so not mentioned. To reduce the risk of missing these 'important but forgotten' constituents we introduced a standardised prompt in the introductory explanation of the GPGI. The prompt involved the enumerator explaining that well-being may have broad themes including subjective, material and relational dimensions, and gave a standardised example of a HWB constituent in each dimension to every participant. The GPGI is 'person-generated', in that it captures individual, emic, well-being constituents which ensures the place-based salience of the data, however, it does not offer a framework through which to organise the multitude of diverse responses given by participants and so is usefully combined with a well-being framework from the theoretical literature (see Data Analysis).

As common with other methods to solicit HWB, GPGI can proffer some inconsistency between the level of response (constituent) given by participants. For example, a response may indicate a HWB outcome (e.g. happiness), or the means (e.g. cash) to achieving an unknown well-being outcome. We do not have data to distinguish between levels. Adaptive preference, particularly in regard to non-longitudinal data is another important issue to consider in well-being research. The context of the COVID-19 pandemic illustrates the issue well, namely that responses are often contingent on the immediate past. For example, if land rights have recently been violated, land rights are likely to be cited as central to well-being. Finally, people tend to feel satisfaction relative to their expectations and experiences which may exaggerate or limit satisfaction in nuanced ways (Nussbaum, 2000). Despite these constraints, GPGI has been successfully validated in a number of contexts including in Bangladesh, Ethiopia, India, Madagascar, Sri Lanka and proven useful to advancing our understanding of what constitutes well-being (Camfield & Ruta, 2007; Coulthard et al., 2014; Devine et al., 2004; Rasolofoson et al., 2018).

2.4 | Focus group discussions

We held a series of focus group discussions (FGDs) to better understand peoples' perceptions of the causal pathways linking interventions with associated impacts on HWB. Researchers invited residents during community meetings and follow-up canvassing, extending the FGD invitation to all. Two FGDs per community were held with between 9 and 16 members present. Discussions were organised into three parts: a general reflection on HWB constituents; second, consideration of the extent of intervention impact on these constituents and finally, a discussion of the pathways through which impacts were perceived to manifest. In each community, participants were divided into two mixed gender groups. Each group had one researcher facilitating and another making notes and documentation via discussion boards and photographs.

2.5 | Open-ended interviews with key stakeholders

Open-ended interviews with key stakeholders associated with the four intervention types were held. Key stakeholders included individuals working as reserve managers [Chico Mendes Institute for Biodiversity Conservation (ICMBio)], environmental agents [Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA)], members of the local rural workers union [Rural workers union, (STTR)], NGO representatives [Health and Happiness Project (PSA)], agricultural extension agents [Technical Assistance and Rural Extension Company (EMATER)] and [Brazilian Agricultural Research Corporation scientists (EMBRAPA)] from Santarém and Itaituba as well as extended discussions with multiple community members during fieldwork. These data do not directly form part of the current study, yet we take note of them here because they served to contextualise our interpretation of the findings and articulate discussion points.

3 | DATA ANALYSIS

3.1 | Integrating place-based human well-being data with existing frameworks

Through the GPGI, 1350 unique responses of well-being constituents were reported by participants spanning the subjective, relational and material dimensions. To structure and present this data, we combined two well-being frameworks. This type of synthesis and 'local flexibility' are considered essential to construct the interdisciplinary frameworks needed to capture the material, subjective and relational constituents of HWB (e.g. see the calls from Agarwala et al., 2014). Specifically, we combined the universal dimensions (UDs) from the 3D well-being approach and built on the 10 domains (hereafter sub-dimensions) of HWB, and associated indicators, offered by McKinnon et al., 2016. Each is briefly described below.

3.1.1 | Universal dimensions

The 3D well-being approach defines three UD of well-being: subjective; material and relational (McGregor et al., 2015). Material

well-being is tangible and includes publicly visible items that can be measured objectively. Subjective refers to quality-of-life constituents such as individual satisfaction with conditions of being. Relational includes relationships and resources necessary for future well-being and includes the social, environmental and to some extent institutional context (or relationality). The relational dimension is central to understanding how HWB is produced and reproduced and distributed across and accessible to citizens.

To date the focus on the relational UD has largely emphasised social–social relations (McGregor et al., 2015). Within our analysis we have developed the relational dimension to engage the flows from nature to people, including how the environment mediates social relations and solicits sentiments for place. This extension of the relational UD, therefore, captures the considerable non-instrumental contributions such as attachments and meanings derived from place (Agarwala et al., 2014; Russell et al., 2013) and speaks directly to the concept of relational values (Chan et al., 2016). The relational UD includes access to institutional forms of relations. For example by distinguishing between *satisfaction with* [e.g. education (Quality of Life UD)] and *access to* [e.g. education (Relational UD)]. Notably the relational dimension subsumes many indirect services of nature (or ES), including for example pure air, soil fertility and water availability (ENV) and peacefulness on the land (CUL). Finally, this formulation considers security, social connections and empowerment as inherently relational (i.e. distinct from their original quality of life classification in the 3D framework). A full description of the well-being frameworks and the relevant definitions and groupings is offered in Figure 2, and raw data categorisation is presented in Table S2.

3.1.2 | Sub-dimensions and indicators

We adapted McKinnon et al.'s (2016) 10 domains (hereafter sub-dimensions) of HWB, and the associated indicators. We developed complementary sub-dimensions and indicators to meet the nuances of the dataset (Figure 2).

3.1.3 | Coding GPGI data

Individual responses (i.e. constituents) were coded iteratively. In each iteration the lead author categorised the constituents data,

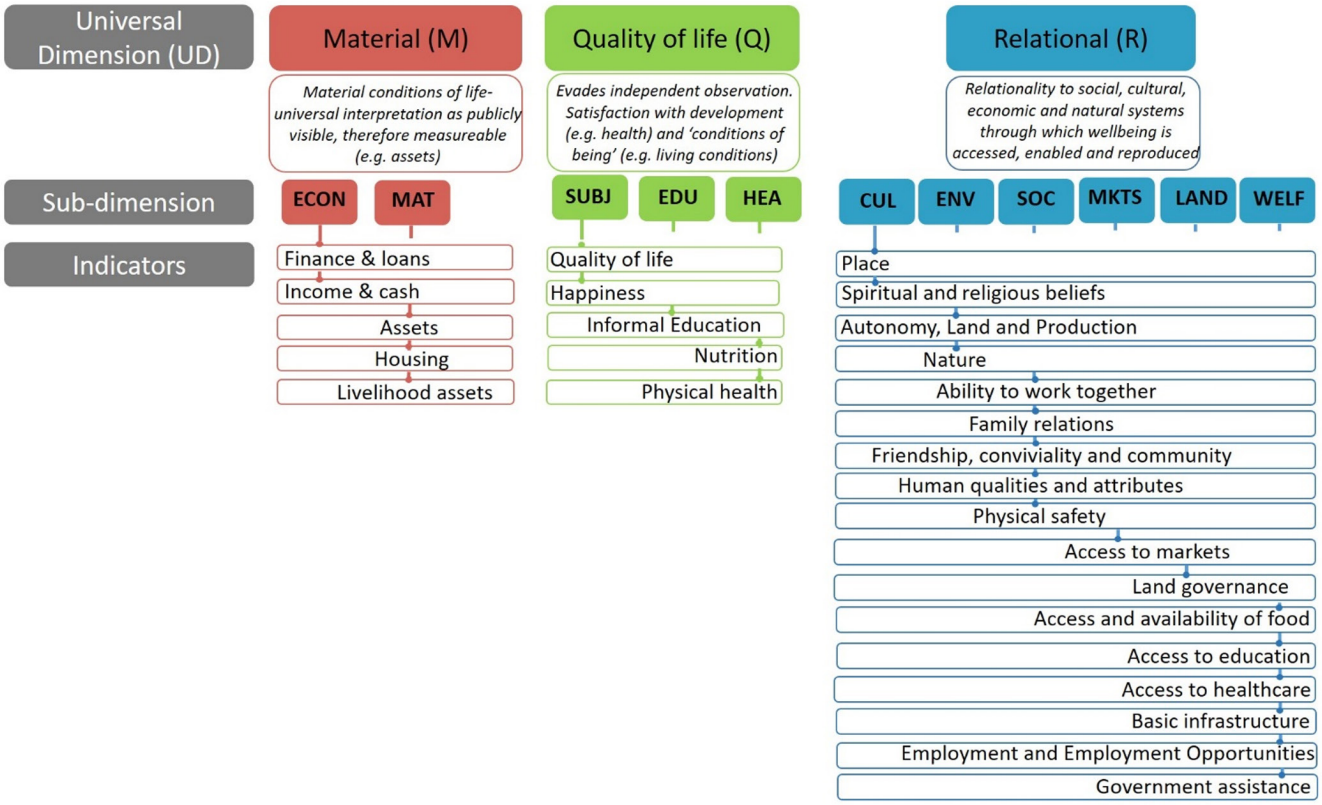

FIGURE 2 The well-being framework that fit the data. The three universal dimensions (UDs) subsume a number of sub-dimensions, as follows: Material UD includes economic (ECON) and material (MAT). The quality-of-life UD includes subjective well-being (SUBJ); education (EDU) and health (HEA). The relational UD includes culture and spirituality (CUL); ecosystem and environment (ENV); social relations (SOC); markets policy and institutions (MKTS); land policy and institutions (LAND) and work and welfare policy and institutions (WELF). In turn, sub-dimensions are composed of groups of indicators. Indicators represent themed clusters of the responses given by participants through application of the Global Person Generated Index (GPGI). A full breakdown of all individual responses (i.e. raw data/constituents) grouped in to the indicators is available in the Supplementary material, as are full definitions of sub-dimensions (Table S2).

after which deliberative workshops (n 3) with the full author group enabled reflection and categorisation was modified as needed. The process was repeated until coherence was reached.

3.2 | Data analysis

To obtain the GPGI satisfaction scores of residents, we calculated at the respondent level (*j*) the sum of each constituent's (*i*) weighted performance scaled to 100 as follows:

$$\mathrm{GPGI}_j = \sum \frac{\mathrm{Status\_Constituent}_i \times \mathrm{No.\ pebbles\_Constituent}_i}{\mathrm{Max}_{\mathrm{Status}} \times \mathrm{Total\ pebbles}} \times 100.$$

We analysed the data at two levels. First, we used all 1350 responses (i.e. including constituents with null impact on respondents HWB), and second, we analysed only impacted constituents (343 responses). We tested differences on the continuous variables 'relative importance' and 'GPGI' using the nonparametric Dunn test for unbalanced sample sizes (Dinno, 2017). Additionally, the categorical variable 'impact' was classified as positive for all responses indicating 'Improved a little' and 'Improved a lot' and negative for all responses indicating 'A lot worse' and 'A little worse'. We used R to conduct all analyses (R Development Core Team, 2020).

4 | RESULTS

4.1 | Overall human well-being satisfaction across interventions

Results indicate that overall satisfaction with HWB (i.e. GPGI value) was highest in the SOY site while the FLONA, PA and RESEX demonstrated lower, and similar, levels of satisfaction (Figure 3a). However, crucially, satisfaction scores in the SOY site were predominantly unrelated to perceived impacts of the SOY intervention. Indeed, across all interventions, null was the most commonly reported impact perceived (Figure 3b). Of the impacts that were reported, the land sharing style integrated approaches and land sparing style single-sector approaches exerted '*polarised (opposing) impact footprints*'– integrated approaches accrued more, and mostly positive impacts, and single-sector approaches accrued less impact of which impacts were mostly negative (Figure 3b).

4.2 | Importance and satisfaction across universal dimensions of human well-being

The analysis of UDs (i.e. material, subjective and relational) of HWB and importance (weighted) scores revealed relatively similar patterns across UDs. Quality of life and relational dimensions consistently made the most important contributions to HWB across all sites. This prominence was statistically significant only for the SOY site (Figure 4a). Across sites and UDs, respondents tended to report more 'very good' levels of satisfaction, and satisfaction was highest in the relational UD (Figure 4b).

4.3 | Comparative impacts of distinct interventions on locally defined human well-being

Disaggregating impacts across the well-being sub-dimensions revealed that the two integrated, land sharing style approaches had relatively similar impact footprints, particularly for the positively impacted sub-dimensions. For example, residents in both integrated sites reported positive impacts on health (HEA), work and welfare (WELF), social relations (SOC) and economic well-being (ECON). The positive impacts on welfare (WELF), SOC and ecosystem and environment (ENV) indicates that the integrated interventions have contributed to the high satisfaction scores reported in the relational UD in these sites. Furthermore, positive impacts were perceived across all three UDs and negative impacts were rare (Figure 5). In addition, of the positive impacts incurred in the integrated sites, many delivered to locally meaningful (i.e. weighted most highly in the GPGI process) sub-dimensions of HWB (Figure 6). For example, health (HEA) was prioritised locally and economic living standards (ECON) and WELF were locally prioritised in the FLONA and RESEX, respectively. Yet, neither intervention managed to deliver heavily to improving satisfaction in these sub-dimensions, indicating scope for enhancement. Improvements in SOC were perceived, although less of a local priority, indicating resources associated with these impacts could potentially be realigned and invested in more highly weighted constituents (Figure 6).

The two single-sector approaches had inverse impact footprints to the integrated interventions. They had fewer positive impacts overall, and where positive outcomes were reported they were outweighed by the negative impacts perceived in the same sub-dimension. Examples include, culture and spirituality (CUL) and SOC in the PA which did achieve some few reports of positive impacts, yet these were outweighed by reports of negative impacts. In the SOY site the few positive reports in WELF and ECON were also considerably outweighed by negative impacts perceived. Notably, each of these single-sector interventions had more negative impacts reported across UDs. The SOY site was notable for the public health (HEA) infringements perceived by many residents, while both sites had similarly distributed negative impacts reported for ENV, SOC and ECON (Figure 5).

Patterns of impact and weighted importance stood-out in the single-sector interventions (Figure 6). In these sites, negative impacts were reported across multiple sub-dimensions including those that people weighted highly such as SOC, ECON and ENV in the PA. Negative impacts in these sub-dimensions also occurred in the SOY site, although the sub-dimensions were weighted less highly. In the SOY site, health was a local priority and perceived to be deteriorating as a direct impact of the intervention (Figure 6).

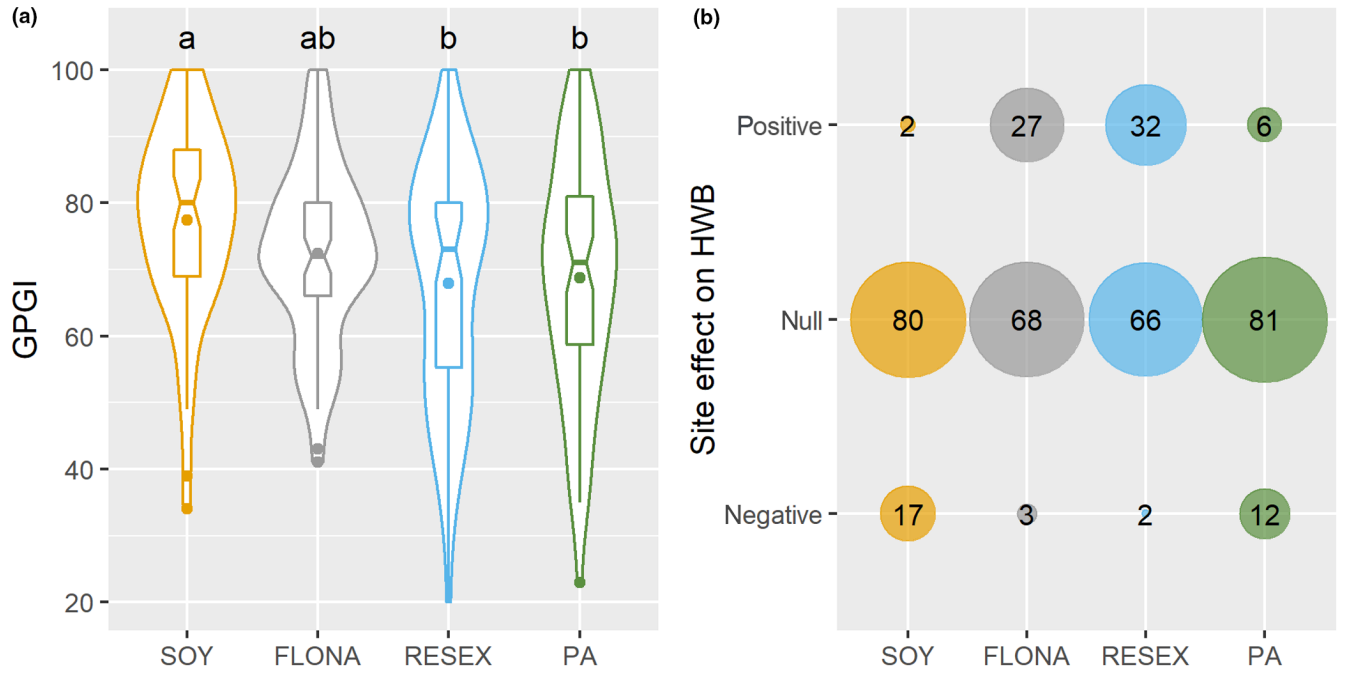

FIGURE 3 Left (a): Distribution of respondents' GPGI score in each site (land sparing: SOY and PA, and land sharing: RESEX and FLONA; see Equation 1 for calculation). Boxplot displaying upper and lower percentile, median and mean values (75th and 25th percentiles, lines and dots, respectively). When different, letters indicate statistically significant differences (at p-value < 0.05), according to Dunn's test. Right (b): Count of constituents that the intervention was perceived to have positive, negative or null effect on respondent's HWB (sample sizes – SOY: 300, FLONA: 350, RESEX: 350, PA: 350).

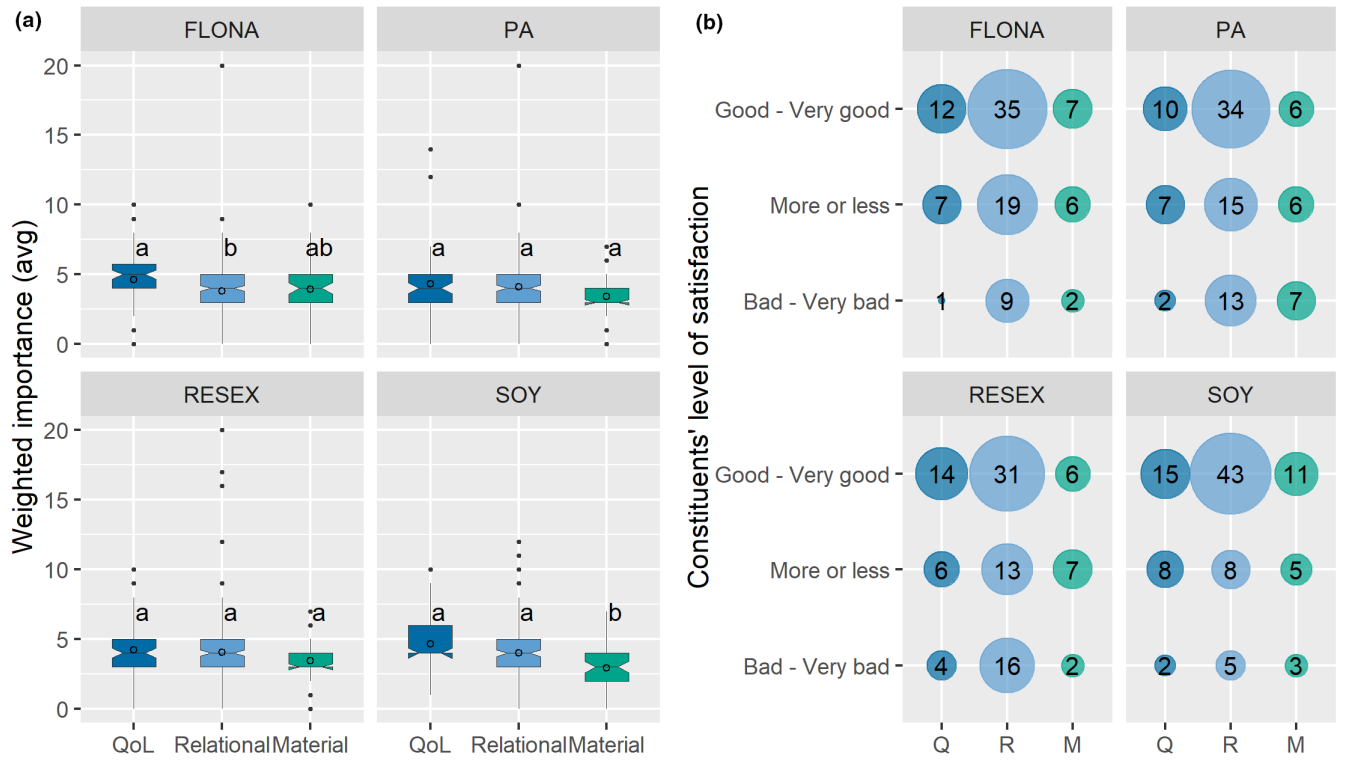

FIGURE 4 Left (a): Average weighted importance for each universal domain across land sparing (SOY and PA) and land sharing (RESEX and FLONA) sites. Right (b): Proportion (%) of responses indicating the perceived level of satisfaction for each indicator grouped by universal dimension (UD) across sites: Dark blue Q – Quality of life, light blue R – Relational and green M – Material. Sample sizes – FLONA: 350, n PA: 350, n RESEX: 350, n SOY: 300.

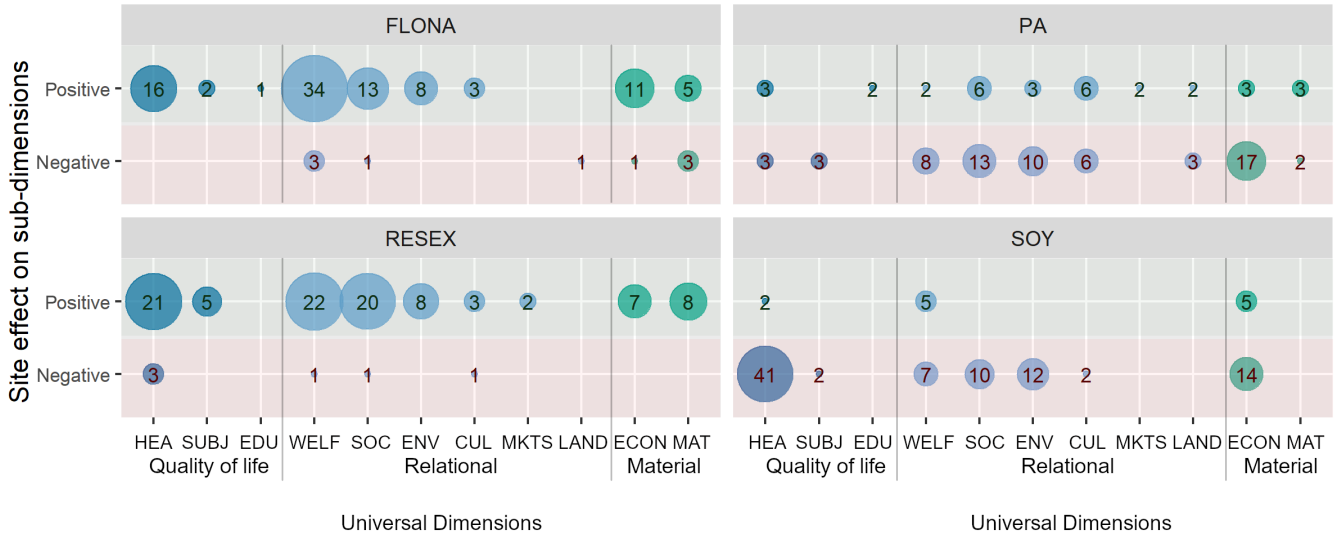

FIGURE 5 Proportion of constituents classified across sub-dimensions with a positive or negative effect according to participants perceptions across four intervention types (land sparing: SOY and PA, and land sharing: FLONA and RESEX). Sample size: n FLONA: 103, n PA: 63, n RESEX: 119, n SOY: 58. Acronyms indicate the sub-dimensions within the universal dimensions (UDs) as follows: Material UD – economic living standards (ECON); material living standards (MAT). Relational UD – relational culture and spirituality (CUL); ecosystem and environment (ENV); social relations (SOC); market policy and institutions (MKTS); land policy and institutions (LAND) and work and welfare policy and institutions (WELF). Quality of life UD – subjective well-being (SUBJ); education (EDU); health (HEA).

Interventions are failing to impact some of the most important sub-dimensions of well-being reported by respondents, and these were the same across all intervention types, accounting for 79% of the null responses in the FLONA, 70% in RESEX, 88% in PA and 63% of the null responses in SOY. Three of them were relational UDs including culture (CUL), SOC and WELF, and health (HEA) was quality of life (Figure 7).

4.4 | Perceptions of impact pathways: Focus group insights

The focus groups offered insight in to the reasons and pathways through which positive and negative impacts accrued, or null impacts resulted. Discussions highlighted that the overall more positive impacts experienced in the integrated land sharing style sites was specifically due to their more diverse bundle of activities and actions (i.e. their integrated nature). The establishment of both the RESEX and the FLONA was explicitly intended as social-environmental initiatives and case respondents perceived that the reserve status enhanced the visibility of their landscapes to local governments, which in turn, was associated with cross-sectoral bundles of actions including the establishment of services such as local health posts and schools. Furthermore, the interventions themselves are associated with partner entities that help explain the welfare impacts. Partners deliver multiple social, biodiversity, agricultural, livelihood and health related support projects. Notably among these is the well-established NGO – Health and Happiness Project (PSA), which has brought agricultural training, health services and ecotourism to these interventions' sites over a sustained period. FLONA residents had received extension supporting small-scale enterprise, which included machinery to extract fruit pulp that could then be sold at a higher market price. In integrated interventions the community representatives participate in deliberative reserve management councils, creating a co-management structure that enhances the sense of trust, autonomy, co-determination and security of rights – fundamental to elements of the SOC impacts perceived. The land sparing, single-sector approaches (i.e. of protection and agricultural intensification) do not have these packages or governance structures, and residents lamented both the limited extension services and the absence of services such as community-based health posts.

The hardships and negative impacts of the SOY and PA site were discussed at length in FGDs. In the SOY site people believed that the chemical inputs used in soy production (fertilisers and pesticides) had polluted their soils, crops and the adjacent areas and expressed considerable concern for their health. People feared that the aerial application of pesticides and the 'dust' created when the soy is harvested released carcinogens that residents are exposed to and that had generated serious health conditions and even deaths in their community. Furthermore, the SOY intervention was perceived to have burdened economic life due to the loss of land and access to the means of production. Farmers compared their socio-economic situation with that of the capitalised and mechanised farmers who now presided over land previously held by smallholders and their communities, engendering a sense of hardship and injustice. Residents in the SOY site experienced foregone access to land, dearth of job opportunities on the mechanised fields and a sense of dismay and consternation that the burdens incurred were in exchange for delivering to export markets

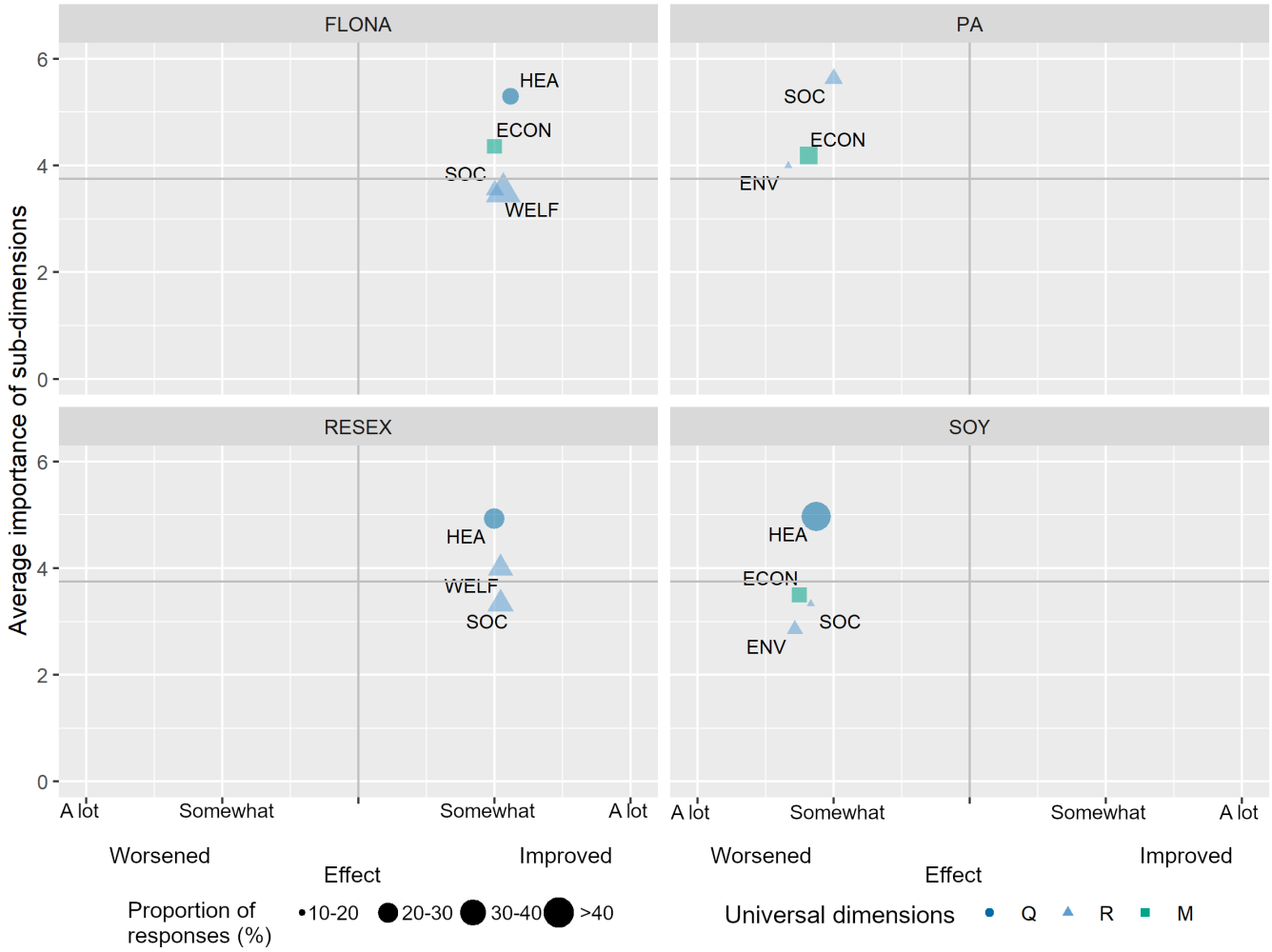

FIGURE 6 Average weighted importance of impacted sub-dimensions against the mean effect score on impacted sub-dimension. Sub-dimensions that worsened (a lot or somewhat) and that improved (a lot or somewhat) as a result of the intervention are averaged separately for land sparing (SOY and PA) and land sharing (RESEX and FLONA) sites. Sample size: n FLONA: 103, n PA: 63, n RESEX: 119, n SOY: 58. Vertical line indicates the division between positive and negative effects. Horizontal line indicates the overall mean importance value. Data are shown where >10% of responses reported the impact.

to feed pigs to be consumed in faraway lands. People expressed sorrow that the land accumulation process had dispossessed their neighbours and diminished the community not only in numbers but also in spirit and sense of belonging. The research team were shown the derelict community centre that stood isolated and disused in a sea of soy.

In the PA, people felt the reserve had created economic burdens due to the associated restrictions on access to land and livelihood opportunities. The sensation of restriction was exacerbated by the persistent strained relationship with IBAMA (Brazilian Institute for the Environment and Renewable Natural Resources) officers and their frequent checks, which created a tangible sense of constrained autonomy. SOC were perceived to be negatively impacted in part because the establishment of the reserve and influence of the land reform agency (INCRA). INCRA distributes private-owned smallholding lots, including in the area surrounding the reserve and farmers were settled into lots managed individualistically, rather than a communal model.

Notably, the FGDs highlighted the holistic reality of well-being and the difficulty of isolating its constituent parts, since well-being in one sub-dimension influences those in others. Discussion around the health benefits of the RESEX and FLONA, for example, were not limited to the health posts established in the reserves, but also related to the good condition of the forest which in turn contributed to health, vitality, medicines, autonomy and contentment. Land rights secured by reserve establishment also contributed to health, because through land access, farmers maintained the means to their own production, fresh and organic produce and access to resources, which in turn alleviated sentiments of material poverty, as people felt secure in knowing they had sufficient land and resources for living independently. The tenure security brought with it an assurance of cultural protection which was a cross-cutting benefit that people spoke about within the integrated interventions. In these sites, participants acknowledged that their forest was safe, and protected by law in the case of invasion from land or resource prospectors. However, parents were preoccupied with the conundrum that a lack of services would act as a push factor for young

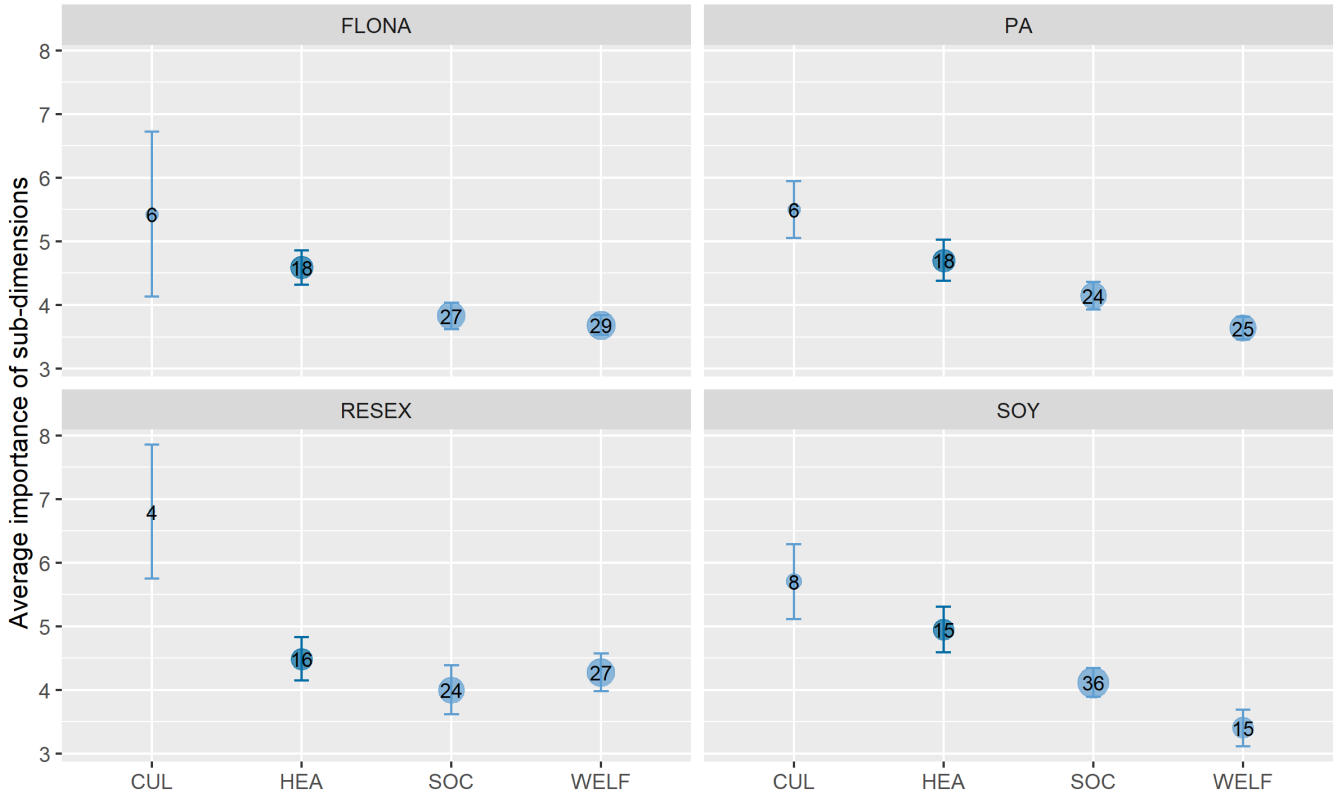

FIGURE 7 The four sub-dimensions weighted 'most important' and reported with null (i.e. no impact) impacts from the intervention, accounting for 79% of the null responses in FLONA, 70% of the null responses in RESEX, 88% of the null responses in PA and 63% of the null responses in SOY. Sample size: n FLONA: 240, n PA: 238, n RESEX: 231, n SOY: 284. Circle vertical alignment represents the mean importance, numbers inside the circles = proportion of responses and bars = standard error. Acronyms indicate the sub-dimensions within the universal dimensions (UDs) as follows: Relational UD – culture and spirituality (CUL); social relations (SOC); work and welfare (WELF). Quality of life UD – health (HEA).

people to leave to urban centres. There were also concerns over invasions, especially for illegal logging, and how to maintain governance over such extensive territories.

5 | DISCUSSION

5.1 | Conventional impact appraisal underplays the centrality of quality of life and relational dimensions to human well-being

The results challenge popular, conventional approaches to impact assessment of land use-facing interventions. These often focus disproportionately on the tangible, material aspects of lives and livelihoods, rendering the subjective and relational invisible. However, we show that relational and quality of life related components of well-being contribute equally, if not more, to locally defined understandings of HWB than their material counterparts. This finding has important implications not only how we measure the impacts of interventions but also how we design interventions to impact, and contribute, to well-being in locally meaningful ways (Biedenweg & Gross-Camp, 2018; McGregor et al., 2015). Contrary to the predominant focus of conventional impact evaluation as highlighted in recent conservation and agriculture impact reviews (McKinnon et al., 2016; Rasmussen et al., 2018), and within the ES literatures (Himes & Muraca, 2018), material aspects of well-being do not appear to have the prominence often anticipated. While progress is being made to understand and assess poverty in its multi-dimensional forms (e.g. Leisher et al., 2013; McGregor et al., 2015; Narayan, 2000; Nussbaum, 2000; OECD, 2013), including leading contemporary economists to underscore the inadequacy of material measures alone (Stiglitz, 2019), conservation and agricultural sciences remain largely embedded in Western views of progress, conceptions of poverty and aspirations of well-being (Kothari et al., 2019). The ubiquity of economic growth in conservation and agriculture policy (Otero et al., 2020), and the tendency of site-level conservation interventions to focus on income generating activities, such as conditional payments, or alternative livelihoods highlight this focus (Roe & Elliott, 2004). Our findings suggest that this concentration is at odds with what people value locally and supports calls for the conservation and agriculture development sector to critically reflect on what constitutes HWB beyond material constituents and how best to allocate intervention investments to enable rural communities to flourish (Martin, 2017).

Our findings join others in a call for expanding beyond conventional material indicators of impact and towards plural valuation

approaches which contribute to the justice, equity and environmental sustainability of interventions (Jacobs et al., 2016; Pascual et al., 2021; Zafra-Calvo et al., 2020). Due to the central role of impact metrics in prescribing intervention activities and ascribing goals (or determining desired endstates), we highlight a need to co-create impact metrics in a decolonialised approach cognizant of diverse framings of living well (Jacobs et al., 2018). Such a process gives voice to the under-represented constituents of well-being and is vital to raising the visibility, and legitimacy of otherwise invisible well-being constituents. Indeed, conservation and development is experiencing a resurgence in the interest of relational values, which has included helpful advances in distinguishing their attributes and approaching their measurement (see the contributions in this Special Feature). Beyond the environmental justice argument of giving recognition to diverse values, and the promise of plurality in biodiversity values, engaging these dimensions of well-being can also avoid perverse outcomes such as those associated with crowding-out, or interventions failing due to having misjudged what matters to people (Chapman et al., 2020; Ezzine-de-Blas et al., 2019; Schlosberg, 2009).

5.2 | Integrated land sharing approaches to conservation and development outperform single-sector land sparing interventions

The results underscore the weak performance of single sector, land sparing style approaches compared against more integrated, sharing approaches when considering place-based well-being. Integrated interventions delivered comparatively more, and comparatively better (i.e. positive and salient) contributions to locally relevant HWB than the single sector, land sparing style approaches. Positive contributions to the environment, health, welfare, SOC and economic incomes were all highly valued locally and positively impacted in integrated sites. The importance of the social fabric and solidarity networks of Amazonian communities to well-being has been witnessed in the recent COVID-19 pandemic and has contributed to community resilience to COVID (Castro et al., 2020; Silva et al., 2020). Conversely, the SOY and the PA sites were dominated by negative impacts, including on locally valued well-being sub-dimensions such as health, SOC – particularly a splintered sense of community belonging and damaged environment. The land sparing idea demonstrates considerable weaknesses related to the narrative that higher yields return food and income – a pattern not evidenced in our analysis. Notably, ECON, often a central goal of such single sectoral efforts, and an argument commonly used to earn public support for the arrival of transnational international soy companies, was negatively impacted. Although some intensification of smallholder agriculture may be a useful model for material livelihoods, evidence suggests that many forms of land sparing through intensification do not generate win-wins (Dawson et al., 2016; Rasmussen et al., 2018). Single-sector intervention types appear to incur unreasonable and unjust trade-offs between people, nature and the quest for development, and raise questions around ethics, justice and cost-effectiveness (Riechers et al., 2020; Schleicher et al., 2019; Schleicher, Schaafsma, Burgess, et al., 2018). Furthermore, while a strong lobby of influential conservation and agriculture scientists argue for land sparing, our analysis adds to the evidence suggesting such single-sector style approaches do not perform for HWB. The feasibility of land sparing contributing to nature protection in practice is uncertain and depends on additional measures (Phalan et al., 2016), and the environmental externalities generated compared with traditional low-input agriculture are intensely debated (Balmford et al., 2018; Kremen & Merenlender, 2018; Padoch & Pinedo-Vasquez, 2010; Perfecto et al., 2019).

Previous studies have shown the important contribution of sustainable use reserves and indigenous lands to carbon sequestration, forest protection and fire reduction (Nepstad et al., 2006; Soares-Filho et al., 2010; Walker et al., 2014), while we also know that small-holder agriculture is an important source of local and regional food security and biocultural diversity in Amazonia and beyond (Ricciardi et al., 2021). Critiques of the land sharing vs sparing debate have made the case that extending the discussion to encompass well-being could ameliorate the stale-mate (Bennett, 2017). Combining our results with this broader literature suggests that integrating across environment and agriculture development in locally contextualised forms can achieve improved well-being synergies for local residents. However, our results highlighted the relatively scarcity of very noticeable impacts (i.e. few 'improved a lot' responses).

5.3 | Dominance of null

Null was the most prevalent impact reported on HWB and this was true across interventions, further null impacts were concentrated in the most highly weighted constituents of well-being, three of which were relational UDs. A number of explanations exist and include the vast territorial extents of the intervention sites, within which intervention agent inputs are not uniform, and could be perceived as weak, and the possibility that interventions incur well-being impacts in indirect, and therefore non-perceived ways. This context likely results in the stronger influence of the broader political economic context in which all interventions are embedded. This highlights the possibility that interventions are fairly insignificant amid a swathe of more powerful political economic drivers and structural factors, that may act in favour of conservation and agriculture development, or be held in tension. For example, since 2003, most families also came to benefit from federal-level income distribution programs, such as Programa Bolsa Familia, which offers conditional cash payments to female heads of households, whereas others gained access to rural retirement pensions through farmers union movements that provided a greater level of income earning stability and autonomy. Importantly, the dominance of null responses, points to the potential weakness of site level interventions when operating in

contexts where powerful political economic influences come to bear (Balmford et al., 2021). Furthermore, the dominance of these political economic forces emphasises the need for transformative governance that can better deliver across the biodiversity-climate-society nexus (Pascual et al., 2022).

5.4 | Collaborative cross-sectoral partnerships to improve future efforts

Analysis of the most salient (i.e. heavily weighted) yet not-impacted well-being sub-dimensions highlighted that to increase local relevance and contribute meaningfully to HWB; interventions must focus on strengthening and empowering cultural practices and the sense of place embedded in communities (CUL). Residents highly valued the peace, security, autonomy and contentment of living in a calm and tranquil place, within a community away from town with access to autonomous production, as well as the centrality of conviviality and SOC enabled through their embeddedness in place. Most respondents did not see development as a binary option between the persistence or loss of their forests and the relational, subjective and material richness. In fact respondents suggested that keeping forests intact would benefit production, livelihoods and non-material well-being. Such types of relational contributions of place to well-being might be nurtured through right-based conservation and development interventions that deliver to enhancements in these sub-dimensions. Health was an additional locally prioritised well-being sub-dimension not always impacted, and even negatively impacted (in the case of SOY) across the interventions. Focus groups indicated that residents were largely happy and proud of their livelihoods, food production and cultural identities but resolutely lamented the health provisioning, schooling options and clean water available to them. A significant conundrum faces rural residents, community leaders and members emphasised their predicament of how to make territories such as the RESEX and FLONA more attractive to all residents, including their youth. These findings resonate with the migration literature that shows that people migrate out of rural areas to better access services so far only available in urban areas. This evidence suggests a need for the conservation and development sector to reflect on the complexity of local lives and livelihoods and co-create grounded theories of change that engage local realities through diverse partnerships with local stakeholders (Almeida, 2004). Thus, reorienting environment-facing interventions to closer collaboration with the sectors that can deliver these welfare rights seems important, and resonates with momentum in some conservation efforts that are adopting these cross-sectoral engagement approaches with promising results to both people and nature (Qiu et al., 2018). SOC too were weighted highly and yet often not impacted by interventions, suggesting that the learning from participatory, bottom-up and right-based approaches could offer pathways to foster, strengthen and empower the social fabric of rural smallholder communities (Martin, 2017).

5.5 | Future steps and ways forward: Expanding impact metrics

The data collected in this study is laden with examples of where the environment contributes directly, or indirectly in manifold ways to well-being and attests to the need for a deeper recognition of the environment in HWB (Schleicher, Schaafsma, Burgess, et al., 2018). Although the ES framework is not applied here, evidence of the categories of services it articulates (i.e. regulating, provisioning, cultural and supporting) are evident across the indicators. We develop the concept of relational values in specific reference to their contribution to HWB, drawing links between the 3D well-being framework, and contemporary research on relational values (Chan et al., 2016; McGregor et al., 2015). We identify scope for the HWB,conservation and agriculture communities to integrate their complimentary understandings of the social–social element of relational values on one hand and how these are themselves imbued with and facilitated by emersion in place and people–environment relations. Future research efforts could build on this contribution to adapt existing HWB frameworks to capture, value and recognise this interplay and for these to be brought in to expand conventional impact metrics. The local salience of relational dimensions is at odds with their invisibility which obscures our understanding of the full impact of interventions. Furthermore, the health impacts of conservation and environment-facing interventions remains understudied (McKinnon et al., 2016), yet we find health is central across sites.

We need better knowledge of the role of intangible flows from nature to people and their contribution to HWB to inform alternative developments and ensure just conservation and agriculture development. Furthermore, the legitimacy of such values is in crucial need of strengthening and countering the hegemony of material and growth related indicators that are routinely deemed synonymous with positive impact.

AUTHORS' CONTRIBUTIONS

R.C.: conceptualisation, data interpretation, methodology, formal analysis, investigation, data curation, supervision, project administration; writing – original draft and review; A.S.: conceptualisation, data interpretation, methodology, investigation, supervision, writing – review and editing; A.A.: data curation, data interpretation, methodology, investigation, writing – review and editing; R.C.: data curation, data interpretation, methodology, investigation, writing – review and editing; B.V.: conceptualisation, data interpretation, methodology, supervision, funding acquisition; N.E.C.: conceptualisation, data interpretation, formal analysis, data curation, writing – review and editing, visualisation.

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CONFLICT OF INTEREST

No conflict of interest.

DATA AVAILABILITY STATEMENT

The data for the anlaysis in this paper are available in the Harvard Dataverse repository under the following citation: Carmenta, Rachel; Steward, Angela; Albuquerque, Adrielly; Carneiro, Renan; Vira, Bhaskar; Estrada Carmona, Natalia, 2022, 'The comparative performance of land sharing, land sparing type interventions on place-based human well-being', https://doi.org/10.7910/DVN/YAKQ98, Harvard Dataverse, V1.

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