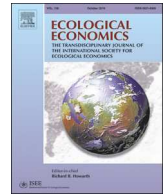




ELSEVIER

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Analysis

The Gendered Nature of Ecosystem Services

M. Fortnam^{a,*}, K. Brown^a, T. Chaigneau^b, B. Crona^{c,d}, T.M. Daw^d, D. Gonçalves^g, C. Hicks^e, M. Revmatas^a, C. Sandbrook^f, B. Schulte-Herbruggen^d^a Geography, College of Life and Environmental Sciences, University of Exeter, Amory Building, Rennes Drive, Exeter, EX4 4RJ, UK^b Environment and Sustainability Institute, University of Exeter, Penryn Campus, Cornwall, TR10 9FE, UK^c Global Economic Dynamics and the Biosphere, The Royal Swedish Academy of Sciences, Box 50005, SE-104 05, Sweden^d Stockholm Resilience Centre, Stockholm University, Kräftriket 2B, SE-1069, Sweden^e Lancaster Environment Centre, Lancaster University, Lancaster, LA1 4QY, UK^f Department of Geography, University of Cambridge, Downing Place, Cambridge, CB2 3EN, UK^g Parque Nacional da Gorongosa, Mártires da Revolução Avenue. Nr. 1539, Beira, Mozambique

ARTICLE INFO

Keywords:

Gender
Coastal ecosystem services
Wellbeing
East Africa

ABSTRACT

This article assesses the extent to which our conceptualisation, understanding and empirical analysis of ecosystem services are inherently gendered; in other words, how they might be biased and unbalanced in terms of their appreciation of gender differences. We do this by empirically investigating how women and men are able to benefit from ecosystem services across eight communities in coastal Kenya and Mozambique. Our results highlight different dimensions of wellbeing affected by ecosystem services, and how these are valued differently by men and women. However, it is not just the division of costs and benefits of ecosystem services that is gendered. Using a heuristic device of the ‘ecosystem-wellbeing chain’, we explain patterns within our primary data as an outcome of gendered knowledge systems, gendered behavioural expectations, gendered access to resources and gendered institutions. We conclude that this holistic, gendered understanding of ecosystem services is important not just for how ecosystem services are conceptualised, but also for the development and implementation of sustainable and equitable policy and interventions.

1. Introduction

Ecosystem service approaches are recognised as vital for alleviating poverty and achieving the global Sustainable Development Goals (SDGs; UN, 2015). The SDGs (specifically goal 5), along with other global agreements, also strongly emphasise the importance of addressing gender inequalities. Yet, past global ecosystem assessments, such as the Millennium Ecosystem Assessment (MA, 2005) and The Economics of Ecosystems and Biodiversity (TEEB, 2010), barely mention gender, except for reporting that women are often vulnerable to changes in ecosystem services. In the current Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) assessment process there is a commitment to integrate different worldviews and knowledges, but primary those of indigenous people rather than those of women (Kelemen et al., 2016). This omission reflects a tendency to research the aggregate benefits of ecosystem services for human wellbeing rather than differences across social groups (Daw et al., 2011). Out of 49 case study scientific articles on ecosystem services and wellbeing, Cruz-Garcia et al. (2017) identified only five

that consider gender, and a systematic review by Yang et al. (2018) found only 0.7% of ecosystem services research examined gender dimensions. If the SDGs are to be achieved while ‘no one is left behind’ (UN, 2015, p 12), it is vital that the variable perspectives, knowledge and interests of both men and women, and those of other social groupings, be integrated into ecosystem services conceptualisations, analyses and, ultimately, decision-making (Brown and Fortnam, 2018).

The small body of ecosystem services literature that does examine gender shows how perceptions of and preferences for ecosystem services are often gendered (e.g. Calvet-Mir et al., 2016; Martín López et al., 2012). However, there is a need to move beyond documenting ‘how’ to explain ‘why’ ecosystem services are gendered. To this end, gender and environment studies – e.g. ecofeminism, Women Environment Development (WED), feminist environmentalism and feminist political ecology – offer important insights (e.g. Agarwal, 1991, Rocheleau et al., 1996, Shiva, 1988, review by Meinzen-Dick et al., 2014). Firstly, this work points to culturally defined gender roles and responsibilities that affect gendered patterns of resource use and divisions of labour (e.g. income, food, childcare, domestic duties)

* Corresponding author.

E-mail address: m.fortnam@exeter.ac.uk (M. Fortnam).<https://doi.org/10.1016/j.ecolecon.2018.12.018>

Received 9 February 2018; Received in revised form 12 October 2018; Accepted 18 December 2018

Available online 13 February 2019

0921-8009/© 2019 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

(Rocheleau and Edmunds, 1997). Secondly, it describes how access to resources is mediated by customary and legal rights and that women tend to have a limited voice in environmental decision-making (Leach et al., 1995). Thirdly, capabilities and entitlements are often gendered, as elaborated in Leach et al.'s (1999: 225) work on ‘environmental entitlements’ that shows how ‘differently positioned social actors command environmental goods and services that are instrumental to their well-being’.

In this article, we combine insights from the gender-environment literature and apply a disaggregated perspective of ecosystem services, conceptualised in Daw et al.'s (2016) ecosystem services-wellbeing (ES-WB) chain heuristic, to frame a holistic analysis of the interlinked elements and mediating processes that determine how coastal ecosystems deliver human wellbeing benefits for men and women in East Africa. First, we review existing literature on ecosystem services and gender, and present key concepts and heuristics. Second, we introduce our study region and sites, and the multiple qualitative and quantitative methods, datasets and analyses used in a large-scale multi-disciplinary research project, which we draw upon in our gender analysis. Third, we present results on how ecosystem services are gendered in coastal Mozambique and Kenya in terms of use, values and the share of benefits derived by men and women, and the processes that drive these differences. We conclude that multi-dimensional gender trade-offs should be integrated into ecosystem assessments so that the inclusive development ethos of the SDGs can be better represented in ecosystem service research, policy and practice.

2. Situating Gender Within Ecosystem Services

2.1. Ecosystem Services and Gender

To date, research on ecosystem services has given scant attention to gender issues, with some notable exceptions. Several studies, for instance, have considered how perceptions, preferences and valuations of ecosystem services differ by gender. Some of these studies show that women value ecosystem services more than men. Martín López et al. (2012), for example, found that women are more likely than men to recognise ecosystem services from a range of protected and non-protected ecosystems in Spain, and Calvet-Mir et al. (2016) found that women value ecosystem services from home garden ecosystems in the Catalan Pyrenees more highly than men. Similarly, Shen et al. (2015) show that women in Japan were more willing to pay for ocean ecosystem services than men. Other studies have produced contrasting findings, however, with women perceiving or valuing ecosystem services less than men or having less positive perceptions of ecosystem services (Hartter, 2010; Rönnbäck et al., 2007; Warren-Rhodes et al., 2011; Orenstein and Groner, 2014). For example, men had more positive attitudes than women towards mangrove planting in Kenya and protected areas in Myanmar (Rönnbäck et al., 2007; Allendorf and Allendorf, 2013). Perceptions, however, are usually influenced by more variables than gender alone, including wealth, education, cultural traditions and age (citations in Muhamad et al., 2014, Daily, 1997,

Costanza, 2000, Plieninger et al., 2013, Daw et al., 2011) and how these characteristics intersect in particular contexts. This makes isolating and generalising gender differences very tricky. But examining ecosystem services as gendered means recognising that not all women are the same, and that many social processes and structures underpin these gender differences.

Empirical research has also highlighted gender differences in the types of ecosystem services perceived and valued. Martín López et al. (2012) found men were more likely to recognise and value provisioning services, and women more likely to recognise and value regulating services. Likewise, in a socio-cultural valuation of ecosystem services associated with pastoralism in Spain, Oteros-Rozas et al. (2014) show that men value provisioning goods most while women value regulating services most. Kalaba et al. (2013) also found that male-headed households in Zambia were more likely to use forest provisioning ecosystem services than women-headed households to cope with stresses and shocks.

While this small but growing body of literature indicates ecosystem services preferences vary by gender, many studies remain focused on a single case or site, and the reasons for these differences have not been investigated thoroughly. Case studies have also predominantly been conducted in the developed world in agricultural or forestry contexts. To address these shortcomings, we draw from environment and gender studies and a disaggregated conceptual framework of ecosystem services-wellbeing relations to inform and frame our holistic analysis of empirical data on the gendered nature of coastal ecosystem services in East Africa.

2.2. Gendered Ecosystem Services-wellbeing Chain

There are increasing calls in ecosystem services research to disaggregate analyses in order to understand how trade-offs between ecosystem services affects the wellbeing of different individuals and social groups (Dawson and Martin, 2015; Daw et al., 2011, 2016; Howe et al., 2014). Aggregated approaches, used in global assessments like the MEA, consider the benefits of ecosystem services to all humans, while disaggregated approaches recognise that benefits are unevenly distributed across groups and individuals (Daw et al., 2011). Daw et al. (2016) provide a conceptual framework, referred to here as the ecosystem services-wellbeing chain (ES-WB chain), to capture the causal pathways amongst a chain of elements – ecosystem stocks, flows, goods, value and shares – that produce multi-dimensional human wellbeing outcomes for different people. It also identifies *multipliers*, which are processes that explain the relationships between the elements (Fig. 1i–v). The framework captures flows and feedbacks between ecosystem service production, valuation processes, trade-offs and human wellbeing to holistically conceptualise the relationships between ecosystems and wellbeing, rather than focusing on one or a few of these aspects.

The chain provides a heuristic to expand beyond perceptions and valuations of ecosystem services by men and women, to explore how and why the chain of causality between ecosystems and human

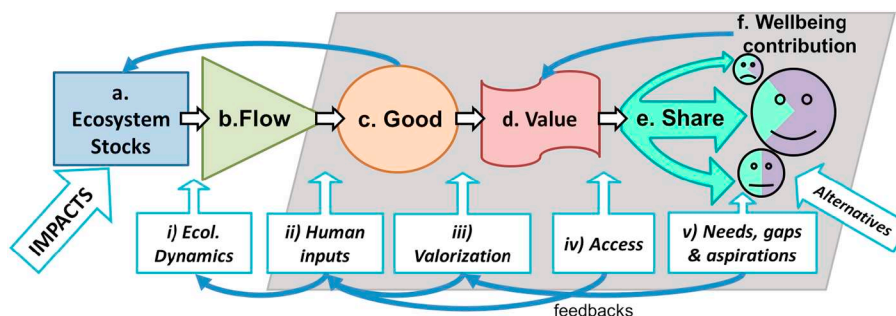


Fig. 1. Ecosystem service-wellbeing (ES-WB) chain (Daw et al., 2016). Grey shaded area highlights components of the chain considered in this study.

Table 1

Ecosystem services-Wellbeing chain elements and multipliers, and gender dimensions and observations. This article focuses on the research questions highlighted in bold.

Element or multiplier	Proposed gender dimensions of the chain	Research questions
<p>Impacts Either external, non-human impacts such as climate change, or resulting from feedback within the chain, such as impacts from extraction of Goods, or the manipulation or stewardship of ecosystems to generate valued ecosystem services</p>	<p>Different roles, norms and gender relationships influence the behaviours of men and women and the impacts they have on ecosystems. E.g. masculine identities underpin illegal fishing by men in Philippines (Fabinyi, 2007), while overexploitation of octopus increased in Tanzania when men entered a previously female-dominated activity (Porter et al., 2008). Meanwhile, gendered actions lead to manipulation of ecosystems to promote desired ecosystem services. E.g. Gambian women tending to specific tree species and changing garden composition to their advantage (Schroeder, 1999). As women often have limited involvement in decision-making on natural resources (review by Meinzen-Dick et al., 2014) ecosystems may be impacted without recognition of ecosystem services of importance to women. For example, flooding of coastal land in Bangladesh with saline water enhances benefits from commercial aquaculture at the expense of fruit and vegetable production essential to local women's reproductive labour (Dewan, 2017).</p>	<p>How do the impacts of men and women on ecosystems differ? How do gendered power relationships, through gendered preferences for different ecosystem services inform the use, stewardship and manipulation of ecosystems?</p>
<p>Ecosystem stocks and flows Natural capital, ecological structures and processes that potentially generate benefits to people</p>	<p>Ecosystem stocks and flows, and the supporting ecosystem services underpinning them, are biophysical, and thus not gendered in themselves. However, they are determined by potentially gendered impacts (see above), and have gendered implications as they determine potential goods that feed into a highly-gendered chain.</p>	<p>How do gendered ecosystem impacts, and feedback from other components of the chain alter natural capital, ecological processes and potential ecosystem services?</p>
<p>Human inputs Human factors that combine with Flows to coproduce Goods</p>	<p>Cultural and socialised gendered roles, responsibilities, labour divisions, expertise and knowledge define extraction and use of goods (Rocheleau and Edmunds, 1997, Leach et al., 1995, Goebel et al., 2000, Reyes-García et al., 2010, Pfeiffer and Butz, 2005).</p>	<p>How are human inputs gendered? And hence how do gender relations influence the co-production of goods?</p>
<p>Goods Things and services directly experienced or used, and valued by people</p>	<p>Women and men perceive and use different types and varieties of goods (Martín López et al., 2012, Calvet-Mir et al., 2016, Oteros-Rozas et al., 2014, Kalaba et al., 2013). Women often use renewable resources (plant crops or gather firewood) and men consumptive resources (e.g. harvest trees) (Rocheleau et al., 1996).</p>	<p>How are the uses and experiences of goods gendered?</p>
<p>Valorization Processes that determine the societal value of Goods</p>	<p>While Daw et al. (2016) present valorization as an aggregate societal process, factors such as cultural norms and access to markets are highly gendered, allowing a conceptualization of <i>gendered valorization</i>. Gender socialisation is a process that influences the way people value the environment (Calvet-Mir et al., 2016). However, valorization is context specific (Arora-Jonsson, 2014) and influenced by gendered roles and responsibilities (German and Taye, 2008)</p>	<p>How are the processes that determine the societal value of ecosystem goods gendered?</p>
<p>Value Aggregate worth of benefit from goods produced, regardless of distribution</p>	<p>Perceived value varies by gender and other factors, such as ethnicity and wealth (Rocheleau and Edmunds, 1997), demonstrated by divergent preferences for goods and willingness to pay (Shen et al., 2015, Calvet-Mir et al., 2016, Hartter, 2010, Rönnbäck et al., 2007, Orenstein and Groner, 2014).</p>	<p>How is the aggregate value assigned to goods gendered?</p>
<p>Access Processes that determine who can access Goods and benefit from their value</p>	<p>Men and women have different access and control over resources because of their divergent social and cultural roles, management responsibilities and rights (e.g. property and tenure rights), defined by customary and legal institutions (Rocheleau et al., 1996). These mechanisms manifest in men and women having different access to information (Allendorf and Yang, 2013), environmental and social spaces (Leach, 2007) and knowledge systems. Women often lack control over their labour and have restricted access to the labour of others to derive benefits (Leach et al., 1995).</p>	<p>What access mechanisms determine how men and women benefit from ecosystem goods?</p>
<p>Share The amount of Value that each person/group actually benefits from</p>	<p>Given gender-differences in access, the share of value derived from goods is likely to differ amongst men and women. This has been shown in studies of, for example, income from tourism (Sinclair, 1997, Sandbrook and</p>	<p>How does the share of value derived from ecosystems differ by gender?</p>

(continued on next page)

Table 1 (continued)

Element or multiplier	Proposed gender dimensions of the chain	Research questions
	Adams, 2012), fish consumption (Hossain et al., 2008), and food and nutrition intake (Sudo et al., 2004).	
<i>Needs, Gaps, and Aspirations</i> The contextually and personally determined needs and aspirations of a group/person that can be satisfied by ecosystem services	Some needs are biologically differentiated by sex, such as medicines for menstruation pains, while other needs are related to gendered roles, such as childcare, or cultural activities (e.g. goods from a landscape for male initiation rituals in South Africa; Masterson et al., 2016).	How do the needs and aspirations of women and men differ in different contexts, and how are these needs and aspirations satisfied by ecosystem services?
Wellbeing contribution The improvement in wellbeing experienced by a group/person as a result of their Share meeting their Needs	Men and women are likely to value aspects of their wellbeing differently, e.g. Abunge et al. (2013) found that women emphasised relational aspects of wellbeing. Ecosystems are likely to benefit different domains of men's and women's wellbeing differently.	How do women and men perceive and appreciate ecosystem service contributions to different aspects of wellbeing? How do interlinkages and feedbacks in the chain manifest in different contributions to wellbeing?

wellbeing is gendered. Importantly, by considering how multipliers are gendered, we aim to better understand the mechanisms that produce gender differences in the use and experience of ecosystems. Table 1 defines each of the elements and multipliers, and synthesises existing ecosystem services and gender research, and wider gender and environment literature, to propose how the various elements and multipliers in the chain are gendered. While the gender and environment literature cited does not explicitly address gender and ecosystem services, we utilize it to hypothesize gendered interlinkages along the chain between ecosystem services and wellbeing. We use our empirical data to analyse several of these questions (highlighted in Table 1) related to the right-hand components of the chain (see Fig. 1): Human inputs and Goods; Valorisation and Value; Access and Share; and the Contribution to Wellbeing. We particularly emphasise the access multiplier, since gender and environment studies identify this as a key determinant of how men and women interact with the environment. We do not address feedbacks between the components, and highlight that this would be fruitful area for further research on gender and ecosystems.

3. Methods

This study draws upon gender-disaggregated quantitative and qualitative social research from the Sustainable Poverty Alleviation from Coastal Ecosystem Services project (SPACES), a 4-year research project exploring the relationship between coastal ecosystem services, wellbeing and poverty in East Africa (SPACES, 2017). SPACES utilised several methodological tools and analyses to investigate a range of questions on this relationship, one of which was on the influence of gender. Each dataset was thus disaggregated by gender to explore the research questions of this study.

3.1. Study Sites

The project studied eight coastal sites across Kenya and Mozambique, representing both urban and rural contexts where people benefit from coastal ecosystem services (Fig. 2 and Table 2).

In Mozambique, Vamizi and Lalane are sparsely populated rural sites located in the far north of the Quirimbas archipelago, where fisheries are the primary source of livelihood. Vamizi has abundant mangroves from which poles are cut and used in construction. Although isolated from markets, traders visit Vamizi to purchase dried fish, and fishers travel to the mainland to sell their products. In contrast, few traders visit Lalane because of its remote location and there are no formal fish landing sites. Mize village is an agriculture-based community adjacent to extensive mangroves that support crab and shrimp fishing, and pole extraction. Maringanha is a peri-urban site on the outskirts of the port city of Pemba with primarily agriculture-based

livelihoods, but reflecting its urban setting there are also many jobs in the service sector (SPACES, 2016).

In Kenya, Vanga is the largest fish landing site south of the city of Mombasa, with about half of households dependent on fisheries (HHS). An extensive mangrove forest around Vanga provides firewood, poles and medicines. In the coastal town of Shimoni and on the adjacent island of Wasini, farming and fishing livelihoods are supplemented by a tourism industry based on the nearby Kisite-Mpunguti Marine National Park and Reserve. On Wasini, mangroves are exploited for firewood, building materials, medicine and as a tourist attraction. Kongowea, is a large and populous suburb of Mombasa, with a range of livelihood activities including many casual labourers with some engagement in fishing from nearby landing sites. Finally, Tzunza village, situated on a peninsula in a large creek has limited transport connections despite its proximity to Mombasa. Tzunza people fish in open water and amongst the mangroves, which are also exploited for firewood, construction poles and medicine (SPACES, 2016).

3.2. Data Collection

The SPACES project investigated ecosystem service-wellbeing relations using a range of analytical approaches, each focusing on specific but overlapping aspects of the chain. Table 3 provides details of the methods employed, including sample sizes, the data generated on gender and the relevant component of the chain, and the study site where the methods were deployed. The diversity of analytical perspectives and associated methods, each involving independent data collection, enabled the triangulation of findings to strengthen our analysis. Data were collected between 2013 and 2015.

The household survey (HHS) collected individual-level data within a sample of households on the gendered division of labour across livelihood activities to support analysis of how the Access multiplier influences human inputs.

We conducted value chain analysis for mangrove (MVCA) and fisheries (FVCA) products to describe market structures emerging from the sales relationships between actors operating in the market for these particular commodities (Kaplinsky and Morris, 2001). This allowed us to examine flows of benefits from mangrove and fisheries ecosystems to various market actors (characterised by gender), and how institutional access mechanisms determined shares. A tourism value chain analysis (TVCA) was undertaken for a specific tourism product in Kenya: boat trips from mainland Shimoni to Wasini island and to coral reefs to go diving or snorkelling. As recommended by Daw et al. (2011), tourism was separated from other cultural ecosystem services because the primary benefit for local people is through tourism-based income. We identified and surveyed key actors in the tourism value chain in Shimoni, Wasini and the coastal resort of Diani to examine the roles of individuals and organisations that provide goods and services to

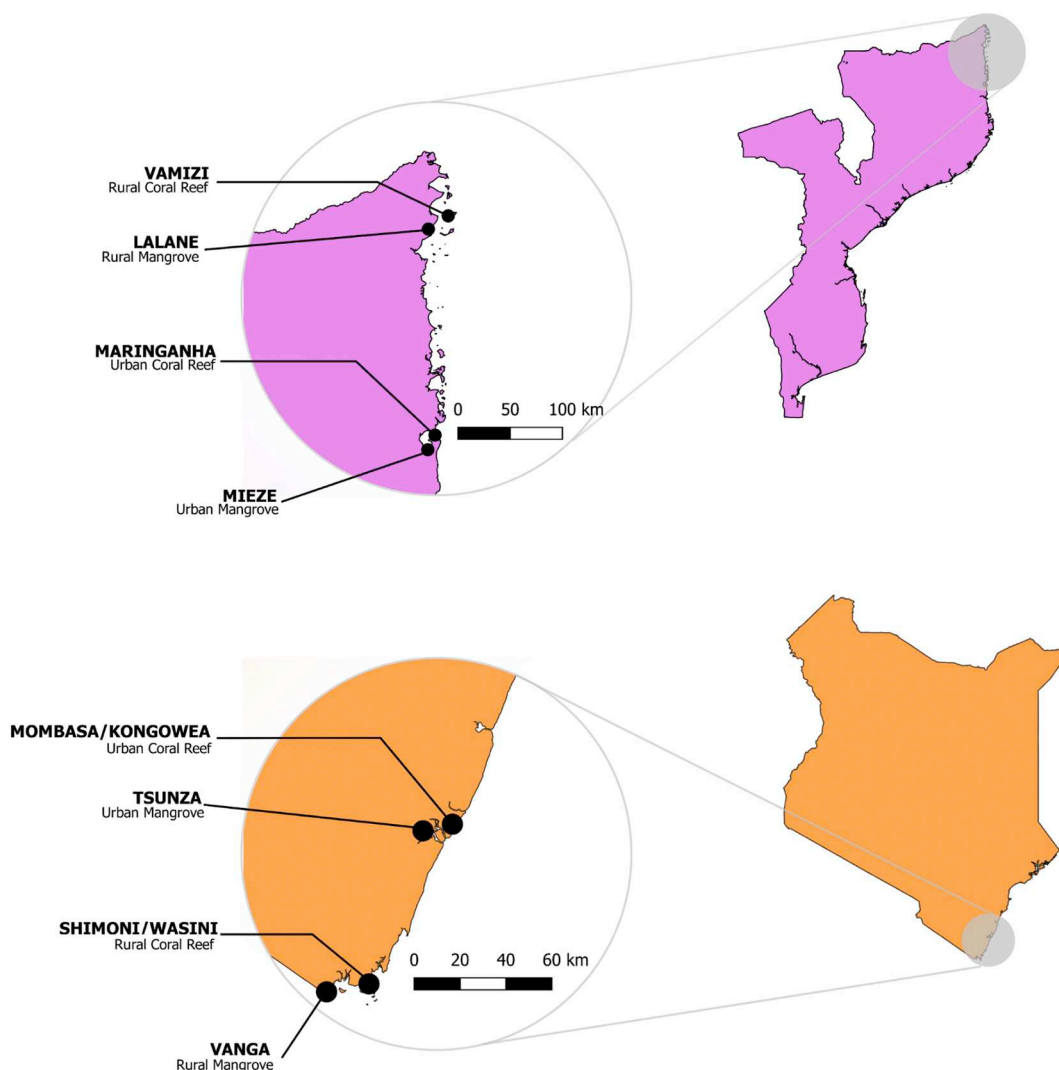


Fig. 2. Study sites in northeast Mozambique (upper) and southeast Kenya (lower).

tourists and the value they derive from their activities. From these data, we analysed the roles and responsibilities of men and women in the value chain and whether access to the sector were gendered.

Photovoice (PV), a participatory action research method that combines photography with participant reflection and dialogue (Sutton-

Brown, 2014), identified perceived gendered differences in activities, places and identities associated with ecosystem services. An in-depth qualitative case study (QA) of Wasini Island (Kenya) used participatory mapping and timeline development in gendered focus groups to understand differences in how men and women identify and value

Table 2

Characteristics of study sites.

Source: Household survey (HHS) and SPACES (2016).

Country	Community	Rural (R) or Urban (U)	Ecosystems		Coastal Ecosystem-based Livelihoods (% households involved)				Demographics		
			Coral reefs	Mangroves	Fisheries	Tourism & hospitality	Mangrove & non-timber forest products	Agriculture	Population	Religion	
									Muslim	Christian	
Mozambique	Vamizi	R	✓	✓	65	4	1	3	533	100	0
	Lalane	R	✓		61	0	11	66	1150	100	0
	Maringanha	U	✓		23	4	0	9	4000	99	1
	Mieze	R		✓	12	0	2	88	32,000	55	45
Kenya	Kongowea	U	✓		17 ¹	6 ¹	8 ¹	15 ¹	100,000	57 ¹	43 ¹
	Tsunza	R		✓	63	2	75	92	10,000	89	11
	Shimoni and Wasini Island	R	✓	✓	✓ ²	✓ ²	✓ ²	✓ ²	5000	✓ ²	✓ ²
	Wasini Island	R	✓	✓	69	15	33	18	1900	99	1
	Vanga	R	✓	✓	49	5	14	52	6500	100	0

¹ Data from a sub-sample of villages in Kongowea near the coast.

² Quantitative data not available as sub-site was not included in the household survey.

Table 3
Methods.

Methods cluster (code)	Chain component	Description	Gender insights	Study sites (Kenyan then Mozambican)
Household survey (HHS)	Human Input and Access	Survey of 2000 men and women from 1000 households. Questions on: household composition; livelihood strategies; household income; food consumption.	By conducting the survey with male and female members of each household, differences in perceptions and responses to questions could be analysed, and the proportion of men and women participating in each livelihood activity calculated.	Mkwiro, Tsunza, Mombasa, Vanga, Maringhana, Mizeze, Lalane, Vamizi
Mangrove (MVCA) and fisheries (FVCA) value chain analysis	Human Input, Access and Share	The VCAs involved: (i) participant observations and informal conversations in each study site; (ii) about 25 semi-structured interviews in each site on topics related to nodes in the value chain. This data was used to develop value chain maps, from which a survey was conducted targeting key actor groups to generate data on species caught, gears used, traded volume/value, assets and expenses, barriers to entry and upgrading opportunities, market structure and conduct, household characteristics and individual demographics.	Share of income from fisheries and mangrove value chains by actor group, including female and male traders; the barriers to accessing parts of the value chains; and participation of men and women in decision-making.	Vanga, Mkwiro, Tsunza, Shimoni, Mombasa Vamizi, Lalane, Mizeze, Maringhana
Tourism value chain analysis (TVCA)	Human Input, Access and Share	Mapping survey (39 participants) and detailed structured surveys (111 men, 21 women) conducted with actors from key nodes in the tourism value chain. Gender bias in the sample reflects gendered participation in the value chain.	Identified roles of men and women in tourism activities, benefits and costs of participation, barriers to access and the role of associations and other institutions in shaping individual outcomes.	Shimoni, Wasini and Diani
Photovoice (PV)	Access	(i) Photovoice focus groups (18) and interviews (18) that involved 6 women, 36 men, and 6 youth representatives; (ii) follow up structured survey held with 11 women, 53 men, and 16 with gender unreported (total 80).	Identified perceived gendered differences in activities, places and identities associated with the environment, including gendered roles and benefits, and transfer of knowledge	Vanga (survey only), Tsunza, Kongowea, Kibuyuni
In-depth qualitative case study analysis (QA)	Value, Valorization and Access	(i) 17 focus groups (15 men and 17 women); (ii) semi-structured interviews (total 43 men, 52 women); (iii) timeline workshops; (iv) participatory mapping. Methods identified perceptions of goods and societal values, places of importance, and perceived changes over time associated with mangrove ecosystems	Identified the gender differentiated goods (components) of the mangrove system and the values and use attributed to goods and the mangrove system. Provided in-depth data on why men and women use, perceive and value mangroves differently.	Wasini
Access focus groups (AFG)	Access	Generated access focus groups in each study site on who has access and who doesn't (and why) to different ecosystem services.	Data was thematically coded to identify access mechanisms that create barriers to men and women benefiting from ecosystem services.	Mkwiro, Tsunza, Mombasa, Vanga
Multi-dimensional wellbeing analysis (MWA)	Value, Valorization and Contribution to Wellbeing	Five gendered focus groups (6–9 participants at each) on (i) the community benefits derived from the coastal environment; and (ii) the importance and contribution of ecosystem services to community wellbeing	Women's and men's perception of how ecosystem services contribute to aspects of wellbeing	Mkwiro, Tsunza, Mombasa, Vanga Maringhana, Lalane, Vamizi

different spatial areas and services in a mangrove ecosystem, and social and cultural access mechanisms underpinning these values. Furthermore, we held separate access focus groups (AFG) of men and women in each site to discuss who does and does not have access to different ecosystem services and why. These participatory and other qualitative methods were selected to capture locally appreciated cultural ecosystem services, and to explain the gendered dimensions of valorization and access.

To understand gendered perceptions of the contribution of ecosystem services to wellbeing, our multi-dimensional wellbeing analysis (MWA) involved male and female focus group participants self-identifying the benefits they derive from the coastal environment and discussing the contribution these benefits made to their wellbeing. Because of this bottom-up approach to identifying ecosystem services, there was predominant focus on provisioning and cultural services directly benefitting participants rather than supporting or regulating services, which were less readily identified. We first analysed male and female perspectives on the importance of different ecosystem services for the community. Secondly, we disaggregated the dataset to ascertain how men and women differentially recognise the contribution of their self-identified ecosystem services to 12 wellbeing domains, predefined from the theory of basic human needs (Doyal and Gouhh, 1991). These wellbeing domains were shelter, economic security, sanitation, drinking water, food security, health, education, physical security, respect, relationships, autonomy and participation.

4. How Are Ecosystem Services Gendered in Coastal East Africa?

In this section, we present our results on the gendered nature of selected elements and multipliers in the ES-WB chain.

4.1. Human Inputs and Goods

The ES-WB chain describes goods as the commodities and services that are co-produced by human inputs, such as labour and capital, and ecosystem processes. In our coastal study sites, we found stark differences in how men and women use and experience goods, with labour and livelihood activities strongly differentiated by gender (Fig. 3). Male activity was focused on several key economic activities, including pole cutting, tourism and fishing, while women engaged in a wider range of activities, with seaweed collection, firewood collection and trading, palm and charcoal trading, and gleaning being female dominated economic activities (HHS). The only activities where men and women engaged to a similar extent were fish trading, hospitality and farming.

However, within the activity of fish trading, the fisheries VCA showed the roles to be highly gendered. In Kenya, male large-scale fish traders (*Tajiri*) dominated commercial markets in larger and high-value species, and owned their own fishing boats and pick-up trucks to ship large quantities of fish products to markets. Small-scale male traders (*Wachuuzi*) bought from local auctions, as well as direct from fishers, and sold fresh fish to fishmongers, food vendors and tourist hotels and resorts with little or no processing. They made use of simple transportation such as bicycles, motorbikes or public transport to travel to sellers and buyers. In comparison, women tended to be small-scale traders known as *Mama Karanga*, and bought lower-grade (and typically smaller) fish direct from small-scale fishers or from male traders, then processed (scaling, gutting, washing, salting and frying) and sold them directly to local consumers on the beach or along the road. Therefore, the type and size of fish, the input of labour for processing, the distance travelled, transportation mode and type of client varied by gender.

Mangrove goods are also highly gendered. The mangrove VCA found that in the sites of Tsunza and Vanga, women's role was confined to collecting firewood, and no women were involved in pole cutting. The HHS confirmed this observation, with no women involved in pole cutting across the study sites and 97% of firewood collection

undertaken by women (Fig. 3). In-depth qualitative research on Wasini Island (Kenya) elaborated that men within the community harvested timber and poles, vital for building *dhow*s and other boats used either for fishing or tourist activities, while women primarily collected goods that benefit households directly, such as firewood, medicine and roots made into utensils, rather than those that provide a source of household income. While women did earn income from selling firewood collected from mangroves, these findings suggest that income-generating mangrove ecosystem services tended to be the domain of men, while other services that have non-monetary benefits were mainly the domain of women.

While Fig. 3 shows that, across the study sites, the proportion of men and women involved in hospitality is similar, there were distinct gender roles in the tourism sector. The tourism VCA found that men accounted for 100% of boat operators, independent boat owners, curio and snack sellers, and managerial roles within the local Kenya Wildlife Service office. Men also accounted for over 80% of independent travel agents, small tour operator owners and staff, boat operators who crew the boats, and hotel staff. Women were present in the tourism value chain in a limited number of roles; only outnumbering men amongst travel agent sales staff (100% female), restaurant staff (80% female) and members of a tourism-focused women's group on Wasini Island, which runs a coral gardens and mangrove boardwalk attraction (100% female). Women's participation in the value chain was almost always as an employee rather than as an owner of an enterprise. The exception is a small number of independent travel agents (17%) and co-owners of large tour operators, all of whom were born outside the study area. Thus, direct income from tourism related ecosystem services, and particularly control over tourism enterprises, was primarily the domain of men.

4.2. Valorization and Value

In the multidimensional wellbeing analysis, focus groups explored the value of goods for multiple wellbeing domains as collectively perceived by men and women. These give an indication of gendered differences in values, and lead to hypotheses of the gendered processes of valorization that lie behind these differences. Fig. 4 shows scores for the importance of thirteen ecosystem services (identified in focus groups) aggregated across all sites and wellbeing domains to summarise perceptions of their importance for wellbeing, and hence infer how men and women value different goods. These data capture both the number of links identified between each ecosystem service and each wellbeing domain by male and female focus groups, and the score of importance for each link. In Section 4.4, we present the disaggregated data to report on perceptions of how ecosystem services contribute to each wellbeing domain.

Fig. 4 shows that both men and women perceived a high importance of provisioning goods (such as fish, mangrove poles and octopus) to the community regardless of gender. There were, however, considerable differences in the degree to which men and women valued different ecosystem services. First, women in general attributed higher importance and/or links to more wellbeing domains than men for nine of the twelve ecosystem services. Second, these differences reflect culturally embedded roles and responsibilities of men and women, which contribute to the valorization of each good by each gender, contingent on how easily the benefits are perceived. When looking at Fig. 4, three ecosystem services stand out as being differently valued by men and women: poles and shells were more valued by men, firewood by women. The valorization processes behind these relate to men's roles in the construction of houses and toilets, men's concern with physical security and valuing of social relations associated with collective harvesting and building (MWA). The gendered participation in firewood collection (Fig. 3) means that it is women who value its contribution to their autonomy, because they can collect it themselves without relying on others, and their income can be used to buy food and/or scholarly

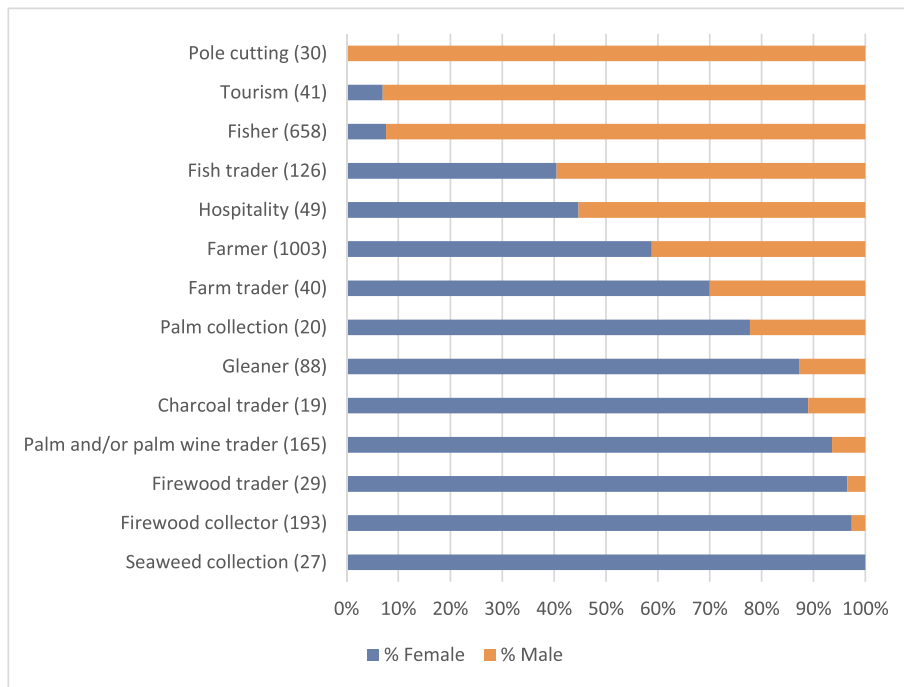


Fig. 3. Gendered livelihood activities. It shows the proportion of those men and women engaged in each of the most common ecosystem-service-related livelihood activities across all sites. Respondents self-reported activities, which were then categorised, with activities where only a few people participated excluded from the analysis. Total number of participants in each activity shown in parenthesis. Source: HHS

equipment for children (MWA). On Wasini Island, in addition to its value for domestic chores such as cooking and heating, women valued the activity of collecting firewood for social interaction, such as discussing certain topics considered taboo, including menstruation and marriage (QA). It is surprising that shells were regarded as more important by men than women given that it was a female dominated activity, but this is likely to be due to the category of shellfish being interpreted to include high-value lobster and crabs, often exploited by male divers (MWA, QA). In support of this conclusion, on Wasini Island men regarded crabs and other crustaceans as more important than women, since they sold them to hotels or tour operators, while women

regarded cowrie shells, which provide an income to young and older women, as more important than men (QA).

Overall, the wellbeing data shows that the goods most valued by both men and women were income-generating, such as fish, octopus and poles, and that generally, valorization reflects participation in the collection or use of each good (compare Figs. 3 and 4). However, we also see that women do value goods that are primarily male dominated in the harvest (e.g. fish) suggesting valorization through the processes of intra-household sharing of income that can support multiple wellbeing domains, and eventual use of goods by women (such as through cooking). The higher perceived importance of mangrove firewood

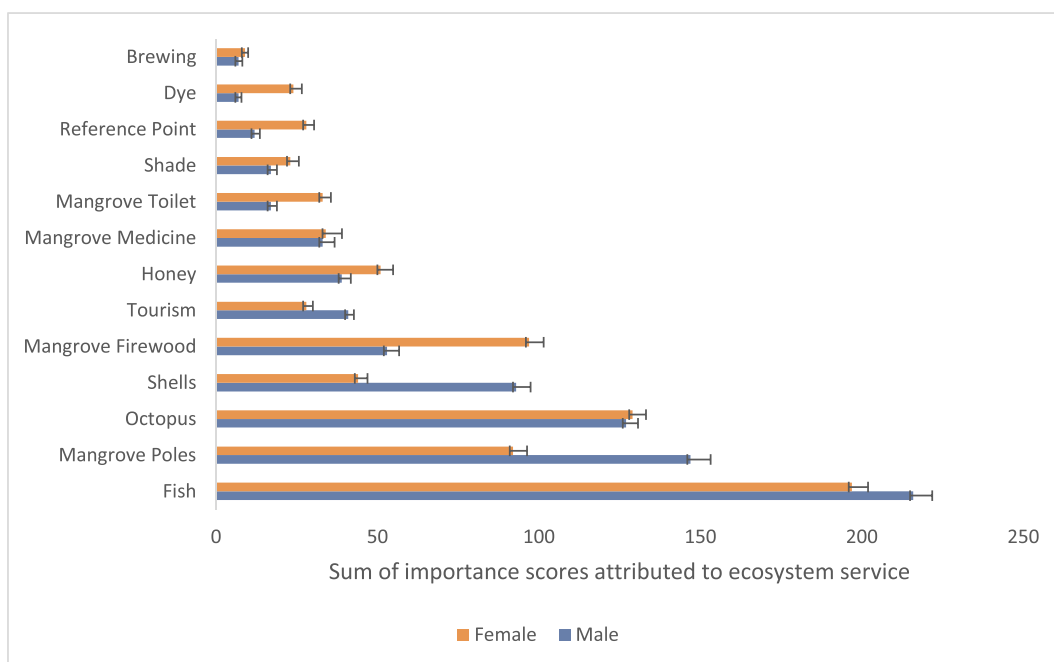


Fig. 4. Gendered perceptions of the importance of ecosystem services for wellbeing. Importance of each ecosystem service scored 0–3 for each of 12 dimensions of wellbeing. Scores are summed (with standard deviations) across all dimensions of wellbeing and across all focus groups (with maximum possible total score of 288). Ecosystem services were self-identified by the communities and then categorised.

collection by women suggests that the lower incomes and contribution to household income from this activity, are less recognised by men, who also do not perceive the broader value to women's autonomy and relationships. We also see that processes of valorization for men and women go beyond income, such as their importance for gendered social relations, that often, but not always, relate to their gender's roles and responsibilities.

4.3. Access and Share

The access multiplier in the ES-WB chain refers to processes that determine who can access goods and benefit from their multiple values. Access mechanisms are critical determinants of why other elements of the chain are gendered, including how benefits are shared between men and women. Access focus groups (AFG) were not specifically probed for gender, but gendered access was spontaneously discussed for 71% of the different goods at the different sites. In 48% of these cases, men were considered to have more access than women, while for 26% of cases women were considered to have more access. The data point to several key access mechanisms that influence the share of benefits received by men and women.

First, capital was often stated as a barrier to accessing higher value fisheries and tourism activities. For example, different fishing vessels and equipment were required to access different fisheries grounds, and boat operators needed to have substantial capital to invest in suitable vessels and equipment to cater for international or domestic tourists (AFG, TVCA). In Vanga (Kenya), female fish traders lacked the financial capital to purchase large containers of fish auctioned at markets, and were forced to purchase smaller volumes from middlemen at higher rates outside of the market, thus limiting the profitability of their business (FVCA). Research on *mama karangas* in Kenya has shown that because they lack access to financial and social capital, they have limited bargaining power to access fish and to invest in their businesses (Matsue et al., 2014; McClanahan and Abunge, 2017). Barriers to access capital may partly explain why women engage in activities that require no or limited resources or technology to undertake, such as gleaning and firewood collection.

Second, gendered differences in access to transportation affected mobility and the ability to access and sell goods. Women often depended on walking or public transport to reach fish markets, whereas men used motorbikes. The time taken to get to a larger market, when they had domestic responsibilities, made it only feasible to sell to local markets (FVCA). Given differences in mobility, the distance to particular parts of coastal ecosystems (fishing grounds, mangrove forests or tourist attractions) was a barrier to accessing ecosystem services (AFG). For example, mangroves situated some distance from homes were difficult to access by women with limited access to transportation and primary responsibility for household and caring tasks (AFG).

Third, skills and knowledge affected which livelihood activities were accessible to individuals. In the tourism sector, professional qualifications and the need for European language skills presented a major barrier to entry. Those with high level qualifications, such as accountancy or management diplomas, came from outside the local area, including the women employed by travel agents in Diani, Kenya (TVCA). The educational attainment of girls and women in the study sites is lower than men, with boys on average spending 1.5 years more in education than girls (HHS), creating a barrier to women entering the tourism sector. In the fisheries, knowledge of the seasonality of fishing grounds, the coastline, and of using specific fishing gears was essential. For pole cutting, knowledge was needed by men on what species are best suited for different uses, such as boat building, house construction or fences, and skills required to use specialist tools (e.g. saws, machete), while female gleaners knew where to find the best shells (WB). This knowledge had been transmitted through story and experience as an integral component of traditional and cultural life (PV).

Elders were reported as gatekeepers of ecological knowledge

transmission, such as elderly women knowing which tree bark and species of mangrove cure certain ailments or produce dye (AFG). Often, because of the structure of society, this transmission occurred along gendered lines, through conversation and storytelling from older female relatives to girls and older males to boys, or through experiencing gendered roles and activities, such as fishing or traditional practice:

“the ancestors pass over to the young people. Already my daughter knows that my mother told me this and that” (female, PV)

“in short, this old man is knowledgeable and knows all medicinal trees. Usually, the grandfather would pass this knowledge to one of (his) grandsons who seems keen to him. He would show the grandson that this medicinal tree, you can boil its contents to cure a sick child. So, in that process we learn” (young male, PV)

Fourth, formal institutions play a pivotal role in how men and women access tourism, mangrove harvesting, gleaning and fishing areas. Because of gendered roles and responsibilities, sector- or ecosystem-service-specific regulations and licenses can have variable outcomes for men and women. Women in Vanga highlighted, for example, that the introduction of permits for firewood collection, a female dominated activity, limited the time they could access the mangroves and thus their ability to benefit from them (AFG). Formal and informal agreements between traders and fishers, and decision-making on prices, are often linked to patron-client relations that are dominated by men (FVCA). Further, many of the most lucrative roles for individuals working in tourism are accessed to some extent through membership of a particular association. Boat operators in Shimoni are all members of one of two community boat associations, and beach operators in Diani are licensed to operate through membership of an association. Membership is usually cheap, but requires other characteristics such as long-term residence and being ‘of good character’. It seems quite possible that these groups, many of which include only men or women amongst their members, reinforce the gendered nature of the tourism industry in the area. Institutionalisation of the labour market may also limit women's work opportunities. On average, workers in the tourism sector had been involved for 8–10 years or more. In contrast, the employment roles in which women outnumbered men had shorter average periods of involvement, of 3.5 years (restaurants) and 5 years (travel agents) respectively. This suggests that women's work in tourism is shorter term and more transient, and that there is a lower rate of turnover in roles dominated by men, perhaps limiting opportunities for women to become involved in tourism (TVCA).

Fifth, access to ecosystem service benefits is linked to traditions, culture and behavioural expectations. For example, in Mozambique, a 7-year-old girl said that her grandmother said that girls should not go in the water or swim (FVCA), while others said only boys have the right to swim and fish from a boat: a young girl from Lalane (pers. comm) said, girls *“are only allowed in a boat when travelling otherwise it is bad luck for the fisherman”*. This reproduces marine and terrestrial gendered spaces. Indeed, the Photovoice analysis found that, although both men and women tended to be involved in farming, gendered differences emerged in how coastal marine physical space is used, with men and women often photographing, featuring in, and discussing different places in their community. Activities and identities closely related to fishing and involving travel to sea were frequently associated with men, including traditional and modern forms of fishing, opportunities for relaxation and reflection, and the identity and unity formed through these activities (PV). The activities women engaged in tended to be restricted to land, the shoreline and home. Men and women often therefore used ecosystem services in different physical spaces because of their roles and responsibilities, and cultural behavioural expectations.

Women often see themselves as responsible for the household and childcare (WB), and are expected to show respect, hold nurturing roles and behave in certain ways, including how they dress and talk, or even where they look (PV):

“to show respect for the [...] community, the women usually will start from her dressing. She will wear respective clothing that will cover the whole body, a buibui clad, a jalbab. She will also be careful on what she talks, no abusive words uttered. If somebody come to argue with her, she will not respond back to that person. If she goes out to a neighbour in the morning or afternoon, she will greet a neighbour. If you do not greet your neighbour, then you are disrespectful.” (female respondent, PV)

Men, on the other hand, are expected to undertake roles that are perceived to require courage:

“No, only the men go, ... because the honey is produced from the bees and they really bite ... so it must be a person that is used to collect honey [...]and] is a real man...” (female participant, Wasini, QA).

“[Do women also collect or fish octopus?] No [a big no], ...octopus is dangerous and can kill. Not anyone can catch octopus, it must be someone brave because octopus is dangerous ...” (male participant, Wasini, QA)

Behavioural expectations also constrained men from undertaking female roles. For example, men in Mozambique said that if they participated in shell collection it could erode one's respect because it is a woman's activity (AFG). Behavioural expectations are shaped by religion, culture and the patriarchal system, which influence access to ecosystem services. For example, in Vamizi (Mozambique), women were prevented from working in hotels if they were married (AFG); in Wasini (Kenya), men said that women should not work with tourists because they start to copy how they dress and act, which they fear would lead them to leave their faith (QA); and married women are prevented from engaging in the fish trade because it involves being out of the house and engaging in business transactions with men (FVCA). Likewise, some men were said to prevent their wives from joining the Wasini Women's Group, which is one of the only tourism opportunities available to women in the study area (TVCA).

These access mechanisms influence the share of value men and women extract from ecosystem services. The fisheries VCA in the Kenyan sites of Kongowea and Vanga showed that the mean income of male small-scale traders is about 3–4 times more than that of female small-scale traders (Table 3), while large-scale traders earn approximately 36 times more than female small-scale traders in Vanga. Women in the fisheries clearly capture a significantly smaller direct share of fisheries value than men. The mangrove VCA collected data on the average income of men and women in Tzunza and Vanga (Kenya) from the mangrove goods of firewood and poles (Table 4). First, the data show that women are confined to firewood collection and not do engage in the higher earning activity of pole cutting. Second, in Tzunza,

the mean income of men from firewood collection is almost six-fold that earned by women from firewood collection (in Vanga only women collect firewood). Third, the mean income of men is between 1.6 and 9.9 times more than women.

As might be expected given the clearly gendered roles and responsibilities related to tourism, income is also highly uneven between men and women in the tourism sector. Those able to make the most income (but also taking more risk in doing so) are the owners of enterprises (e.g. hotels or tour operators) and key assets (e.g. tourism boats) or self-employed beach and boat operators who interact with tourists directly, bringing the chance to earn tips and charge tourists premium prices for products. These roles are almost always held by men. In contrast, employment provides a potentially steadier income, but at a lower level. For example, a boat captain might earn 291 USD per month and travel agent sales staff around 194 USD per month. The lowest paid jobs are usually held by women. For example, Women's Group employees who run the coral gardens and associated shop receive just 19–29 USD per month (TVCA).

4.4. Wellbeing Contribution

Data from eight male and eight female focus groups provide a subjective assessment of how men and women view the contribution of ecosystem services to twelve wellbeing domains. By further disaggregating the data on values displayed in Fig. 4, Fig. 6 shows the perceived importance of different ecosystem services for different wellbeing domains in a matrix. Importance scores given by men were subtracted from those of women; therefore, negative scores (shaded blue) represent the degree to which men scored the importance of an ecosystem service for a wellbeing domain higher than women (and vice versa for positive scores, shaded orange). It shows a pattern of men being more likely than women to identify the contribution of ecosystem services to autonomy and shelter, which may reflect that men value personal autonomy and respect from the community (MWA). Women associated ecosystem services more strongly with economic security. This may be because they ascribe a higher importance to a wider range of ecosystem services than men and therefore, overall, economic security was more frequently contributed to by these goods and services during the analysis.

The disaggregated analysis in Fig. 6 shows that perceptions of the importance of different ecosystem services is linked to whether human inputs are gendered. For example, men considered mangrove poles, which they harvest, to have significantly higher contribution to wellbeing domains than women, while the opposite was true for the female related ecosystems service of mangrove firewood. For shells, women

Table 4

Gendered income (shown as mean net daily income, in USD) from fisheries and mangrove goods across Kongowea, Tzunza and Vanga (Kenya). Figures represent net income during the Kaskasi (northeast monsoon/high) season in rural and urban settings. (–) indicate non-relevant cross-tabulation. Total number of participants in each activity shown in parenthesis.

Source: FVCA/MVCA

	Value chain actor	Commodity type			
		Reef fish	Firewood	Firewood and poles	Poles
Kongowea (urban)	Fishers (male)	15.6 (88)	–	–	–
	Female small scale trader	6.1 (47)	–	–	–
	Male small scale trader	20.7 (17)	–	–	–
Vanga (rural town)	Fishers (male)	23.2 (117)	–	–	–
	Female small scale trader	5.6 (25)	–	–	–
	Male small scale trader	20.7 (28)	–	–	–
	Large scale trader (only men)	199.5 (5)	–	–	–
	Female collectors	–	-2.4 (5)	–	–
	Male collectors ^a	–	–	23.7 (1)	9.4 (10)
Tzunza (near but poorly connected to Mombasa)	Female collectors	–	2.5 (10)	–	–
	Male collectors ^a	–	11.9 (3)	4 (5)	4 (18)

^a Note that only males engage in both firewood and poles, and there are only male pole cutters.

	Brewing	Shade	Reference Point	Tourism	Mangrove Medicine	Mangrove Toilet	Mangrove Firewood	Mangrove Poles	Mangrove Dye	Mangrove Honey	Octopus	Fish	Shells	Totals
Female minus Male														
Health	13	0	13	-8	29	-4	-4	-4	0	8	-4	4	-8	8
Education	4	-4	4	-8	0	0	25	8	0	13	0	-8	-21	13
Physical Security	8	-4	13	4	13	25	-33	-58	0	0	21	13	0	-25
Water	-4	0	0	29	0	13	8	0	0	-8	13	8	4	-21
Respect	8	-8	17	-4	38	4	13	0	-4	4	0	54	-33	-96
Autonomy	0	-4	13	-4	4	0	17	-33	13	0	29	21	-46	117
Shelter	0	13	8	13	4	13	21	-29	8	-8	8	8	-17	17
Food	0	0	-4	0	4	0	33	-8	8	4	0	-4	-42	-8
Economic Security	0	0	13	0	21	0	29	0	38	29	4	0	-17	117
Participation	8	33	8	-8	-8	0	33	-25	13	13	-4	17	-13	33
Sanitation	0	13	0	8	0	13	29	-46	13	0	0	0	-13	-8
Relationships	-4	13	8	8	0	4	13	-33	8	-4	25	-8	0	4
Totals	8	25	67	54	4	67	183	229	71	50	8	79	204	-83

Fig. 6. Differences between male and female perceptions of the contribution of ecosystem services to wellbeing domains aggregated across all sites. High positive numbers (coloured orange) represent where women perceive contribution to be substantially higher than men, while high negative numbers (coloured blue) represent men perceiving the contribution to be substantially higher than women. Ecosystem service categories were generated based on benefits identified by the study communities during focus groups, while wellbeing domains are informed by theory (see Section 4.2, Data collection). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Source: MWA

regard shells as contributing much less to respect than men do, which again, as Section 4.2 explained, is likely due to high economic value crustaceans being interpreted as shells during data collection. Interestingly, while men scored the contribution of fish to respect, autonomy and participation far higher than women, the scores were fairly similar for other wellbeing domains, despite fishing being a male dominated activity. Perceptions of tourism were also similar. This may reflect the importance of fishing and tourism for everyone in a household because of it being a key income-generating activity, but men benefit most in terms of respect and autonomy because their direct participation in associated activities.

5. Discussion

The ES-WB chain heuristic provides a systematic, disaggregated approach for understanding how complex social and ecological processes shape how and which individuals and social groups benefit from ecosystem services. Using the chain as our starting point, we disaggregate services provided by ecosystems, the multiple and differential ways in which they contribute to wellbeing, and the intervening processes that mediate how ecosystems contribute to human wellbeing. We show that men and women differentially use, experience and share benefits from ecosystem goods; that human inputs and valorization processes are gendered; and we outline some of the mechanisms that

determine what benefits are and are not accessible to men and women. Our holistic, disaggregated framing of ecosystem-wellbeing linkages revealed several significant findings about the relationship between gender and ecosystems in coastal Mozambique and Kenya that have important implications for the way ecosystem management is implemented.

First, we identify highly gendered participation in coastal livelihoods and strong culturally defined roles for men and women. These led to stark differences in the share of income derived from ecosystem services, with women confined to low income activities, which is typical of tropical coastal communities (Eder, 2005; Hauzer et al., 2013; O'Neill and Crona, 2017; O'Neill et al., 2018). We also identified gendered processes of valorization. Women scored income-generating provisioning services (particularly fisheries) highest, even though men dominate and capture most benefits from these. This suggests that women recognised the value of these activities to households and the community, and perhaps viewed their own work as subsidiary to male coastal occupations (Savard and Fraga, 2005, Gereva and Vuki, 2010 in Kleiber et al., 2015). In contrast, men had less recognition for subsidiary income generated by women. The analysis concurs with existing studies (Section 2.1) that women value a wider range of ecosystem services, and also found that the degree to which each ecosystem service was valued by men and women often varied in accordance with the type of contribution it made to their wellbeing. In particular, non-

monetary and personal benefits, such as social relationships of collecting firewood or respect gained from fishing, were derived according to distinct gender roles and responsibilities. This finding on gendered valorization and the share of benefits highlights the importance of assessing how a wide range of ecosystem services are valued by men and women, and how they contribute to multiple dimensions of their wellbeing – beyond economic wellbeing. Such an analysis can expose gendered trade-offs and reduce the risk of decision-making processes prioritising masculine values to the detriment of women.

Second, male and female roles and responsibilities, and behavioural expectations, meant that men and women interact with different parts of coastal marine ecosystems. In our study sites, men dominated livelihood activities farther away or in deeper water, while women tended to exploit ecosystem services accessible from land or exposed at low tide. As found elsewhere (Kleiber et al., 2015; Chapman, 1987), intertidal zones are therefore male spaces at high tide (for fishing) and female spaces at low tide (for gleaning) and that women often collect provisioning ecosystem services from, what Rocheleau et al. (1996) describe as, ‘in-between spaces’. In agreement with Crona and Bodin (2006), the interaction between spaces and people influences the knowledge developed about the system. Accounting for gendered spaces in ecosystem management is, therefore, important because protecting ecosystem services situated in a place – such as the supporting services of inter-tidal habitats for the early life stages of many fish species – requires engaging the right male and/or female stakeholders, with relevant knowledge.

Third, these differences in how men and women use, experience and benefit from ecosystem services can be explained by gendered access mechanisms. Formal institutions (such as resource permits or resource user groups) even if not explicitly gendered, can create obstacles for women's participation in livelihood activities and decision-making; as documented in natural resource management literature (e.g. Agarwal, 1991). Informal institutions were perhaps even more important in determining access to ecosystem benefits. Behavioural expectations make certain roles masculine (e.g. those considered dangerous like seafaring), while others are feminine (e.g. those associated with caregiving) (Zelezny et al., 2000). In line with feminist political ecologist perspectives (Leach et al., 1995), these findings illustrate how ecosystem service relationships are social constructs of gender roles and responsibilities determined by contextually specific cultures, social-economic circumstance (Rocheleau et al., 1996) and processes of socialisation (e.g. Zelezny et al., 2000). The transmission of knowledge by gender observed in our study sites is likely to be a key source of such socialisation. Like Crona and Bodin (2006), who observed that ecological knowledge sharing occurs primarily within groups of fishers using the same gear in Kenya, we found that knowledge and skills are transferred amongst gendered social groups. Such institutions result in differential access to capital, education and mobility for men and women, with profound effects on which ecosystem services are accessible and how benefits are derived and shared. This suggests that narrow, technical interventions aimed at improving the effectiveness of ecosystem management cannot achieve development that is inclusive to women and other marginalised groups. Instead, deeper institutional reforms such as rights-based interventions are needed, that transform social structures and allow women to benefit from ecosystem services (Brown and Fortnam, 2018). Examples include reforms to statutory institutions, and behavioural and cultural change programmes to address underlying norms, values and societal principles. This requires policy and programming well beyond the current ambition and scope of ecosystem management.

Nevertheless, women in coastal Kenya and Mozambique demonstrated an adeptness to exploit spaces between formal and informal institutions, for example through their use of peripheral spaces (e.g. intertidal zone) and markets (e.g. low value, small fish). Women may have preferential access to some ecosystem services either because they hold relevant knowledge or because it is regarded as a feminine activity

creating cultural barriers for men to take part. However, the insecure tenure of ‘inbetween’ spaces also leaves women vulnerable (Razavi, 2009) since their preferential access may erode if an ecosystem service receives an economic value (Fröcklin et al., 2013). Porter et al. (2008), for instance, report that women in Tanzania were displaced by men from octopus fishing and trading as its commercial value rose. By recognising the importance and vulnerability of ‘inbetween ecosystem services’ for women, development programmes might seek options for institutionalising access mechanisms to prevent capture of emerging markets by men.

Further research could explicitly examine feedbacks between elements of the chain to develop a more dynamic understanding of gendered aspects of ecosystem services that could inform interventions. Feedback in the chain is likely to influence the aggregate impact on ecosystems and how gendered differences are reproduced or challenged over time. Activities of some women can diverge from culturally proscribed roles and responsibilities in exceptional cases, with potential feedbacks that alter gendered access mechanisms. For example, members of a women's group responsible for the management of a mangrove boardwalk used income generated from tourists to invest in girls' education, in a culture where boys' education is prioritised. A member of the group explained how she has been assisted with her education:

“For me, if there would not have been many of these developments, I would not have been able to have attended secondary level of education. The group assisted me in achieving, and many other more [...]. For me, if there was not the women group, I would have not been able to reach the level [of education]” (Wasini Women Group's member; QA)

There are also rare individual women who escaped gendered roles, with potential feedbacks on their own wealth, buying power and status that enables them to challenge gendered norms, such as a few large-scale female fish traders found at our study sites (FVCA). Matsue et al. (2014) also documented an unusual case of a woman who expanded her fish-trade operations well beyond the scope of the usual Mama Karanga role, and even became a creditor for male fishers. Such individual breaking of cultural norms can, however, come at a personal cost. In Vamizi island, one successful female trader of octopus and reef fish said she was ostracised in the community and accused of prostitution and witchcraft (FVCA). Opportunities for women to alter the gendered chain were also shown to be constrained in the tourism sector by the low turnover of staff in male dominated activities. ‘Breaking the chain’ is therefore very challenging, but understanding these system feedbacks could provide a first step to identifying opportunities and barriers for challenging existing inequitable distributions of ecosystem service benefits and seeding transformations towards more gender-equitable ecosystem governance – by, for example, supporting those pioneering women deviating from social institutions. Thus, gendered differentiation may alter over time – for better or worse – through feedbacks in the chain, or through external pressures such as economic, political or cultural changes.

6. Conclusion

Ecosystem services are highly gendered, reflecting the social construction of ecosystem services and the critical importance of social mechanisms that underpin the relationships between people and ecosystems. These are embedded within cultures, traditions and socially proscribed gender roles, and in the institutions and governance of natural resource systems, markets and labour relations. Because, as this study shows, men and women often use, experience and benefit from ecosystem services in different ways, and may possess different ecological knowledges, changes to the availability, quality and bundle of ecosystem services will have different outcomes for men and women. Time and time again the failure to account for social diversity means that the most vulnerable fail to benefit from development interventions. Drawing upon the established insights of gender and environment

studies, this article presents in-depth empirical data to demonstrate that gendered trade-offs and social differentiation more widely must be a critical consideration in ecosystem service research and ecosystem management if the ambition of inclusive development, promoted in the Sustainable Development Goals, is to be realised.

There are no easy ‘magic bullets’, however, that will remove inequalities in benefits from ecosystems, but there may be some opportunities to make inroads into them. Understanding gender and ecosystem services relationships helps researchers and practitioners to avoid exacerbating biases, or enhancing gendered vulnerabilities, and to identify where interventions can make a difference. We demonstrate that disaggregated approaches to ecosystem service-wellbeing analysis offer a means to identify inequity in ecosystem governance. To address such inequities, we suggest that ecosystem management should: make gendered values and gendered contributions of ecosystem services to multiple aspects of wellbeing explicit in decision-making; account for gendered physical spaces; and strengthen, adapt or transform underpinning institutions to create equitable opportunities for the fair sharing of ecosystem benefits amongst men and women.

Acknowledgements

This paper results from the project Sustainable Poverty Alleviation from Coastal Ecosystem Services (SPACES; project number NE-K010484-1), granted by the Ecosystem Services for Poverty Alleviation (ESPA) programme. The ESPA programme is funded by the UK Department for International Development (DFID), the Economic and Social Research Council (ESRC), and the Natural Environment Research Council (NERC). We are most grateful to the eight communities in Mozambique and Kenya for participating in the multiple sub-projects of this research, and to the Wildlife Conservation Society and Universidade Eduardo Mondlane for facilitating and coordinating fieldwork. Special thanks go to Nyawira Muthiga and Eunice Riour for reviewing manuscripts, and to our research assistants: Anchinha Abdul, Amisse Abel, Caroline Abunge, Rosebelle Apamo, Christopher Cheupe, Joaquim Cheupe, Ezidio Cuamba, Dominique Demille, Dominique Gonçalves, Rose Kazungu, Hamisi Kirauni, Júlio Lipaná, Nhamo Macamei, Vilma Machava, Gudilla Maiwa, Innocent Mulwodo, Atija Mussa, Wycliffe Nyamao, Evans Nyamache, Jane Nyanapah, Boaz Odembo, Dixon Odongo, Siran Offman, Hawa Abdul Nordini Pingalsi, Eunice Ribeiro, António Francisco de Sousa, Derrick Sulubu, Amini Tengeza, Andrew Wamukoto, Caroline Wanjiru and Stephen Wanyonyi.

Declaration of Interest Statement

Conflicts of interest: none.

References

Abunge, C., Coulthard, S., Daw, T.M., 2013. Connecting marine ecosystem services to human well-being: insights from participatory well-being assessment in Kenya. *Ambio* 42, 1010–1021.

Agarwal, B., 1991. Engendering the Environment Debate: Lessons From the Indian Subcontinent. Center for Advanced Study of International Development, Michigan State University.

Allendorf, T.D., Allendorf, K., 2013. Gender and attitudes toward protected areas in Myanmar. *Soc. Nat. Resour.* 26, 962–976.

Allendorf, T.D., Yang, J., 2013. The role of ecosystem services in park–people relationships: the case of Gaoligongshan Nature Reserve in southwest China. *Biol. Conserv.* 167, 187–193.

Arora-Jonsson, S., 2014. Forty years of gender research and environmental policy: Where do we stand? *Women's Studies International Forum Elsevier*, pp. 295–308.

Brown, K., Fortnam, M., 2018. Gender and ecosystem services: a blind spot. In: Schreckenberg, K., Mace, G., Poudyal, M. (Eds.), *Ecosystem Services and Poverty Alleviation: Trade-offs and Governance*. Routledge, Oxon, UK.

Calvet-Mir, L., March, H., Corbacho-Monné, D., Gómez-Baggethun, E., Reyes-García, V., 2016. Home garden ecosystem services valuation through a gender lens: a case study in the Catalan Pyrenees. *Sustainability* 8, 718.

Chapman, M.D., 1987. Women's fishing in Oceania. *Hum. Ecol.* 15, 267–288.

Costanza, R., 2000. Social goals and the valuation of ecosystem services. *Ecosystems* 3, 4–10.

Crona, B., Bodin, Ö., 2006. What you know is who you know? Communication patterns among resource users as a prerequisite for co-management. *Ecol. Soc.* 11, 7.

Cruz-García, G.S., Sachet, E., Blundo-Canto, G., Vanegas, M., Quintero, M., 2017. To what extent have the links between ecosystem services and human well-being been researched in Africa, Asia, and Latin America? *Ecosyst. Serv.* 25, 201–212.

Daily, G., 1997. *Nature's Services: Societal Dependence on Natural Ecosystems*. Island Press.

Daw, T.M., Brown, K., Rosendo, S., Pomeroy, R., 2011. Applying the ecosystem services concept to poverty alleviation: the need to disaggregate human well-being. *Environ. Conserv.* 38, 370–379.

Daw, T.M., Hicks, C.C., Brown, K., Chaigneau, T., Januchowski-Hartley, F., Cheung, W.W.L., Rosendo, S., Crona, B., Coulthard, S., Sandbrook, C., 2016. Elasticity in ecosystem services: exploring the variable relationship between ecosystems and human well-being. *Ecol. Soc.* 21.

Dawson, N., Martin, A., 2015. Assessing the contribution of ecosystem services to human wellbeing: a disaggregated study in western Rwanda. *Ecol. Econ.* 117, 62–72.

Dewan, C., 2017. Fish, salt and loss: capitalist assemblages and the translation of climate change for export promotion in coastal Bangladesh. In: *Nordic Geographer's Meeting 2017*. Stockholm University.

Doyal, L., Gough, I., 1991. *A Theory of Human Need*. Guilford Press, New York.

Eder, J.F., 2005. Coastal resource management and social differences in Philippine fishing communities. *Hum. Ecol.* 33, 147–169.

Fabinyi, M., 2007. Illegal fishing and masculinity in the Philippines: a look at the Calamianes Islands in Palawan. *Philipp. Stud.* 509–529.

Fröcklin, S., de la Torre-Castro, M., Lindström, L., Jiddawi, N.S., 2013. Fish traders as key actors in fisheries: gender and adaptive management. *Ambio* 42, 951–962.

German, L., Taye, H., 2008. A framework for evaluating effectiveness and inclusiveness of collective action in watershed management. *J. Int. Dev.* 20, 99–116.

Goebel, A., Campbell, B., Mukamuri, B., Veeman, M., 2000. People, values, and woodlands: a field report of emergent themes in interdisciplinary research in Zimbabwe. *Agric. Hum. Values* 17, 385–396.

Hartter, J., 2010. Resource use and ecosystem services in a forest park landscape. *Soc. Nat. Resour.* 23, 207–223.

Hauzer, M., Dearden, P., Murray, G., 2013. The fisherwomen of Ngazidja island, Comoros: fisheries livelihoods, impacts, and implications for management. *Fish. Res.* 140, 28–35.

Hossain, M.A.R., Nahiduzzaman, M., Sayeed, M.A., Saha, D., Azim, M.E., 2008. Fish consumption amongst poor people in Bangladesh: effects of gender, location and wealth class. In: *Aquaculture News, Bangladesh*.

Howe, C., Suich, H., Vira, B., Mace, G.M., 2014. Creating win-wins from trade-offs? Ecosystem services for human well-being: a meta-analysis of ecosystem service trade-offs and synergies in the real world. *Glob. Environ. Chang.* 28, 263–275.

Kalaba, F.K., Quinn, C.H., Dougill, A.J., 2013. The role of forest provisioning ecosystem services in coping with household stresses and shocks in Miombo woodlands, Zambia. *Ecosyst. Serv.* 5, 143–148.

Kaplinsky, R., Morris, M., 2001. *A Handbook for Value Chain Research*. IDRC Ottawa.

Kelemen, E., Potschin, M., Martín-López, B., Pataki, G., 2016. Ecosystem services: a gender perspective. In: *OpenNESS Ecosystem Services Reference Book*. EC FP7 Grant Agreement no. 308428.

Kleiber, D., Harris, L.M., Vincent, A.C., 2015. Gender and small-scale fisheries: a case for counting women and beyond. *Fish. Fish.* 16, 547–562.

Leach, M., 2007. Earth mother myths and other ecofeminist fables: how a strategic notion rose and fell. *Dev. Chang.* 38, 67–85.

Leach, M., Joeks, S., Green, C., 1995. Gender relations and environmental change. *IDS Bull.* 26, 1–8.

Leach, M., Mearns, R., Scoones, I., 1999. Environmental entitlements: dynamics and institutions in community-based natural resource management. *World Dev.* 27, 225–247.

MA, 2005. *Millennium Ecosystem Assessment Findings*. Island Press.

Martín-López, B., Iniesta-Arandia, I., García-Llorente, M., Palomo, I., Casado-Arzuaga, I., García Del Amo, D., Gómez-Baggethun, E., Oteros-Rozas, E., Palacios-Agundez, I., Willaarts, B., González, J.A., Santos-Martín, F., Onaindia, M., López-Santiago, C., Montes, C., 2012. Uncovering ecosystem service bundles through social preferences. *PLOS ONE* 7, e38970.

Masterson, V., Tengö, M., Spierenburg, M., Folke, C., 2016. *Culture and Development: Social-ecological Dynamics in the Former Transkei, South Africa*. PhD Thesis. Stockholm University.

Matsue, N., Daw, T.M., Garrett, L., 2014. Women fish traders on the Kenyan coast: livelihoods, bargaining power, and participation in management. *Coast. Manag.* 42, 531–554.

McClanahan, T.R., Abunge, C., 2017. Fish trader's gender and niches in a declining coral reef fishery: implications for sustainability. *Ecosystem Health and Sustainability* 3, 1353288.

Meinzen-Dick, R., Kovarik, C., Quisumbing, A.R., 2014. Gender and sustainability. *Annu. Rev. Environ. Resour.* 39, 29–55.

Muhamad, D., Okubo, S., Harashina, K., Parikesit, Gunawan, B., Takeuchi, K., 2014. Living close to forests enhances people's perception of ecosystem services in a forest-agricultural landscape of West Java, Indonesia. *Ecosyst. Serv.* 8, 197–206.

O'Neill, E.D., Crona, B., 2017. Assistance networks in seafood trade—a means to assess benefit distribution in small-scale fisheries. *Mar. Policy* 78, 196–205.

O'Neill, E.D., Crona, B., Ferrer, A.J.G., Pomeroy, R., Jiddawi, N.S., 2018. Who benefits from seafood trade? A comparison of social and market structures in small-scale fisheries. *Ecol. Soc.* 23 (3), 12. <https://doi.org/10.5751/ES-10331-230312>.

Orenstein, D.E., Groner, E., 2014. In the eye of the stakeholder: changes in perceptions of ecosystem services across an international border. *Ecosyst. Serv.* 8, 185–196.

Oteros-Rozas, E., Martín-López, B., González, J.A., Plieninger, T., López, C.A., Montes, C.,

2014. Socio-cultural valuation of ecosystem services in a transhumance social-ecological network. *Reg. Environ. Chang.* 14, 1269–1289.
- Pfeiffer, J.M., Butz, R.J., 2005. Assessing cultural and ecological variation in ethnobiological research: the importance of gender. *J. Ethnobiol.* 25, 240–278.
- Plieninger, T., Dijks, S., Oteros-Rozas, E., Bieling, C., 2013. Assessing, mapping, and quantifying cultural ecosystem services at community level. *Land Use Policy* 33, 118–129.
- Porter, M., Mwaipopo, R., Faustine, R., Mzuma, M., 2008. Globalization and women in coastal communities in Tanzania. *Development* 51, 193–198.
- Razavi, S., 2009. *The Gendered Impacts of Liberalization: Towards "Embedded Liberalism"?* Routledge.
- Reyes-García, V., Vila, S., Aceituno-Mata, L., Calvet-Mir, L., Garnatje, T., Jesch, A., Lastra, J.J., Parada, M., Rigat, M., Vallès, J., Pardo-de-Santayana, M., 2010. Gendered homegardens: a study in three mountain areas of the Iberian Peninsula. *Econ. Bot.* 64, 235–247.
- Rocheleau, D., Edmunds, D., 1997. Women, men and trees: gender, power and property in forest and agrarian landscapes. *World Dev.* 25, 1351–1371.
- Rocheleau, D., Thomas-Slayter, B., Wangari, E., 1996. *Gender and Environment: A feminist political ecology perspective.* In: *Feminist Political Ecology: Global Issues and Local Experience.* Routledge, London.
- Rönnbäck, P., Crona, B., Ingwall, L., 2007. The return of ecosystem goods and services in replanted mangrove forests: perspectives from local communities in Kenya. *Environ. Conserv.* 34, 313–324.
- Sandbrook, C., Adams, W.M., 2012. Accessing the impenetrable: the nature and distribution of tourism benefits at a Ugandan National Park. *Soc. Nat. Resour.* 25, 915–932.
- Schroeder, R.A., 1999. *Shady Practices: Agroforestry and Gender Politics in the Gambia.* Univ of California Press.
- Shen, Z., Wakita, K., Oishi, T., Yagi, N., Kurokura, H., Blasiak, R., Furuya, K., 2015. Willingness to pay for ecosystem services of open oceans by choice-based conjoint analysis: a case study of Japanese residents. *Ocean Coast. Manag.* 103 (1–8).
- Shiva, V., 1988. *Staying Alive: Women, Ecology and Development.* Zed Books.
- Sinclair, M.T., 1997. *Gender, Work and Tourism.* Psychology Press.
- SPACES, 2016. Study sites [Online]. ESPA Sustainable Poverty Alleviation and Ecosystem Services project. Available: <http://www.espa-spaces.org/study-sites/>, Accessed date: 5 October 2017.
- SPACES, 2017. About SPACES [Online]. ESPA Sustainable Poverty Alleviation from Coastal Ecosystem Services project. Available: <http://www.espa-spaces.org/>, Accessed date: 4 October 2017.
- Sudo, N., Sekiyama, M., Watanabe, C., Mozammel Haque Bokul, A., Ohtsuka, R., 2004. Gender differences in food and energy intake among adult villagers in northwestern Bangladesh: a food frequency questionnaire survey. *Int. J. Food Sci. Nutr.* 55, 499–509.
- Sutton-Brown, C.A., 2014. Photovoice: a methodological guide. *Photogr. Cult.* 7, 169–185.
- TEEB, 2010. *Mainstreaming the Economics of Nature: A Synthesis of the Approach, Conclusions and Recommendations of TEEB.* UNEP, Ginebra (Suiza).
- UN, 2015. Transforming our world: the 2030 agenda for sustainable development. In: *United Nations General Assembly (ed.) A/RES/70/1.*
- Warren-Rhodes, K., Schwarz, A.-M., Boyle, L.N., Albert, J., Agalo, S.S., Warren, R., Bana, A., Paul, C., Kodosiku, R., Bosma, W., Yee, D., Rönnbäck, P., Crona, B., Duke, N., 2011. Mangrove ecosystem services and the potential for carbon revenue programmes in Solomon Islands. *Environ. Conserv.* 38, 485–496.
- Yang, Y.E., Passarelli, S., Lovell, R.J., Ringler, C., 2018. Gendered perspectives of ecosystem services: a systematic review. *Ecosyst. Serv.* 31, 58–67.
- Zelezny, L.C., Chua, P.P., Aldrich, C., 2000. New ways of thinking about environmentalism: elaborating on gender differences in environmentalism. *J. Soc. Issues* 56, 443–457.