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How valuing cultural ecosystem services can advance participatory resource management: The case of the Dutch peatlands

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1. Introduction

The concept of "ecosystem services" (ESs) has become increasingly influential in transforming environmental science and policy around the world (Chaudhary et al., 2015). However, several knowledge gaps remain, especially regarding more effective contributions to resource management and decision-making (Guerry et al., 2015). To advance the impact of ES assessments, many authors stress the need for integrated decision-making approaches that consider both monetary and non-monetary valuations, encompassing intersubjective and multi-dimensional cultural values (Beria et al., 2012; Daniel et al., 2012; Guerry et al., 2015; van den Belt and Stevens 2016; Jacobs et al., 2016). In this paradigm, the main aim of valuation shifts from underpinning trade-off analysis toward developing a shared understanding and dialog about plural values (Kenter, 2016a).

A common approach for integrating monetary and non-monetary valuations is the use of multiple evaluative endpoints, drawing on the traditions of multi–criteria analysis and cost–benefit analysis (CBA). For example, in their impact assessment of agricultural land-use changes on ESs in the UK, Bateman et al. (2013) used a non-monetary biodiversity index to complement monetary valuations of agricultural production, the greenhouse gas balance, recreational visits, and urban green space amenity. And Sijtsma et al. (2013) proposed to complement economic project appraisals with non-monetary assessments of the ESs that impact ecological quality and human health. Although the number of case studies with similar approaches is rapidly expanding, still relatively few examples exist of integrated approaches that incorporate assessments of cultural ESs (CESs), i.e. the non-material benefits that arise from human–ecosystem relationships.

Except for the easily marketable service of recreation and eco-tourism, the valuation of CESs is considered particularly challenging because of their intangible and incommensurable properties (Chan et al., 2012; Daniel et al., 2012). The incorporation of CESs in integrated decision-making approaches requires valid and intuitively accessible non-monetary CES indicators to which values can be assigned. There is a broad science base for operationally defining CES indicators, but many CES indicators are deficient, for instance because spatially explicit information is lacking, or local stakeholders are not involved in their conceptualization (Hernández-Morcillo et al., 2013). To improve indicator quality, participatory mapping tools can be used to elicit place-based information and reveal to what extent values are shared by various stakeholder groups. For example, Plieninger et al. (2013) engaged the villagers of a cultural landscape in East Germany to map CESs and disservices, and Darvill and Lindo (2015) used participatory GIS to map provisioning and cultural ES indicators in a rural Canadian catchment across seven stakeholder groups. Newton et al. (2012) used participatory mapping to elicit "hotspots" of CESs across a catchment in the UK and demonstrated how to use this information to evaluate restoration strategies in conjunction with monetary assessments of provisional ESs and a non-monetary assessment of biodiversity.

Another challenge for CES valuation approaches is their ability to support deliberation between stakeholders. It is increasingly recognized that CESs reflect shared values that transcend individual preferences and do not exist a priori but are formed through deliberative processes (Irvine et al., 2016). Consequently, aggregated individual values may significantly differ from group-deliberated values (Kenter, 2016b). CES valuation approaches need to acknowledge this conception of shared values and should allow for value deliberation between stakeholders.

Although there is a growing body of literature on CES assessment, many authors still call for further examples that advance our understanding of which valuation approaches are best suited to support participatory decision-making in different contexts and at different scales (Daniel et al., 2012; Van den Belt and Stevens, 2016; Jacobs et al., 2016). Therefore, this paper aims to contribute to our collective understanding by demonstrating how participatory non-monetary CES valuation and CBA were employed to support a local resource management process in a part of the Dutch peatlands. The question we seek to answer is how CES valuation can be used to advance participatory resource management at a local scale. In addition, we will discuss the strengths and weaknesses of our approach and point out avenues to effectively engage stakeholders.

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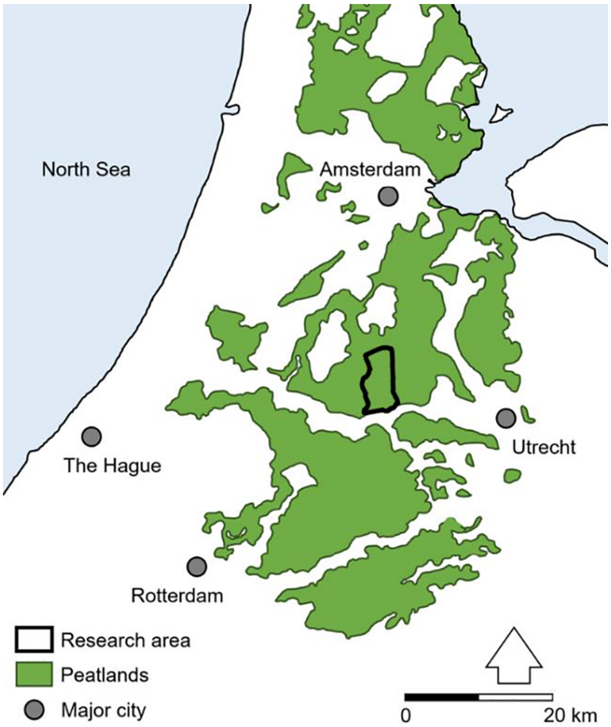

Fig. 1. Location of the research area in the western part of the Netherlands.

2. Background: The research area

The case we used for our endeavor is a participatory planning process of land use and water management scenarios in a part of the Dutch peatlands. We focused on an area of 24 km^2 in the peatland area in the west of the Netherlands, where the predominant land use is dairy farming (Fig. 1). During the Middle Ages, the natural fens in the area were drained and converted to arable fields and meadows by constructing polders: artificial catchments with a dense network of watercourses. The surface water levels in the watercourses determine the depth of the water table below ground, which steers the soil subsidence rate. The cumulative soil subsidence since the Middle Ages amounts to approximately 2 m (Schothorst, 1977), resulting in the current land elevation ranging from 0.5 m above to 2.0 m below sea level. Although the peatlands have been subsiding for centuries, their medieval water system and allotment patterns still exist: long, narrow plots bordered by ditches, alternating with two small villages and three linear settlement zones of farmsteads and houses. The total population in the area is 4200.

The overriding problem in the area is soil subsidence, which affects the regulating ES “erosion regulation”. The soil subsidence results in high management costs for roads, sewers, utility cables, gardens, and the water system. It also results in real estate damage, and affects the emission of greenhouse gasses, thereby affecting the regulating ES “climate regulation”. Although the undesirable effects can be diminished by raising the water levels, thereby reducing the rate of soil subsidence, this will reduce crop yields and hence affect the provisioning ES “food” (Van Brouwers-Haven and Lokker, 2010; Van Hardeveld et al., 2017).

The long-term strategy for land use and water management in this area will have to address a broad and diverse range of values for all stakeholders. It should include not only the monetary costs and benefits of soil subsidence, but also the non-monetary CESs of the area. Changes in land use and water management may impact the medieval allotment patterns, which are acclaimed as valuable Dutch cultural heritage (Curtis and Campopiano, 2014). Moreover, land use and water management also affect the breeding and chick rearing of meadow birds, for whom the Dutch peatlands are a major European stronghold (van der Vliet et al., 2015). Furthermore, an estimated 150,000 people visit the research area each year for low-intensive recreation activities such as bird watching, hiking, and cycling.

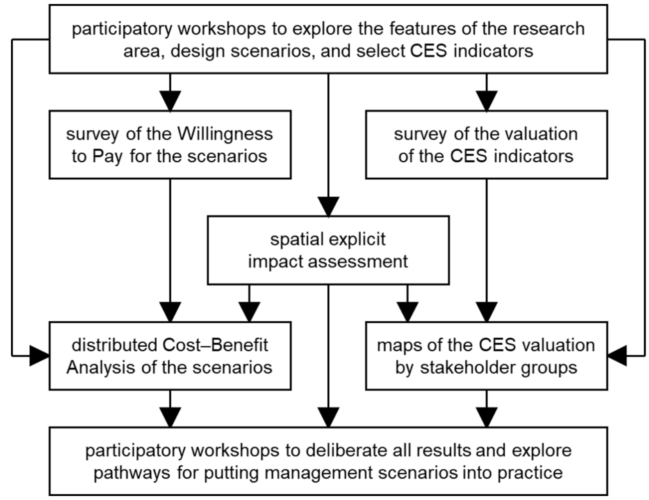

Fig. 2. Flow chart of the research approach of the current study. Arrows indicate the direction in which the research components feed into each other. CES = Cultural Ecosystem Service.

3. Methods

3.1. Outline of the research approach

Our research approach consisted of five sequential steps (Fig. 2). First, we organized a sequence of three participatory workshops with local experts in which we explored the features of the research area, and designed scenarios for land use and water management with diverging impacts on the research area. To map the impacts on the CESs, we selected robust, transparent, and stakeholder-relevant CES indicators. Second, we surveyed the stakeholders’ willingness to pay (WTP) for the current situation and the scenarios, as well as their valuation of the selected CES indicators. Third, we assessed the spatially explicit physical impacts of the current situation and the scenarios. Fourth, we used the designed scenarios, the results from the survey and the impact assessment to assess the resulting costs and benefits of the scenarios for several stakeholder groups, and construct maps of the CES valuation by the stakeholder groups. Fifth, in workshops with stakeholders who participated in the survey we used the DialogueMaps tool to deliberate all the results and explore pathways for putting sustainable management scenarios into practice.

3.2. Designing scenarios and selecting indicators

The first step of our research approach consisted of a sequence of three participatory workshops. In the first workshop (December 8th, 2014), we discussed the scope of the research with three peatland experts of the local municipality, the National Cultural Heritage Agency, and an interest group for cultural heritage. The local municipality was primarily concerned about their management options in response to agricultural developments, which on the one hand might reflect a scale enlargement of dairy farming, and on the other hand a conversion in land use to adapt to higher water levels. These developments would have divergent impacts on the ESs, the management costs of the municipality and the water authority, and the distribution of costs and benefits over stakeholder groups. The key stakeholder groups the local municipality wanted to engage in a dialog about these developments were (a) the farmers, i.e., the main land owners, (b) the inhabitants of the villages and settlement zones, and (c) the recreational visitors.

To accomplish this, we opted for a multi-phase participatory process. The chosen goal of the first phase was to initiate a process of broadly informing stakeholders about CESs and developing a dialog on planning options from the perspective of three key stakeholder groups. We envisioned the first reconnoitering phase would be followed by subsequent phases in which assessments would be more detailed. For the first phase, we decided to use a deliberative tool called DialogueMaps, which draws from experiences with a mediation and negotiation tool for the early phases of participatory land use planning processes (Janssen et al., 2005), using stakeholder-specific valuations of landscape-features to assess patterns of CES provision (see Sections 3.3 and 3.5). To prepare for this endeavor, we organized two additional workshops.

In the second workshop (March 2nd, 2015) we asked thirteen local experts on ecology and cultural heritage from governmental organizations and interest groups to reflect on the results of the first workshop. They concurred with our selection of key developments, and suggested to use a timeframe of 50 years, which on the one hand allows for the gradual impacts of soil subsidence to manifest themselves, and on the other hand is still relevant for the long-term policy of the local municipality. Next, we discussed which features of the research area were most important to include in the research. This resulted in a comprehensive list of features that relate to the CESs in the research area. In addition, they suggested to value "modern livestock barns" and "agricultural traffic" as well, because they believed these features to have a big negative impact on the CESs in the research area.

The third workshop (March 26th, 2015) was attended by two landscape architects and the participants of the first workshop. Guided by the landscape architects, we used the features that were highlighted by the participants of the second workshop to design coherent topographic maps of the current situation and three land use and water management scenarios with diverging impacts on the research area (Fig. 3):

1. Current situation (year 2015). 95% of the area is used for dairy farming, with surface water levels maintained at 55 cm below the level of the adjacent land. 3% of the area is built-up, with surface water levels maintained at 35 cm below the level of the adjacent land. In the remainder of the area, which is used for recreation and osier beds, the surface water levels are similar to those in the dairy-farming area.
2. Business as usual (year 2065). This scenario reflects a continuation of the current land use and water management, with only small, incremental changes.
3. Scale enlargement of current land uses (year 2065). This scenario reflects larger scale dairy farms, with more livestock and correspondingly bigger livestock barns, and a new road to accommodate the agricultural traffic. Most cattle remain indoors all their life. The surface water levels remain unchanged. However, in the area used for dairy farming, a new technique is applied, in which field drains are installed at depths below the surface water level to moderate fluctuations in the groundwater table: during wet periods, the water drains away faster, thereby limiting the rise in groundwater level, but during dry periods, the drains supply water to the soil, thereby limiting the fall in the groundwater table. These drain-dependent groundwater tables have been reported to increase agricultural production and to retard soil subsidence (Querner et al., 2012). In addition, we assumed that the field drains would make it possible to decommission half of the ditches and incorporate them into the adjacent meadows.
4. Wetter conditions (year 2065). This strategy reflects a substantial rise in surface water levels in the northern part of the research area, up to 35 cm below the level of the adjacent land, which results in a large-scale conversion from dairy farming to the production of cranberries, withies, and reed.

Note that to maintain the surface water levels at the same level below the land surface throughout the considered timeframe, they must be periodically lowered to keep pace with the soil subsidence. See the appendix for further details on the scenarios.

Next, we selected CES indicators with which the impacts of the scenarios on CESs could be mapped. We deliberately limited the number of CES indicators, allowing for a valuation survey that respondents could complete within 10 min (see paragraph 3.3). Because the mapping of CESs is pivotal for our research approach, the CES indicators had to be robust, transparent, and stakeholder-relevant (Willemen et al., 2015). To meet these requirements, we selected four CESs of the Millennium Ecosystem Assessment (2005) classification system for ESs that related to features of the research area that were frequently highlighted by the participants of the second workshop, and were mappable and quantifiable using stakeholder-based valuations at the local scale of our research area: "sense of place", "cultural heritage values", "aesthetic values", and "recreation and ecotourism". We selected three indicators for each CES, which could be mapped spatially accurately, could be easily explained in layperson's terms, and could be quantified using stakeholder-based valuations (Table 1). Following up on the suggestions of the participants of the second workshop, we also selected two important negative impacts on the CESs—"number of modern livestock barns" and "length of roads with much agricultural traffic"—because this could support the design of management scenarios that minimize these impacts.

3.3. Surveying stakeholders' valuation

In the second step of our research approach, we surveyed the stakeholders' valuation of the CESs and their WTP for the current situation and the scenarios. Face-to-face interviews are a common approach for such surveys and have been successfully used for inhabitants (Plieninger et al., 2013) and recreational visitors (Van Berkel and Verburg 2014; Zoderer et al., 2016). However, we doubted if it could be used for farmers, because they are notoriously busy. Therefore, we opted to survey the stakeholders' valuation of CESs by a website, which could be visited at any time that was most convenient for a respondent. The website was online for four weeks (October 5th till November 1st, 2015), during which we promoted it via newspapers, emails, the websites of the municipality and the water authority, and a stand at the annual "cow market" fair in Woerden, the main town near the research area. To encourage participation in the survey, the questionnaire was deliberately short, i.e., respondents could complete it within 10 min. We encouraged participation by offering respondents the chance to enter a prize draw in which the prize was a hot air balloon ride over the peatlands. 295 people responded to the survey. All stakeholder groups were well covered, with multiple respondents stating that they were both farmer and inhabitant, thus belonged to both stakeholder groups. The response covered approximately 5% of the adult population of the research area (sample frame 3400), 58% of the farmers (sample frame 85), and 0.1% of the recreational visitors (sample frame 150,000). The coverage was slightly biased in terms of gender and age: 69% of the respondents were male, compared to 50% of the population of the research area. The average age of the respondents was 52 years, whereas the average age in the research area was 41 years.

The website contained a questionnaire to elicit (a) respondents' non-monetary valuation of the CES indicators, (b) their WTP for the scenarios, and (c) some of their general characteristics: their age, their gender, and the stakeholder group to which they belonged, i.e., farmers, inhabitants, or recreational visitors. The questionnaire was elucidated by several visualizations, because previous studies have shown that visualizations are a powerful tool to elicit stakeholders' preference for landscapes and their constituent elements (Dramstad et al., 2006; Van Berkel and Verburg 2014; Zoderer et al., 2016). We

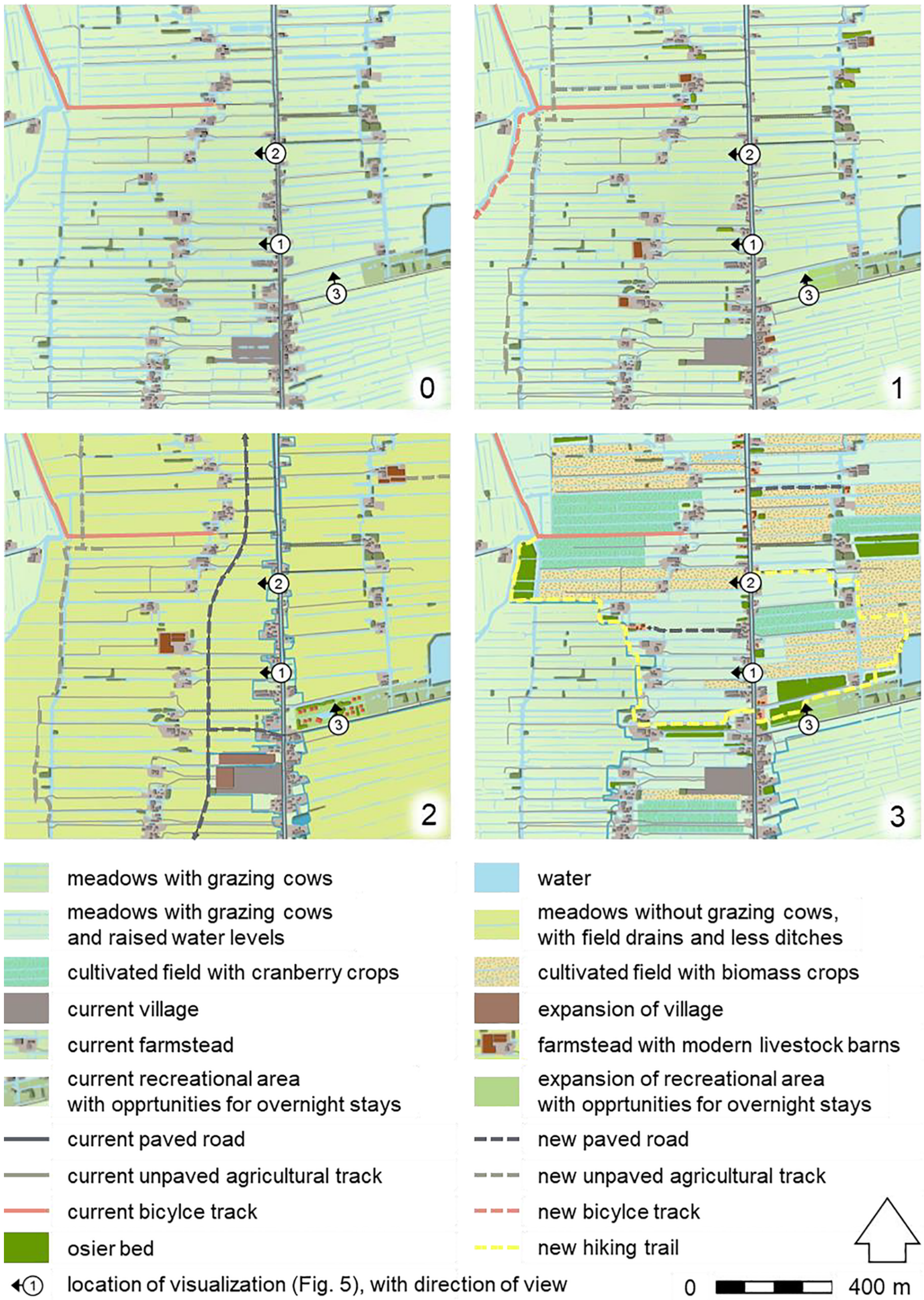

Fig 3. Topographic maps of the central part of the research area for the current situation (0), the “Business as usual” scenario (1), the “Scale enlargement of current land uses” scenario (2), and the “Wetter conditions” scenario (3).

followed up on these examples by using photographs of the research area to visualize the CES indicators and negative impacts (Fig. 4), and the current situation and the scenarios at three locations in the research area (Fig. 5). We used imaging software to manipulate photographs of the current situation in a way that reflected the developments envisioned in the scenarios.

In addition to the visualizations, all CESs were elucidated by short descriptions, e.g., for old farmsteads: “In the linear settlement zones and the villages of Kanis and Kamerik, several old farmsteads with characteristic farmyards are present, dating from the 19th century.” We asked two questions about the CES indicators. First, we asked the respondents to give all individual CES indicators a value on a seven-point scale ranging from -3 (very negative) to +3 (very positive), in response to the question: “How do you value the following peatland features?”. Second, we asked them to quantify the relative weight of the four CESs, by distributing 100 points among the four CESs, in response to the

Table 1
Selection of cultural ecosystem service indicators and negative impacts.

Cultural ecosystem service	Indicators and negative impacts	Reason for selection
Sense of place	Area of meadows	Main land use
	Area of cultivated fields	Important accompanying land use
	Area of meadows with grazing cows	Highly visible, appealing species
Cultural heritage values	Number of ditches which are part of Medieval ditch patterns	Key feature of historical geography
	Number of old farmsteads	Key feature of built heritage
	Area which likely contains archeological remains	Key feature of archeology
	Number of modern livestock barns	Big negative impact on the ensembled cultural heritage values
Aesthetic values	Area visible from the main road and the main hiking trail	Key feature of the aesthetic value of Dutch peatlands
	Area of osier beds	Important accompanying, alternating feature of openness
	Area with high ecological quality	Key feature of the aesthetic value of Dutch peatlands
Recreation and ecotourism	Length of hiking trails	Key reason for recreational visits
	Length of cycling tracks	Key reason for recreational visits
	Area with opportunities for recreational overnight stays	Important activity accompanying hiking and cycling
	Length of roads with much agricultural traffic	Big negative impact on opportunities for hiking and cycling

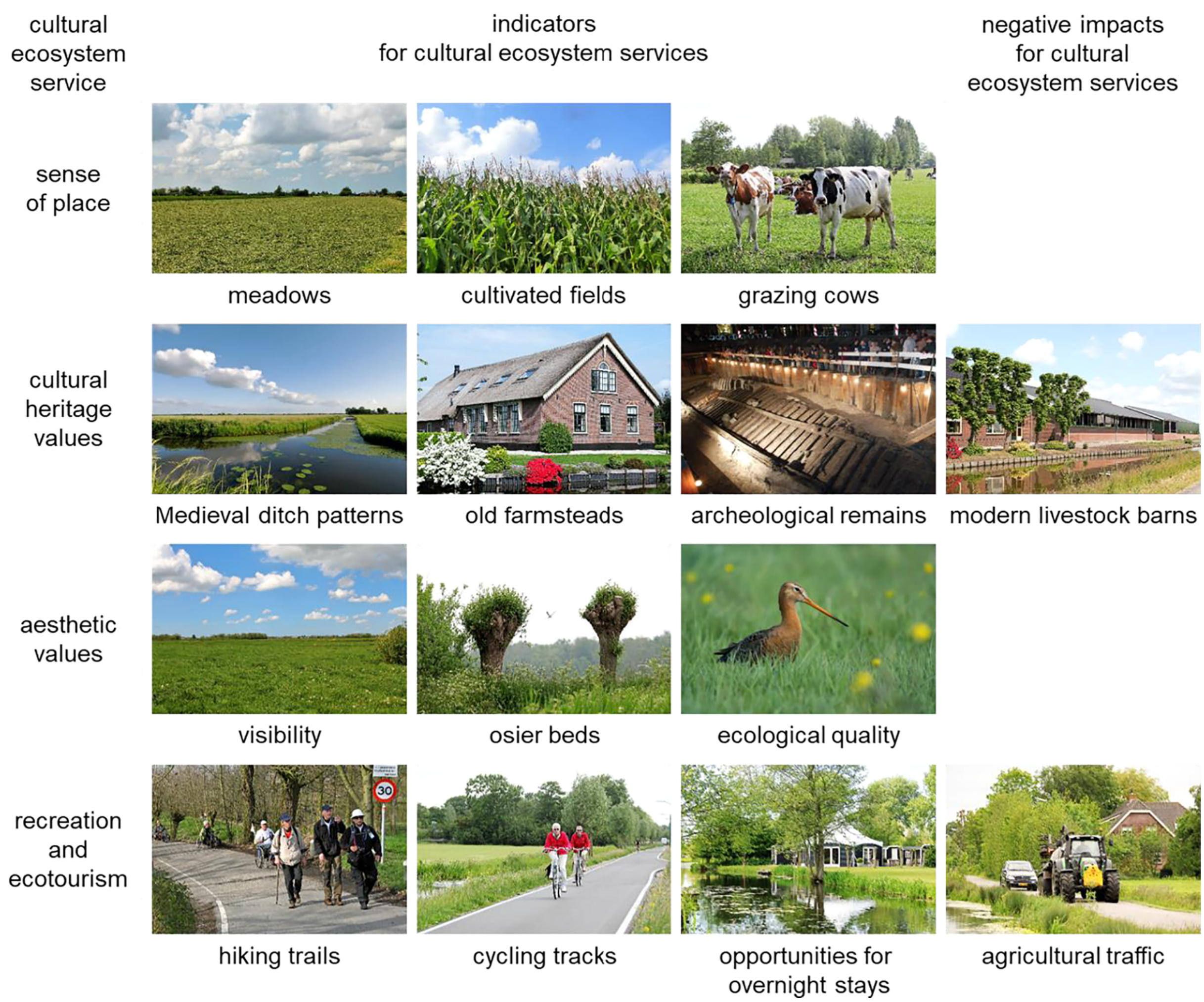

Fig. 4. Visualizations of indicators and negative impacts for cultural ecosystem services.

question: "How important are the following groups of peatland features for your overall valuation of the peatlands?".

The scenarios were elucidated by the topographic maps (Fig. 3) and the visualizations (Fig. 5). The maps were accompanied by some brief background information, resembling the descriptions in section 3.2. The visualizations were accompanied by short descriptions, e.g., for location 3 in scenario 2: "The recreation area at "het Oortjespad" has expanded, adding several luxurious bungalows.". We asked one question about the scenarios: "What is the annual amount you are willing to pay to support the landscape, the cultural heritage, and the ecology in the current situation and the following scenarios?". Note that we used layperson's terms, because we assumed most respondents were not familiar with the ES framework and its terms.

3.4. Assessing impacts

In the third step of our research approach, we assessed the spatially explicit physical impacts of the current situation and the scenarios. We used a GIS-based integrated modeling framework for peatland management (van Hardeveld et al., 2017) to assess the spatially explicit

Fig. 5. Visualizations of the scenarios on three locations in the research area (see Fig. 3).

impacts of the scenarios. As input for the initial situation of each scenario, the modelling framework required maps of the topography (Fig. 3), the terrain elevation, the soil properties, the surface water levels, and the groundwater tables. As output for the chosen timeframe, it produced maps of the terrain elevation, the soil subsidence, the surface water levels, the groundwater tables, the agricultural crop yields, and the ecological quality of the terrestrial vegetation. In addition, it assessed the required number of weirs and embankments, the required maintenance of roads, sewers, and utility cables, the damage to old farmsteads and other real estate due to changes in groundwater tables, and the CO_2 emissions due to subsidence of the peat soils. Subsequently, we used the topographic maps and the terrain elevation maps to map all lines of sight from the main road and the main hiking trail in the area. In addition, we used the topographic maps and the groundwater table maps as input for habitat models (van Dijk et al., 2015) with which we mapped the density of breeding meadow birds.

3.5. Analyzing costs and benefits, and mapping ecosystem services

The forth step of our research approach consisted of a distributed CBA, and the construction of maps of the CES valuation by the stakeholder groups. We used the CBA approach of Van Hardeveld et al. (2018) to derive the costs and benefits of the scenarios for the stakeholder groups involved in the management of Dutch peatlands. This CBA approach reflects a multi-criteria discussion of costs and benefits from multiple evaluative endpoints, rendering it well suited for the participatory valuation process of our case study. As input, the CBA approach required the results from the integrated modeling framework, the assumed features of the scenarios (see Fig. 3 and the appendix), and empirical financial data. As output, it assessed (a) the management costs of the water system, distributed to the water authority, (b) the management costs of roads and sewers, distributed to the municipality, (c) the management costs of utility cables, and the benefits from recreational visits, distributed to the businesses, (d) the costs of real estate damage, distributed to the inhabitants, (e) the benefits of agricultural production, distributed to farmers, and (f) the non-financial benefits of reduced CO_2 emissions, distributed to society at large. In addition, we also assessed the non-financial bequest and existence values for farmers, inhabitants, and recreational visitors, by multiplying their population by the average WTP they stated in the survey.

We used the DialogueMaps tool to construct maps of the overall CES valuation. We constructed the maps separately for the current situation and the three scenarios, and considering the three stakeholder groups (farmers, inhabitants, and recreational visitors). The mapping approach resembled the construction of value maps by Janssen et al. (2005), and landscape preference maps by Van Berkel and Verburg (2014). First, using the results from the integrated modeling framework and the assumed features of the scenarios, we constructed maps of all individual CES indicators and negative impacts. Second, we averaged the values for the individual CES indicators and negative impacts which were stated by the survey respondents and assigned these averages spatially explicitly to the maps of CES indicator and negative impacts. Third, for all four CESs, we aggregated the results of step two spatially explicitly and divided the aggregated result at each location by the number of individual CES indicators or negative impacts per CES. Forth, for all four CESs, we averaged the relative weights which were stated by the survey respondents and multiplied these averages spatially explicitly by the resulting maps of step three. We derived the overall CES valuation maps by aggregating the four CES valuation maps. In addition, the overall CES valuation maps were spatially aggregated and adjusted for land uses that were not valued, i.e., built-up areas and cranberry fields. The results were transformed into an index score, with the average aggregated valuation of the current situation equal to 100.

3.6. Deliberating the results

In the fifth step of our approach, we discussed all results in two workshops (November 16th and November 23rd, 2015) with 16 stakeholders, representing the three stakeholder groups of the CES valuation. Nine stakeholders who also participated in the second workshop during the first step of our approach represented the recreational visitors. In addition, we invited seven stakeholders who participated in the survey to represent the farmers and the inhabitants.

The workshops started with an overview of the results of the CBA and the CES valuation. Next, we let them use the DialogueMaps tool to allow them to interactively examine all maps, and to ponder on and interpret spatial patterns, differences between scenarios and stakeholder perspectives. For each scenario and each stakeholder perspective, the DialogueMaps tool contained the overall CES valuation map, as well as five thematic maps of combinations of individual CES indicators: (1) land use, including the CES indicators “area of meadows”, “area of cultivated fields”, “area of meadow with grazing cows”, “area of osier beds”, “area with opportunities for overnight stays”, and the negative impact “number of modern livestock barns”, (2) lines of sight, i.e., the CES indicator “area visible from the main road and the main hiking trail”, (3) cultural heritage, consisting of the CES indicators “number of ditches which are part of medieval ditch patterns”, “area which likely contains archeological remains”, and “number of old farmsteads”, (4) infrastructure, including the CES indicators, “number of hiking trails” and “number of cycling tracks”, and the negative impact “length of roads with much agricultural traffic”, and (5) the CES indicator “area with high ecological quality”, which reflects the quality of terrestrial vegetation as well as the density of breeding meadow birds. The thematic maps were incorporated along with several pop-up windows with photographs, visualizations, and brief background information we used in the survey.

The second part of the workshops consisted of a semi-structured discussion about (a) their interpretation of the CES valuation, (b) the feasibility of the scenarios and their constituent features, and (c) their advice for integrated management options in the research area. We concluded the workshops with a plenary moment for each participant to express their opinion about the research and the management of the research area. In addition, we asked all participants to answer three open questions in writing, i.e., what their perceived strong and weak points of our approach were, and what advice they could give us for further applications. Afterwards, we grouped their 124 expressed opinions and written answers into 13 feedback themes.

4. Results

4.1. Survey of stakeholders’ valuation

The respondents tended to value the CES indicators positively (Table 2). The indicators that were valued most were “area of meadows”, “area of meadows with grazing cows”, “number of ditches which are part of medieval ditch patterns”, and “area visible from the main road and the main hiking trail”. Only the CES indicator “area which likely contains archeological remains” and the negative impact “length of roads with much agricultural traffic” tended to be valued negatively by some stakeholder groups. Remarkably, “number of modern livestock barns” was valued moderately positively, even though it negatively impacts the ensemble of cultural heritage values. The CES that contributed most to the overall valuation of the peatlands was “sense of place”; “recreation and ecotourism” contributed the least (Table 3).

The differences between stakeholder groups were most pronounced regarding the CES “cultural heritage values”, with farmers valuing the individual CES indicators of this CES markedly lower, and the negative impact “number of modern livestock barns” markedly higher. In addition, farmers also valued the other CESs markedly differently than the other stakeholder groups, with lower scores for “aesthetic values” and higher scores for “sense of place”. They all awarded the individual CES indicator “area of meadows” the maximum score.

The average annual WTP for the CESs in the current situation was € 17.19 (Table 4). Remarkably, for each stakeholder group the average WTP is lower for all scenarios except for scenario 3 (wetter conditions), for which the recreational visitors are willing to pay more. Scenario 2 (scale enlargement of current land uses) is regarded most negatively, with the average WTP being 81% lower compared with the current situation. The differences between the scenarios can be attributed to differences in the amounts stated by the respondents who are willing to pay something, and inter-group differences in the number of respondents who are willing to pay something. For the current situation, 74% of all respondents are willing to pay € 23.67 on average per annum, resulting in an average WTP of € 18.53. For scenario 3 (wetter conditions) the average amount respondents are willing to pay is similar, i.e., € 23.24 per annum, but because only 61% of the respondents are willing to pay something, the resulting average WTP is € 13.91. For scenario 2 (scale enlargement of current land uses) the number of respondents willing to pay something is lower, i.e., 29%, and so is the average amount that they are willing to pay, i.e., € 12.49, resulting in an average WTP of only € 3.31 per annum.

4.2. Assessment of ecosystem services

All the scenarios have markedly different impacts (see Appendix). For instance, scenario 2 (scale enlargement of current land uses) results in fewer grazing cows and fewer ditches. Because both these CES indicators are highly valued (Table 2), scenario 2 is valued less than the other scenarios. In addition, the valuation of the scenarios reflects the spatial patterns of the CES indicators. For instance, the landscape is very open in the west of the area but is much less open in the southeast, which is why the western part of the research area is valued more positively, and the southeastern part more negatively (Fig. 6).

The CES valuation maps (Fig. 6) present a different perspective on CES valuation than the WTP, with less pronounced differences between the scenarios and the stakeholders. The main reason is that the CES valuation is more comprehensive and spatially detailed than the single-value, non-spatial WTP amounts. For instance, the recreational visitors are willing to pay 48% more for scenario 3 (wetter conditions) than for the current situation (Table 4), whereas their CES valuation index for scenario 3 is 8 percent lower (Table 5). The reason is they disfavor cultivated fields, which are abundant in scenario 3. Moreover, the cultivated fields negatively impact several of their favored CES indicators, because meadows with grazing cows and ecologically valuable meadow birds are displaced, and the openness is obstructed. Note that farmers have higher CES valuation indexes than the other stakeholders (Table 5). The main reason is the importance they attribute to the CES “sense of place”, which has a major impact on all scenarios.

The scenarios not only impact the CES indicators but also the costs and benefits (Table 6). The main differences are caused by the WTP amounts, the water management costs, and the crop yields (see appendix). Scenario 2 (scale enlargement of current land uses) has the most positive financial effects, but also the most negative non-financial effects. The reverse applies to scenario 3 (wetter conditions). The relative differences between the non-financial effects are much more pronounced than the differences in WTP (Table 4). Because the population of farmers is relatively small, their cumulative WTP is a modest sum for all scenarios, whereas the WTP of recreational visitors can be substantial, because their population is relatively large (see appendix).

Table 2
Average valuation of cultural ecosystem service indicators and negative impacts by stakeholder groups. Value scale ranges from -3 (very negative) to +3 (very positive).

Cultural ecosystem service	Indicators and negative impacts	Farmers N = 49	Inhabitants N = 177	Visitors N = 99	Total N = 295
Sense of place	Area of meadows	3.0	2.8	2.5	2.7
	Area of cultivated fields	1.3	0.8	0.3	0.6
	Area of meadows with grazing cows	2.8	2.6	2.0	2.4
Cultural heritage values	Number of ditches which are part of Medieval ditch patterns	2.0	2.5	2.6	2.5
	Number of old farmsteads	1.2	2.0	2.3	2.1
	Area which likely contains archeological remains	- 0.7	0.4	0.6	0.4
	Number of modern livestock barns	2.0	0.9	0.5	0.8
Aesthetic values	Area visible from the main road and the main hiking trail	2.3	2.4	2.5	2.4
	Area of osier beds	1.0	1.7	1.8	1.7
	Area with high ecological quality	1.7	2.1	2.2	2.1
Recreation and ecotourism	Length of hiking trails	1.0	1.5	1.6	1.5
	Length of cycling tracks	1.2	1.8	1.8	1.7
	Area with opportunities for recreational overnight stays	0.5	0.5	0.1	0.3
	Length of roads with much agricultural traffic	0.0	- 0.4	- 0.9	- 0.6

Table 3
Relative contribution of the cultural ecosystem service to the stakeholders' overall valuation of the peatlands.

Cultural ecosystem service	Farmers N = 49	Inhabitants N = 177	Visitors N = 99	Total N = 295
Sense of place	59%	36%	28%	33%
Cultural heritage values	13%	22%	24%	23%
Aesthetic values	16%	26%	29%	27%
Recreation and ecotourism	12%	16%	19%	17%

4.3. Feedback from stakeholders

In the workshops we witnessed how stakeholders used both the CES valuation and the monetary assessments when deliberating the feasibility of the scenarios and their constituent features. The DialogueMaps tool revealed differences in CES valuation between stakeholder groups (Table 5), as well as the spatial consequences of stakeholder preferences that had so far been inexplicit (Fig. 6). This increased the awareness of CES values, as well as options for synergies and trade-offs. For example, if scale enlargement of current land uses (scenario 2) were to become necessary for financial reasons (Table 6), the stakeholders suggested that these developments be confined to the southeastern corner of the research area, where CES valuation is lowest (Fig. 6). In areas with higher CES valuations, they envisioned agricultural enterprises with mixed features of all scenarios.

Remarkably, the negative impacts “number of big modern livestock barns” and “length of roads with much agricultural traffic” were key features of the deliberations. Regarding the big modern livestock barns, inhabitants and recreational visitors stressed the negative impact on the CES “cultural heritage values”, and farmers claimed it positively contributed to the CES “sense of place” of the agricultural peatlands. This instigated a discussion of how differences in transcendental values shaped their valuation of the research area and how these differences should be reflected in the land use and water management in the research area. Eventually, they all agreed the livestock barns would be necessary if the scale of agricultural farms was enlarged (scenario 2), but several adjustments would be feasible, which could minimize their negative impact on the ensemble of cultural heritage values. A similar debate ensued regarding the roads with much agricultural traffic, with farmers claiming that traffic by the inhabitants of the villages also had a negative impact on the CES “recreation and ecotourism”. Eventually, they all agreed that new hiking trails (scenarios 3) were preferable to a new road to accommodate the agricultural traffic (scenario 2).

The approach's strong point that stakeholders mentioned most frequently in their feedback was the suitability of the approach to support a participatory planning process (Table 7). Their acclaim especially focused on the ability of the approach to support a discussion between different stakeholder groups, and the awareness it raised for sustainable adaptations. The feedback on weak points mainly concerned disputable assumptions and shortcomings of DialogueMaps. It is noteworthy that the broad-brush character of the reconnoitering phase of our approach inevitably results in disputable assumptions, primarily because aspects of CESs are omitted or oversimplified. Both shortcomings can easily be remedied in subsequent phases that focus on secondary, more detailed and critical analyses and dialogues. For example, by including minority views of subgroups of stakeholders.

Almost all the stakeholders advised proceeding with more detailed assessments, believing this would further enrich the social learning process they had embarked on. Moreover, they suggested a further exploration of the underexposed features of the scenarios. Due to unfamiliarity with some CES indicators, some values appear to be not fully preformed, e.g., the value of archeological remains. The elicitation of these values may be enhanced by providing additional information prior to the valuation, e.g., an oral presentation by an expert on the subject.

5. Discussion

To further advance techniques for plural valuation of ESs, many authors have advocated the combined use of monetary and non-monetary assessments (Beria et al., 2012; Daniel et al., 2012; Guerry

Table 4
Stakeholder groups' average willingness to pay for the current situation and three scenarios [€ yr^{-1}], and difference (in %) by comparison with willingness to pay for the current situation.

Scenario	Farmers N = 49		Inhabitants N = 177		Visitors N = 99		Total N = 295	
0. Current situation	€ 18.53		€ 19.38		€ 13.44		€ 17.19	
1. Business as usual	€ 17.68	-5%	€ 18.13	-6%	€ 13.08	-3%	€ 16.13	-6%
2. Scale enlargement of current land uses	€ 8.30	-55%	€ 2.93	-85%	€ 2.25	-83%	€ 3.31	-81%
3. Wetter conditions	€ 3.35	-85%	€ 10.86	-44%	€ 19.94	48%	€ 13.91	-19%

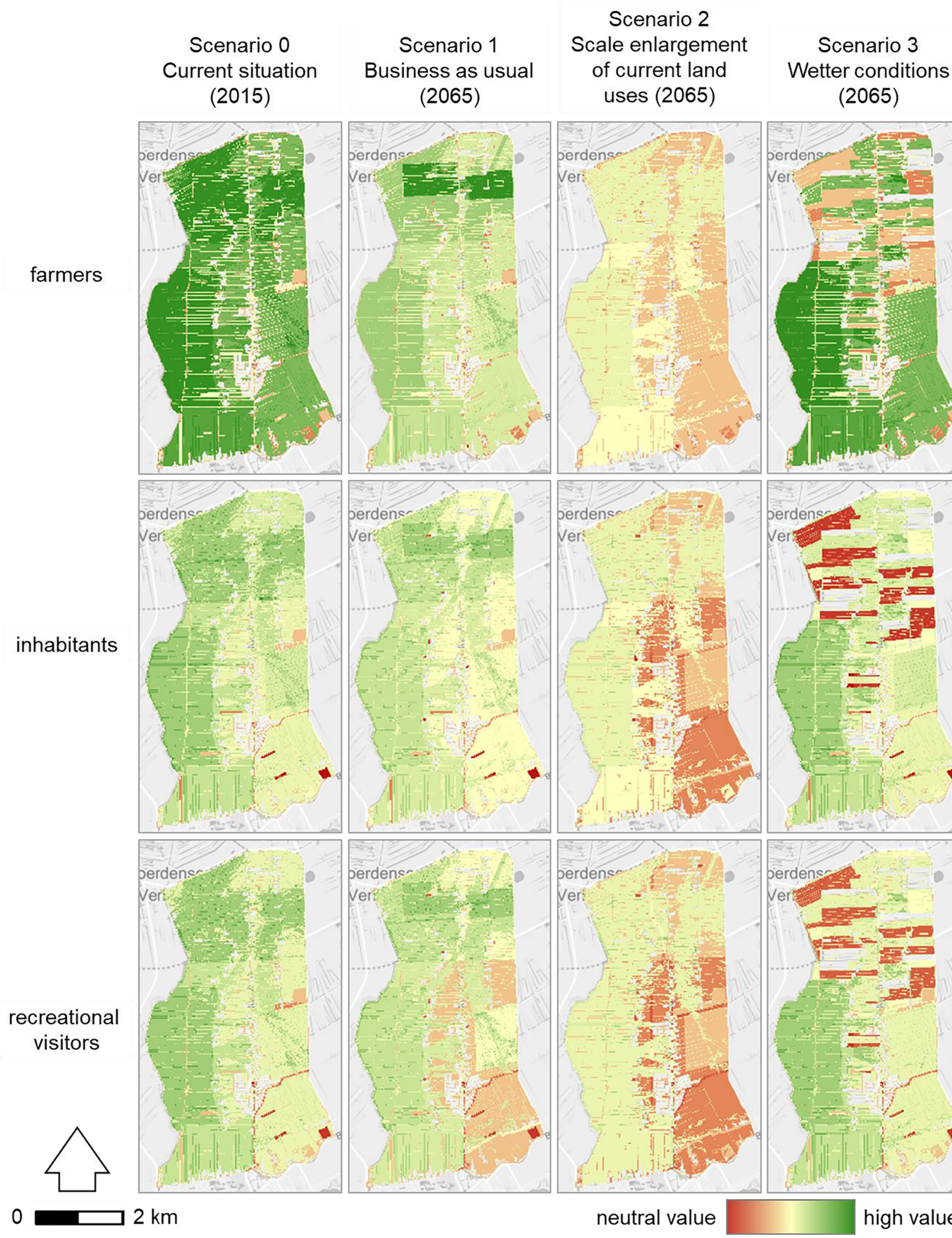

Fig. 6. Valuation of cultural ecosystem services by three stakeholder groups for the current situation and three scenarios. Note that the color range was chosen to accentuate differences, with red colors reflecting neutral values. Respondents were not asked to value built-up areas and cranberry fields.

et al., 2015; van den Belt and Stevens 2016; Jacobs et al., 2016). Arguably, for a successful combination of assessments the mapping of CESs is key. Willemen et al. (2015) suggest best ES mapping practices should be robust, transparent, and stakeholder-relevant. However, most examples of CES mapping practices reflect research on a regional, national, or continental scale, frequently with a marked emphasis on recreation and ecotourism (Hernández-Morcillo et al., 2013).

Our case study reflects research on a local scale, with a focus on a broad range of CESs. We have demonstrated how in these settings, robust, transparent, and stakeholder-relevant CES valuation maps can be used to evaluate planning scenarios. In the workshops, we witnessed how stakeholders used the maps effectively in conjunction with monetary assessments and negotiated planning options across the preferences of multiple stakeholders and multiple evaluative endpoints.

Table 5
Index of the aggregated valuation of cultural ecosystem services by stakeholder groups for the current situation and three land use and water management scenarios (average valuation of the current situation = 100), and difference compared with the current situation [%].

Scenario	Farmers N = 49		Inhabitants N = 177		Visitors N = 99		Total N = 295	
0. Current situation	111		98		91		100	
1. Business as usual	94	-17%	86	-12%	85	-6%	89	-11%
2. Scale enlargement of current land uses	74	-37%	74	-24%	74	-17%	74	-26%
3. Wetter conditions	100	-10%	90	-8%	84	-8%	91	-9%

We therefore believe the added value of our case study is that it demonstrates how participatory CES valuation approaches (e.g., Dramstad et al., 2006; Van Berkel and Verburg 2014; Zoderer et al 2016) can be used to integrate CESs as an additional evaluative endpoint in multi-criteria approaches that combine monetary and monetary assessments (e.g., Newton et al., 2012; Bateman et al., 2013; Sijtsma et al., 2013). Moreover, it demonstrates how the CES valuation can engage the local stakeholders in a planning process, instigating a process of value deliberation and participatory design of management options.

Our approach can be of added value for other local planning processes too, provided that its strengths and weaknesses are duly considered. A main challenge of our approach is the difficulty of designing a set of management scenarios and CES indicators that can not only engage a broad population of stakeholders but can also yield credible valuation results. To achieve this, we solicited the help of local experts and governmental organizations. We suggest future research follows up this approach, exploring its strengths and weaknesses in detail. For example, the participatory selection of CES indicators will enable accurate targeting of the CESs most relevant for the key stakeholder groups. However, it also brings the challenge of integrating laypersons' perceptions of "their" social-ecological system with a scientific system of classifying ESs. In previous studies, this challenge was dealt with by incorporating additional indicators which did not reflect CESs (Saarikoski et al., 2018). In our case study, the participating stakeholders regarded "modern livestock barns" and "roads with much agricultural traffic" as key elements of a discussion on planning options. Yet these elements cannot be classified as CES indicators because they do not contribute positively to a CES. Neither are they ecosystem disservices because they lack an ecosystem origin (Shackleton et al., 2016). For these reasons, we opted to classify them as big negative impacts on CESs. Although this resulted in a survey that is easily interpretable from a layperson's perspective, methodologically it remains somewhat ambiguous. Further examples that address this issue are welcome.

Another challenge of our approach is the difficulty of designing a questionnaire which can objectively elicit the stakeholders' valuations. We used visualizations to illustrate our CES indicators (Fig. 3) and scenarios (Fig. 5). Although previous studies have shown that visualizations are a powerful tool to elicit stakeholders' preference for landscapes and their constituent elements (Dramstad et al., 2006; Van Berkel and Verburg 2014; Zoderer et al 2016), an evaluative bias can occur if respondents are unclear what exactly they are asked to evaluate (Scott and Canter, 1997). We tried to limit the bias by using non-manipulated photos of the research area to visualize the CES indicators, supplemented by short descriptions to elucidate what the photographs represented. We also used photographs of the research area and short descriptions to visualize the scenarios, but for obvious reasons, we needed to manipulate the photographs which represented the scenarios. To limit the bias that may have resulted from our manipulations, we chose to visualize multiple locations. Arguably, this may have been insufficient to exclude all bias in the stated WTP amounts. We are aware of the possible bias but deemed it acceptable for the broad-brush character of the reconnoitering phase of our case study, envisioning more comprehensive and accurate valuations would ensue in follow-up phases, including ample opportunities to deliberate to what extent shared values transcend the stated individual preferences.

Besides exploring how CES valuation can advance participatory resource management, our paper also aimed to point out avenues for effectively engaging stakeholders. In our case study, we achieved stakeholder involvement via a participatorily designed valuation strategy, a well-advertised internet survey, and deliberative workshops. The response of the three separate stakeholder groups in our survey was equal to or greater than the overall response in comparable CES valuation studies that employed more time-consuming face-to-face survey methods (Bryan et al., 2010; Plieninger et al., 2013; van Berkel and Verburg 2014). Moreover, our strategy resulted in a response of approximately 58% of the key stakeholder group in the research area, i.e. the farmers. We believe the high response rate reflects the accurate targeting of the CESs relevant for this stakeholder group. That farmers perceived the CESs as relevant was illustrated by the spontaneous urging of young farmers during our survey at the annual "cow market" fair to engage them in planning processes concerning "their" area. The commitment of farmers was reflected in the high values they attributed to the CES "sense of place" and its constituent indicators (Table 2). A contributing factor to the high response rate was the round-the-clock opportunity to respond to the survey: 60% of the farmers responded after working hours, in the evening or at night. We suggest both factors are duly considered when designing CES valuation approaches.

The main shortcoming of our case study was that for budgetary reasons the follow-up phase had to be postponed. We were therefore unable to further support and enrich the social learning process the stakeholders of our case study had embarked upon. In this regard, our case study shared the fate of many research-driven processes that were able to raise awareness of multiple ESs but were not used instrumentally to effectuate actual changes in resource management (Saarikoski et al., 2018). In our case study, the first loop of the social learning process stressed previous observations of how participatory mapping might elicit values not reflected in WTP amounts (Kenter

Table 6
Distributed monetary effects of three scenarios, i.e., the differences between the scenarios in 2065 and the current situation [€ ha^{-1} yr^{-1}]. The financial and non-financial effects are aggregated separately.

Scenario	1. Business as usual		2. Scale enlargement of current land uses		3. Wetter conditions	
Effect	Financial	Non-financial	Financial	Non-financial	Financial	Non-financial
Water authority	€ -281		€ -29		€ -268	
Municipality	€ 42		€ 25		€ 98	
Businesses	€ 21		€ 64		€ 43	
Farmers	€ -1	€ 0	€ 250	€ -1	€ -273	€ -1
Inhabitants	€ 274	€ -2	€ 289	€ -29	€ 264	€ -15
Recreational visitors		€ 59		€ -657		€ 656
Society at large		€ 47		€ 156		€ 111
Total	€ 56	€ 104	€ 599	€ -531	€ -135	€ 751

Table 7
Feedback from the 16 stakeholder participants in the workshops. The percentage of stakeholders that mentioned the feedback is given in parentheses.

Strong points of approach	Well suited to support a participatory planning process (50%)
	Enhances the apprehension of the social–ecological system (31%)
	Quantitative non-monetary interpretation of values (31%)
	User friendliness of DialogueMaps (31%)
	Integrated assessment (13%)
Weak points of approach	Several disputable assumptions (69%)
	Several shortcomings of DialogueMaps (63%)
	Difficult interpretation of the valuation maps (44%)
	Arbitrary selection of stakeholder groups (38%)
Suggested advice	Follow up process with more detailed assessments (94%)
	Include additional assessments (63%)
	Continue the quest for sustainable land use scenarios (56%)
	Improve the technological performance of DialogueMaps (38%)

2016b). In our case study, the average WTP of the stakeholder groups suggested marked differences between the scenarios (Table 4). These results were largely caused by differences in the proportion of respondents unwilling to pay anything. Yet the CES valuations clearly showed that all respondents assigned some value to the CESs, resulting in less marked differences between the scenarios (Table 5). In the workshops we witnessed how this realization dawned on the participating stakeholders, instigating a process of value deliberation between stakeholder groups. Moreover, they discussed how differences in transcendental values shaped their valuation of the research area, e.g., regarding the reasons why farmers attributed higher values to the CES "sense of place" in comparison to other stakeholder groups.

It is plausible that a second loop of the social learning process that the stakeholders of our case study had embarked upon could have resulted in the formation of shared cultural values, in the sense that Irvine et al. (2016) conceive of such values as normative constructs reflecting communal values beyond the aggregated utilities of individuals. Such multi-loop social learning processes would require additional deliberative methods to elicit shared values. Kenter (2016a) presents a variety of approaches and methods for this task, ranging from analytical-deliberative—e.g., deliberative monetary valuation and participatory modeling—to interpretive-deliberative—e.g., storytelling and arts-led dialog. We believe our approach is well suited for integration with additional analytical-deliberative methods, provided that the interactive features of the DialogueMaps tool are further enhanced. For instance, the transparency of the valuation process may be enhanced by allowing participants to adjust their valuation scores (Table 2), which are currently regarded as fixed parameters. This option would also allow them to further deliberate their valuation, both individually and as a group. Furthermore, an interactive design of the scenarios would enhance the support to mediation and negotiation. This option would require the use of serious gaming techniques, transforming DialogueMaps into a tool for interactive simulation.

6. Conclusion

To advance our understanding of which valuation approaches are best suited to support decision-making in different contexts and at different scales, this paper has demonstrated how participatory CES valuation was used in the reconnoitering phase of a local planning process in a part of the Dutch peatlands, integrating monetary and social valuation techniques, underpinned by biophysical modeling. The added value of our approach is that it:

- successfully engages key stakeholder groups, by a participatorily designed valuation strategy, a well-advertised internet survey, and deliberative workshops;
- presents spatially explicit CES valuation maps from multiple stakeholder perspectives, revealing the spatial consequences of preferences that were not explicit beforehand;
- combines monetary assessments with non-monetary CES valuation, supported by the interactive mapping tool DialogueMaps, which can instigate a process of value deliberation between stakeholder groups and allows for negotiation across multiple evaluative endpoints.

Our approach can be of added value for other local planning processes too, especially in conjunction with additional deliberative methods. Ultimately, this may result in integrated valuation processes that enable multiple stakeholder perspectives and plural value dimensions to be integrated into policy and management decisions.

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Appendix

Characteristics of the scenarios

In the final workshop of the first step of our research approach (see Section 3.2), we used the features that were highlighted by the participants of a previous workshop to design coherent topographic maps of the current situation and three land use and water management scenarios with diverging impacts on the research area (Fig. 3). In addition, we made assumptions regarding the features of the scenarios (Table A1). In the third step of our research approach (see section 3.4), using the assumed characteristics and the maps, an integrated assessment was made of soil subsidence, and the resulting impacts (Table A2).

Table A1
Assumed features of the current situation and three scenarios.

Features	1. Business as usual	2. Scale enlargement of current land uses	3. Wetter conditions
Surface water levels	55 cm below ground in all agricultural areas, 35 cm below ground in villages	55 cm below ground in all agricultural areas, 35 cm below ground in villages	55 cm below ground in southern agricultural areas, 35 cm below ground elsewhere
Meadows	2,067 ha	2,075 ha	993 ha
Grazing cows	On all meadows	On meadows close to farmsteads	On all meadows
Cultivated fields	23 ha	6 ha	1,036 ha
Average farm size	65 ha	416 ha	51 ha
Farmers	66	21	83
Field drains	No	On all agricultural land	No
Medieval ditch patterns	Identical to the current situation	50% less ditches than in the current situation	Identical to the current situation
Modern livestock barns	5 large livestock barns	5 very large livestock barns	No large livestock barns
Osier beds	Identical to the current situation	Identical to the current situation	Several additional locations
Hiking trails	Identical to the current situation	Identical to the current situation	Additional hiking trail
Cycling tracks	Additional bicycle track	Identical to the current situation	Identical to the current situation
Opportunities for overnight stays	Recreational area expands by 2 ha	Recreational area expands by 5 ha	Recreational area expands by 2 ha
Traffic	Identical to the current situation	More spread out, due to an additional road	Identical to the current situation
Recreational visitors	165,000 yr^{-1} (+10%)	195,000 yr^{-1} (+30%)	180,000 yr^{-1} (+20%)
Villages	Identical to the current situation	Villages expand by 5 ha	Identical to the current situation

Table A2
Assessed features of the current situation and three scenarios.

Features	1. Business as usual	2. Scale enlargement of current land uses	3. Wetter conditions
Soil subsidence	8 mm yr^{-1}	6 mm yr^{-1}	7 mm yr^{-1}
CO_2 emission	45.5 10^6 kg yr^{-1}	32.5 10^6 kg yr^{-1}	37.9 10^6 kg yr^{-1}
Pumps	4	3	3
Weirs	51	47	52
Inlets	30	30	50
Embankments	33.8 km	14.4 km	32.5 km
Average height of embankments	99 cm	85 cm	91 cm
Houses with damaged foundations	214	214	212
Houses with damage due to high groundwater tables	270	186	485
Average crop yield on meadows	88%	94%	90%
Average crop yield on cultivated fields	99%	94%	99%

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