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A framework linking ecosystem services and human well-being: Saltmarsh as a case study

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Abstract

1. The ecosystem services approach is based on the interdependencies between nature and human well-being. However, while the ecosystem services aspect of this approach is well-developed, the human well-being aspect remains unstructured and vaguely defined.
2. An integrated conceptual framework was developed by adapting and linking the UK National Ecosystem Assessment-Follow On framework with human well-being domains.
3. As well as benefits, the notion of disbenefits was incorporated to recognise the potentially detrimental effects from interacting with nature. Benefits and disbenefits occur at the social–ecological interface and are classified by the seven domains of human well-being they affect.
4. The framework is applied to saltmarsh habitat as a case study, highlighting knowledge gaps and the potential applicability and usefulness of the framework. In saltmarsh, benefits mainly accrue at larger scales with a greater impact affecting local to global individuals, while disbenefits tend to occur at a smaller scale and impact in-situ individuals.
5. The framework provides in-depth insight into links, trade-offs and dichotomies between benefits and disbenefits and human well-being, and improves accessibility to the complex research area of human well-being.
6. This research can be a useful tool to guide environmental and health policy and management, as well as stakeholder engagement.

KEYWORDS
benefits, disbenefits, ecosystem services, health, saltmarsh, Wales, well-being

1 | INTRODUCTION

The ecosystem services approach refers to the interdependencies between nature and human well-being (Schleyer, Lux, Mehring, & Görg, 2017; Steger et al., 2018). A wealth of research has addressed the challenge of applying the ecosystem services approach empirically (e.g. Burkhard, Petrosillo, & Costanza, 2010; Fisher, Turner, & Morling, 2009) and several definitions and classifications have been developed (e.g. Beaumont et al., 2007; Fisher et al., 2009; de Groot, Alkemade, Braat, Hein, & Willemen, 2010). Whereas the ecosystem services aspect of these classifications is well-developed, the human well-being aspect is still vague. There is a need to clarify and operationalise the links between nature and human well-being, to facilitate embedding of human well-being in policy and decision-making worldwide (e.g. UK What Works Centre for Wellbeing; Global Happiness Council; World Happiness Report—Helliwell, Layard, & Sachs, 2016).

Human well-being is a multi-dimensional concept, with various interpretations and no universally accepted definition (Dodge, Daly, Huyton, & Sanders, 2012), which in part explains the challenges in linking it to ecosystem services. Human well-being refers to positive physical, social and mental conditions, not just the absence of negative circumstances such as disease (Summers, Smith, Case, & Linthurst, 2012; WHO, 1948). Human well-being includes both objective dimensions such as level of wealth (economic) and air quality (environmental), and subjective dimensions such as self-reported life satisfaction (OECD, 2011). Two main approaches of objective well-being have been documented that derive from the field of economics. The first is the Basic Needs approach, developed by Max-Neef (1991), which attempts to classify the minimum needs, health and autonomy, that must be satisfied for long-term well-being (e.g. Reinert,2015). The second is the Capabilities approach developed by Sen (1993), which recognises the importance of a person's ability to do the things they want to do (capabilities), as well as achieving those things (functionings) (e.g. White, Imperiale, & Perera, 2016). There are also two general approaches to subjective well-being derived from the field of psychology: one that focuses on positive feeling, pleasure or hedonia and one focusing on positive functioning, personal fulfilment or eudaimonia (Longo, Coyne, & Joseph, 2017). Alongside these approaches, many indices and classifications of well-being have been developed, such as The Human Development Index (UNDP, 1990), Well-being of Nations (Prescott-Allen, 2001), Gross National Happiness (Ura, Alkire, Zangmo & Wangdi, 2012) and Scales of General Well-being (Longo et al., 2017). Despite these advances, human well-being remains an elusive or abstract term for some, it is not currently traded as a market commodity (Batavia & Nelson, 2017; Garcia Rodrigues et al., 2017) and quantifying it accurately remains a challenge (Breslow et al., 2016; Fish, Church, & Winter, 2016).

The Millennium Ecosystem Assessment explicitly linked nature to human well-being through the definition of a set of ecosystem services (MA, 2005) and is one of the key drivers for the upsurge in its research and integration into policy. The most widely used ecosystem services frameworks globally include the United Kingdom's National Ecosystem Assessment Follow-On (UKNEA, 2014), The Economics of Ecosystems and Biodiversity (TEEB, 2010), the Common International Classification of Ecosystem Services of the European Environment Agency (CICES; Haines-Young & Potschin, 2018) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES; Diaz et al., 2015). Of these, only the UK National Ecosystem Assessment Follow-On framework attempts to provide a link, the additional category of 'benefits', between ecosystem services and specific constituents of human well-being. The importance of distinguishing between services (means) and benefits (ends) is now widely accepted (Boyd & Banzhaf, 2007), with benefits defined as the actual contributions made to human well-being (Fisher et al., 2009). *Benefits* ('good things') and *disbenefits* ('bad things'; often referred to as 'disservices') derive from ecosystems which different people value positively or negatively (Ostfeld & Keesing, 2017; UKNEA, 2011). It is the benefits and disbenefits that provide a direct link between ecosystem services and human well-being.

Benefits and disbenefits are a product of the interaction between nature and the other capital inputs to generate positive or negative human well-being (Fish et al., 2016; UKNEA-FO, 2014). The five capitals are: (a) natural, that is, elements of nature that directly or indirectly produce value to people, such as ecosystems and natural processes (UK Natural Capital Committee,); (b) social, for example, trust, cooperation; (c) human, for example, knowledge, skills; (d) built, for example, infrastructure, equipment; and (e) financial, for example, monetary currency (Fish et al., 2016; Maack & Davidsdotirr, 2015). For example, currency expenditure is often needed to visit natural places and carry out outdoor recreation activities.

Despite the addition of the 'benefits' category and the presence of human well-being in some ecosystem services frameworks and classifications, the majority of the emphasis has been placed on the ecological functions and ecosystem services. There are five key reasons why human well-being remains poorly understood in the context of the ecosystem services approach: (a) there are complex frameworks that do not mention human well-being (e.g. The Common International Classification of Ecosystem Services CICES; Haines-Young & Potschin, 2018); (b) human well-being is included implicitly in frameworks, but without breaking it down into its different components (e.g. Haines-Young & Potschin, 2010; UKNEA, 2011; Vaz et al., 2017); (c) the classification of benefits and disbenefits has been disparate and varied with poor recognition of their role linking ecosystem services and human well-being (e.g. Fisher et al., 2013; Maynard, James, & Davidson, 2010); (d) frameworks have not been applied in practice to test their feasibility (e.g. Leviston, Walker, Green, & Price, 2018; Polishchuk & Rauschmayer, 2012); and (e) the human well-being concept and its linkages with ecosystem services remain broad (e.g. Diaz et al., 2015; Leviston et al., 2018; MA, 2005). Elucidating these linkages has become urgent as policy is increasingly emphasising nature's role in human well-being, for example,

The UN Sustainable Development Goals, The Well-being of Future Generations (Wales) Act 2015.

This paper has two main objectives: (a) to provide an extended framework that links ecosystem services and human well-being; and (b) to operationalise the framework by conceptually applying it to saltmarsh habitat. Saltmarsh was selected as it is one of the most productive, albeit threatened (Kirwan, Temmerman, Skeehan, Guntenspergen, & Fagherazzi, 2016) and declining global habitats (Silliman, 2014) providing valuable, yet little understood, ecosystem services to humans. The proposed framework addresses the five above mentioned reasons for why human well-being remains poorly understood in the context of ecosystem services.

The framework development was based on an initial review of the literature on human well-being and ecosystem services, which informed the selection of the two base frameworks. The potential ecosystem services, benefits and disbenefits of saltmarsh (in supporting information) were mainly based on the UKNEA (2011) and McKinley, Ballinger, and Beaumont (2018), and updated with further literature searches. Figure 3 on parties, spatial scale and impact was developed during the application of the framework to saltmarsh based on the literature and project team expertise. Several draft versions of the proposed framework, and successively of Figure 3, were improved and verified through the invited opinions of the interdisciplinary team of experts (the RESILCOAST and CoastWEB project teams). These views were sought within project meetings and through extensive virtual communications, and included coastal and experimental ecologists, environmental modellers, geomorphologists, social and environmental psychologists, environmental economists, and governance experts (see authorship).

The extended framework is described in Section 1.1. Section 1.2 explains the selection of the saltmarsh case study and operationalises the framework. The supporting information summarises the ecosystem services, benefits, disbenefits and links to human well-being from saltmarsh. Section 2 discusses the framework's implications for policy and practice, as well as its limitations; and Section 3 provides conclusions.

1.1 | A framework linking ecosystem services and human well-being

To conceptualise our understanding of the links between nature and human well-being we propose a framework that builds on the UK National Ecosystem Assessment-Follow On framework by (a) accounting for the concept of disbenefits in addition to benefits, (b) linking the classification of benefits and disbenefits to their effect on seven human well-being domains from the adapted Smith, Case, Smith, Harwell, and Summers (2013) framework, and (c) detailing these domains (Figure 1).

Ecosystem services are the 'means' (MA, 2005), underpinning the benefits (Chan Kai, Satterfield & Goldstein, 2012). Benefits are

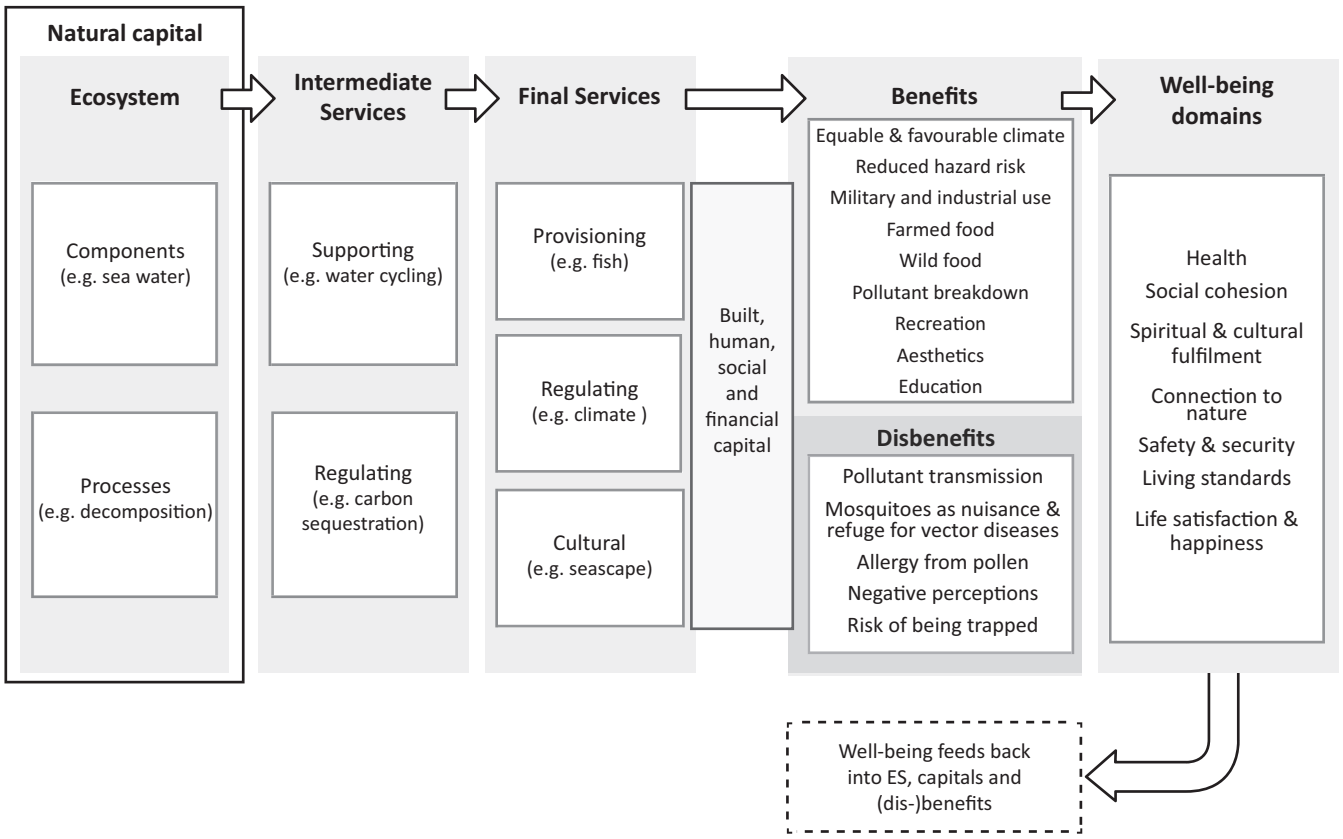

FIGURE 1 Proposed conceptual framework linking ecosystem services and human well-being, building on the UK National Ecosystem Assessment-Follow On and Smith et al. (2013) well-being domains framework

TABLE 1 Measurable objective and subjective examples for each of the seven human well-being domains (adapted from Smith et al., [2013]; and informed by Longo et al., [2017], Dolan & White, [2007], Leisher, Samberg, Buekering, & Sanjayan, [2013])

	Human well-being domains						
	Health	**Social cohesion**	**Spiritual and cultural fulfilment**	**Connection to nature**	**Safety and security**	**Living standards**	**Life satisfaction and happiness**
Examples of each domain	Exercise levels (physical health)	Volunteering rates (pro-social behaviour)	Language use (cultural identity)	connectedness to nature	Crime rates (personal physical security)	Income level	Flexible work options (work-life balance)
	Clinical depression (mental/psychological health)	Participation in social network	Artefacts used in rituals (heritage values)	Positive feelings towards a place (sense of place)	Military threats (national physical security)	Public and household infrastructure	Leisure time
	Child behaviour development	Trust in other people	Attendance at spiritual services	Visits to zoos	Having an emergency fund (financial security)	Energy sources and availability	Clear life goals (sense of purpose)
	Access to clean water and air	Membership in groups (sense of community)	Visits to historical sites	Time spent in nature	Perceived safety in neighbourhood	Parental and elder care access	Loneliness levels
	Intelligence quotient (cognitive abilities)	Divorce rates	Variety of ethnicities (cultural diversity)	Investment in nature access	Accident-related injuries	Household assets	Feelings of inferiority (self-esteem)
	Life expectancy	Migration patterns	Investment in houses of worship or museums	Biomimicry designs (inspiration from nature)	Houses in flooding area (exposure to risks)	Employment distribution across industries (economic diversity)	Self-reported happiness

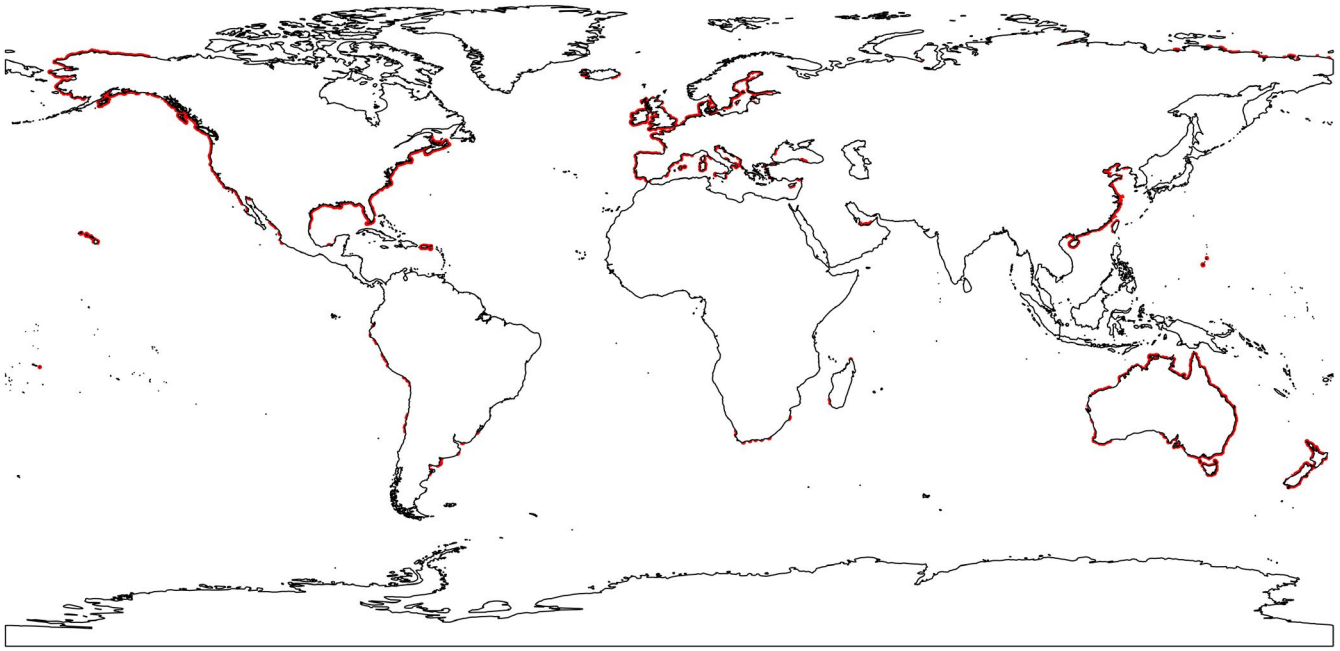

FIGURE 2 Global distribution of saltmarsh habitat (Data source: Mcowen et al., 2017)

thus the 'ends' (MA, 2005), derived from ecosystems, which different people value positively or negatively (Ostfeld & Keesing, 2017; UKNEA, 2011) as the actual contributions made to human well-being (Fisher et al., 2009). We include disbenefits in the framework in order to link nature to human well-being objectively, recognising the potentially detrimental effects from interacting with nature. Compared to the growing surge of publications on ecosystem services, disbenefits have scarcely garnered attention despite their potential to undermine human well-being (Lyytimäki, 2015; Shackleton et al., 2016). Disbenefits are perceived or actual unpleasant, unwanted or economically damaging effects that humans may experience from nature (Lyytimäki, 2014; Ostfeld & Keesing, 2017), for example, risk of drowning, mosquito bites. Humans can perceive or experience a disbenefit from actively or passively interacting with nature. Like benefits, disbenefits can vary in intensity and scale, and they can ensue differently to individuals or communities (Agbenyega, Burgess, Cook, & Morris, 2009; Shackleton et al., 2016) depending on factors such as acquired knowledge, personal values and agenda, and the overall political, economic and social settings at different scales and times (Busch, Gee, Burkhard, Lange, & Stelljes, 2011; Shackleton et al., 2016). For instance, one person's aesthetically pleasing, biodiverse saltmarsh is another person's source of allergies, mud and bleak views. Often disbenefits are a downside of a benefit (Shackleton et al., 2016), for example an ecosystem can breakdown pollutants but also transmit these pollutants up the food chain.

Disbenefits have no universal typology and have been classified based on their origin (Lyytimäki & Sipila, 2009), their consequences (Shackleton et al., 2016), the human well-being dimensions impacted (Vaz et al., 2017) and other broader reasons (Lyytimäki, 2014). However, the above classifications do not allow for an explicit comparison to benefits. Further, benefits have generally been classified in line with the ecosystem services classification, which only takes account of the ecological aspects and is inappropriate for the disbenefits. Benefits and disbenefits occur at the social–ecological interface (i.e. with the input of other capitals), so they should be classified based on their effect on human well-being (von Döhren & Haase, 2015). This distinction between ecosystem services and disbenefit and benefit classifications is important as a key step towards elucidating links between nature and human well-being.

We further extend the framework through the employment of an adapted version of Smith et al.'s (2013) comprehensive human well-being domains (Table 1). The Smith et al. (2013) human well-being domains were selected because they: (a) had a holistic view of human well-being including subjective, economic and environmental elements alongside basic human needs; (b) allows for the effect of changes in (objective and subjective) human well-being as a result of changes in ecosystem services; (c) included physical health as a domain (often absent in other human well-being frameworks, e.g. Longo et al., 2017); and (d) it is based on an extensive review of 157 published human well-being indices. The Smith et al. human well-being domains were shortlisted to seven domains by excluding leisure time and education, as these two are already accounted for in our framework as benefits.

1.2 | Operationalising the framework: saltmarsh as a case study

The framework is tested on saltmarsh habitat with the aim of strengthening the definitions and framework, ensuring that it is fit for purpose and applicable, and also to improve understanding of the nature–human well-being linkages in this habitat. Saltmarshes are

TABLE 2 Summary of the benefits and disbenefits of saltmarsh and the human well-being domains they affect

Benefits	Disbenefits	Wellbeing domain
• Equable and favourable climate • Reduced hazard risk • Farmed food • Wild food • Recreation • Aesthetics • Education • Pollutant breakdown	• Pollutant transmission • Mosquitoes as nuisance & refuge for vector diseases • Allergy from pollen	Health
• Wild food • Recreation		Social cohesion
• Wild food • Recreation • Aesthetics		Spiritual and cultural fulfilment
• Wild food • Recreation • Aesthetics • Education	• Mosquitoes as nuisance & refuge for vector diseases • Allergy from pollen • Negative perceptions	Connection to nature
• Equable and favourable climate • Reduced hazard risk • Military and industrial use	• (Risk of being trapped)	Safety and security
• Reduced hazard risk • Military and industrial use • Farmed food • Wild food • Recreation • Education	• Mosquitoes as nuisance & refuge for vector diseases	Living standards
• Reduced hazard risk • Recreation • Aesthetics	• Mosquitoes as nuisance & refuge for vector diseases • Allergy from pollen	Life satisfaction and happiness

areas vegetated by herbs, grasses or low shrubs (Adam, 1990), typically located at the boundary between land and sea and dominated by tidal hydrodynamic forces. They are key habitats for estuarine biodiversity, with high primary production, supporting many species and providing space for shelter, feeding, mating, nurseries, reproduction and migration (Caçador, Caetano, Duarte, & Vale, 2009; Vinagre, Cabral, & Caçador, 2008).

Saltmarshes are a global habitat that flourishes particularly in temperate regions (Figure 2) (Silliman, 2014). Mcowen et al. (2017) report almost 351,000 saltmarshes globally across 99 countries for a total of approximately 5.5 million ha. Although in the past these habitats were seen as wastelands, they are now widely recognised as among the most productive ecosystems on earth (Silliman, 2014) and provide a range of valuable ecosystem services. Ecosystem services include nursery habitats for fisheries species (Kneib, 1997), sequestering 'blue carbon' (Himes-Cornell, Pendleton, & Atiyah, 2018) and acting as effective natural coast flood protection (Möller et al., 2014). Thus, these habitats are an essential part of countries' economy and culture.

Despite the valuable services provided by saltmarshes, they are highly threatened by human disturbances, including: eutrophication, land use change, pollutants including oil spills, altered hydrologic/sedimentologic patterns, invasive species, and climate change effects, including sea-level rise and extreme weather events (Gedan, Silliman, & Bertness, 2009; Kirwan et al., 2016; Silliman, 2014). Saltmarsh has been found to be declining around the world, having lost between 25% and 50% of their global historical coverage (Crooks, Herr, Tamelander, Laffoley, & Vandever, 2011; Duarte, Dennison, Orth, & Carruthers, 2008). Given their position on the land-sea interface, their provision of diverse ecosystem services at different scales, and unclearly defined links to human well-being, saltmarshes are thus an ideal habitat to operationalise this framework. There is also a tangible need for information on the broader human well-being implications of these threatened habitats to enable their effective and sustainable management.

It is recognised that the links between ecosystem services and human well-being can be complex, are often subtle, and frequently understudied; so this study has focused on the main direct links. The benefits and disbenefits from saltmarsh, and their links to human well-being, are detailed in the supporting information and summarised in Table 2. None of the benefits or disbenefits affected all human well-being domains. The most prominent human well-being domains, that is, those with most linkages, were *health* (11), *connection to nature* (7) and *living standards* (7). The human well-being domains with fewer linkages, in part due to unavailable data and

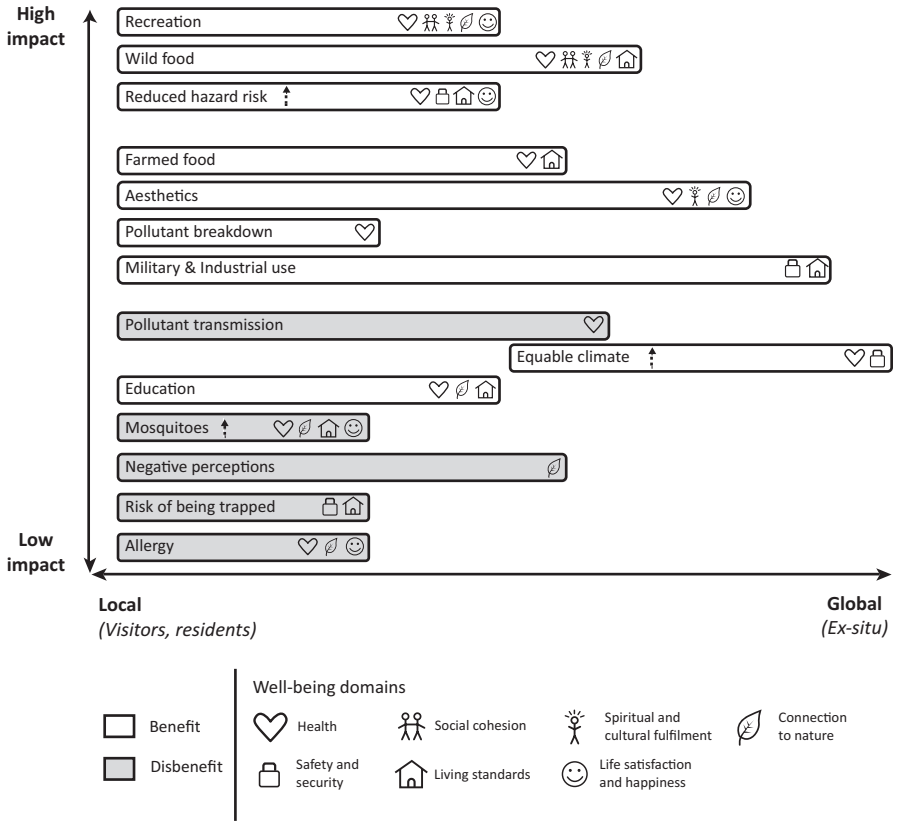

FIGURE 3 Generic diagram of benefits and disbenefits and human well-being of saltmarsh by party, spatial scale, impact on well-being; dotted upward arrow = future potential temporal change

difficulties valuing and quantifying these nonmaterial or subjective domains (Summers et al., 2012; Villamagna & Giesecke, 2014) were *social cohesion* (2) and *spiritual and cultural fulfilment* (3). The human well-being domains with most linkages to benefits were *health* (8) and l*iving standards* (6). Linkages between disbenefits and human well-being were few, influenced by a historically, greater literature focus on benefits compared to disbenefits (Ninan & Inoue, 2013; Sandbrook & Burgess, 2015). This study evidences that grey literature and informal sources need to be considered to obtain evidence for understudied (dis-) benefits from ecosystem services and their links to human well-being.

There is more information and understanding available for some saltmarsh benefits over others, highlighting knowledge gaps in the literature. Areas for future research in saltmarsh benefits include: the quantification of wild and farmed food, saltmarsh-specific aesthetic benefits, the role in (in-) formal education, the contribution to military and industry, and the other four understudied benefits (see supporting information). Further study of these benefits would also help fill gaps in understanding the contribution of saltmarsh to *life satisfaction and happiness*, *social cohesio*n, and *cultural and spiritual fulfilment*.

There is even less information and understanding available for disbenefits, which highlights it as an overall area for future research. Particularly, further investigation is needed to understand the links, if any, between disbenefits and human well-being, particularly on *social cohesion* and *spiritual and cultural fulfilment*, for which no links were identified.

1.3 | Scale, impact and relevant parties

It is important to note that not all benefits and disbenefits accrue homogeneously to all parties, that is, with the same impact on human well-being (positive for benefits or negative for disbenefits) and in the same spatial scale. They are heterogeneous in space and evolve through time (Fisher et al., 2009; Luisetti et al., 2011), and as a result the accompanying human well-being effects will also vary. Thus, Figure 3 was developed as a generic, unidimensional characterisation of saltmarsh (dis-) benefits and human well-being by three key parties, spatial scale and impact on well-being.

Figure 3 is not aimed at representing a specific saltmarsh but to exemplify the importance and potential variability of scale and impact of (dis-) benefits on different parties. We recognise that a location-specific application will be context-dependent involving a complex three dimensional view of (dis-) benefits and well-being. Nevertheless, this diagram evidences some important findings, such as farmed foods can be a benefit to residents, visitors and further afield up to the national level with a mid-range impact. While, equable and favourable climate is an ex-situ benefit at the regional to global level with low impact. Figure 3 also provides examples of potential temporal shifts due to climate change or management efforts. For instance, the transmission of diseases via mosquitoes has rarely been reported in the UK but studies expect this to change with increased marsh creation to mitigate climate change (Medlock & Vaux, 2015).

Notably, most disbenefits accrue at the local scale with a low impact on residents or visitors actually on or near a saltmarsh. These

mainly local disbenefits are most often linked to the human well-being domains of *connection to nature* and *health*. Contrastingly, benefits have a wider scale and impact and can be perceived locally up to global scale. Benefits are most often linked to the domains of *health* and *living standards*, but large scale benefits are often linked to *safety and security*. However, the (dis-)benefits and human well-being domains include several differing sub-categories. For instance, wild food can refer to local resident groups foraging for Samphire, but also to commercial fisheries that are sold locally and ex-situ. In this example, wild food foraging is linked to *social cohesion* with a low impact and commercial fisheries are linked to *living standards* with a high impact. These findings have implications for the management of saltmarsh as very different policy decisions will be made if only the local scale is taken into consideration, or if only the national to global scale is considered.

2 | DISCUSSION

The implementation of the framework provides a promising pathway for future research and raises a number of novel considerations and implications for policy and management.

2.1 | Improving the nature and human well-being linkages: Implications for policy and management

Whilst policy documents are increasingly taking human well-being into account, linking it to nature is still in its infancy (Science for Environment and Policy 2018). Understanding the biophysical, social, economic and political settings where disbenefits can be effectively mitigated, and benefits increased through ecosystem management is shown here to be crucial for enhancing human well-being. Through the explicit and structured clarification of the linkages between ecosystem services and human well-being, our proposed framework provides an improved understanding of the potential implications of ecosystem changes. This framework thus provides a means to incorporate the voice of other sectors, particularly health and social services, directly into environmental management to provide more holistic and informed decision-making considering the impacts on human well-being.

The framework also improves accessibility to the complex research area of human well-being. The many definitions and classifications which are attributable to human well-being can be a barrier to its inclusion in policy and management. Arguably, this challenge has been insufficiently considered to date and there is a clear gap in our understanding (Ninan & Inoue, 2013; Shackleton et al., 2016). The proposed framework is helpful for researchers to identify interdependencies between services and (dis-) benefits, and identify trade-offs with specific impact on human well-being at different scales and for different parties. Without consideration of the full suite of human well-being domains, policy and management risk overlooking a wide range of human well-being implications, potentially leading to inefficient trade-offs.

In the context of saltmarsh (and other coastal habitats), this framework could serve as a useful tool to guide policy and management decisions in practice. This is particularly pertinent in the light of recent policy aspirations, whereby human well-being appears to be rising-up the political agenda in certain countries. For instance, Wales (UK) is the first country to introduce legislation that places a statutory duty on all public bodies to align with nationally specified human well-being goals (*Wellbeing of Future Generations (Wales) Act 2015*). The conceptual framework developed through this research could support initiatives as described above, and its reach extends beyond the UK setting. At the international scale, the UN Sustainable Development Goals explicitly recognise the need for equitable access to health and human well-being in the pursuit of sustainable futures (UN, 2015). This arguably requires the inclusion and integration of human well-being within the management of social-ecological systems, to which this framework provides a valuable stepping stone. It also has potential to provide a valuable contribution to global saltmarsh management, for example, by informing the RAMSAR Convention.

More specifically, the framework can serve as a means of engaging relevant stakeholders in decision-making processes, to better understand perceptions of (dis-)benefits and human well-being, and how these vary with different perspectives. In participatory processes, this framework could help policymakers to negotiate and manage potential trade-offs and dichotomies between (dis-)benefits and human well-being to reach socially acceptable outcomes and enhance the legitimacy of the process (Alexander, Doorn, & Priest, 2017). For instance, in the case study the trade-off of employing saltmarsh for different benefits is evident, for example, military and industrial use prevents use for recreation or farmed food. Regarding dichotomies, saltmarsh plant pollen can support pollinators of neighbouring farm land but it can also be a disbenefit, causing allergies.

2.2 | Limitations and recommendations

Although the concept of ecosystem services has become increasingly embedded in the management of social-ecological systems, the approach itself is not without extensive criticism (e.g. Jadhav, Anderson, Dyer, & Sutton, 2017), especially when it involves monetary valuation (e.g. Gómez-Baggethun & Ruiz-Pérez, 2011). Thus, a risk could be that the framework leads to a reductionist approach, particularly if the framework is operationalised through limited, monetary indicators. Another risk is that due to the many different management sectors often involved in ecosystem management, it might be very difficult to ensure an integrated approach. Thus, this framework would benefit from being applied with a holistic view, including qualitative and quantitative values to derive weightings, and carefully considering the trade-offs of (dis-)benefits at different spatial scales, levels of impact and for different parties.

While the framework has been validated through its application to saltmarsh, others are encouraged to subject the framework to further scrutiny and application to other habitats to investigate commonalities and differences in the linkages and relationships

reported here. A next step in the framework development, depending on the management objective, could be for relevant stakeholders to further delineate the benefits, disbenefits and measures of human well-being through solution-oriented participatory approaches, for example, wild food could be divided into commercial and non-commercial. Exploring the success of transferability to other habitats and specific cultural contexts will be key in the continued development of the framework. Whilst further research is required, this framework represents an important stepping stone for advancing holistic assessments of human well-being in future ecosystem services research.

3 | CONCLUSIONS

The proposed conceptual framework enables the greater inclusion and understanding of the human well-being effects from nature. This is achieved particularly through the holistic approach of considering the benefits and disbenefits from ecosystem services and their links to explicit human well-being domains. The framework increases understanding of the differences in positive or negative well-being impacts from nature on different parties and spatial scales. This research provides important insights for environmental and health policy by providing guidance and clarification for ecosystem management on the relationship between nature and human well-being in social–ecological systems. It provides in-depth insight into links, trade-offs and dichotomies between benefits and disbenefits and human well-being, and improves accessibility to the complex research area of human well-being. This framework can thus serve as a useful tool to guide policy and management decisions and engage and negotiate with stakeholders that have differing perspectives. It also can contribute to the implementation of novel policies like the *Wellbeing of Future Generations (Wales) Act 2015* and the UN Sustainable Development Goals.

The useful application of the framework using a case study habitat highlighted knowledge gaps for saltmarsh habitat; as well as the potential applicability and usefulness of the framework. The application evidenced that saltmarsh benefits mainly accrue at larger scales with a greater impact (e.g. reduced hazard risk) affecting local to global individuals, while disbenefits tend to occur at a smaller scale and impact affecting in-situ individuals. There are also potential temporal shifts in impact of (dis-)benefits due to climate change or management efforts that need to be considered. Previous literature has struggled to account for the human well-being attributes of saltmarshes in a structured and objective fashion, and this approach overcomes this barrier, resulting in the first comprehensive assessment of the human well-being domains associated with saltmarsh.

There is a need for further research into the links between benefits and disbenefits and understudied human well-being domains, particularly life satisfaction and happiness, social cohesion and spiritual and cultural fulfilment. It is also recommended that the framework be further applied across a range of scales and habitat types to enable its continued development and transferability. The proposed framework is a valuable stepping stone providing a structured approach to improving understanding of ecosystem services, benefits and disbenefits and human well-being linkages.

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CONFLICT OF INTEREST

None declared.

AUTHORS' CONTRIBUTIONS

O.R. and N.B. conceived the ideas and designed methodology; O.R. led the literature review with contributions from all co-authors; O.R. led the analyses of the literature review with contributions from all co-authors; O.R. led the writing of the manuscript. All authors contributed critically to the drafts and gave final approval for publication.

DATA AVAILABILITY STATEMENT

No data were used in writing this paper.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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