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Framing ecosystem services: Affecting behaviour of actors in collaborative landscape planning?

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ABSTRACT

The concept of ecosystem services shifts the human–nature relationship from a conservation-oriented into a utility-oriented one. Advocates of the concept assume that it can alter the attitude and behaviour of human actors with respect to nature. The ecosystem services concept has so far received little attention in scientific literature about collaborative landscape planning. Consequently the potential of information about ecosystem services to influence landscape planning processes is unknown. In this paper we address the impact of different storylines about ecosystem services on actor behaviour. In these storylines, we distinguish three frames on ecosystem services: a social–cultural frame (emphasizing social–cultural services), an economic frame (emphasizing production services) and a sustainability frame (highlighting regulation services). We propose a conceptual framework in which we connect the concept of framing to attitudinal, sender–receiver and contextual factors. The framework is illustrated by a spatial planning experiment with academic students and by a case of collaborative landscape planning. The student experiment illustrates how attitudinal factors may intervene in the impact frames on actor behaviour. The case analysis shows how researchers who facilitated collaborative landscape planning used various frames as they attempted to build up the actor network to create collaborative relations in different phases of the planning process. The significance of our paper is that we provide an approach to investigate how information on ecosystem service benefits is processed by multiple actors in collaborative landscape planning processes. Our exploration implies that planners who facilitate a collaborative planning process have to be aware that purposively using ecosystem service frames stimulates engagement of actors with diverging backgrounds.

Introduction

In scientific literature, the ecosystem services concept is often considered as an argument to support the conservation of nature and biodiversity. For example, it has been suggested that an ecosystem service-based conservation approach raises more support (Goldman et al., 2008; Schneiders et al., 2012) or financial resources (Pagiola et al., 2010; Haslett et al., 2010). The implicit assumption is that if people become aware of the benefits of ecosystem services, their behaviour with respect to nature may change. This influence is particularly relevant when ecosystem services are applied to enhance stewardship of environmental resources (Chapin et al., 2009) or used to foster collaborative planning of landscapes (Opdam, 2013). Such forms of collaborative management have attracted increasing interest because the role of the government as single actor has been shifted into multi-actor governance. This shift implies that the responsibility of the state for environmental management is shared with a range of other actors, often at lower levels of spatial scale, implying an increased need for cooperation

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between these actors and across governance scale levels (Berkes, 2009; Newell et al., 2012). The merits of using the ecosystem services concept in strategies that facilitate such collaborative management modes have been explored poorly.

In this context it is of particular interests to know how information on ecosystem services may enhance collaborative decision making and social network relations. For example, actors of a planning group may discover that because the same piece of landscape produces a variety of benefits, managing that piece for ecosystem services creates multiple values. Actors with different interests may interpret these multiple values as a motive for collaborative landscape management. However, whether or not the discovery of shared benefits turns into collaborative action is influenced by the many different meanings that benefits may have to different actors (Fig. 1). Benefits may be expressed in terms of (for example) money earned by selling crops on the market, augmented mental health obtained by staying in green sites (Ward Thompson, 2011), or acquiring purified surface water by natural processes (Herzon and Helenius, 2008). In these examples benefits are expressed in terms of monetary value, improved well-being or sustainable use of resources. Which expression is meaningful to someone depends on attitude, personal capabilities and contextual factors (Stern, 2000). Indeed, Casado-Arzuaga et al. (2013) found that greenbelt users and interest groups attributed different levels of importance to ecosystem services depending on the direct or indirect benefits they perceived, but also depending on their environmental attitude. Therefore, we propose that the benefits of ecosystem services have different meanings to different actors within local planning groups (depending on their interests and attitudes), leading to different actor responses to information about potential benefits to be gained by adapting the landscape. Because knowledge about information–response relationships are helpful in managing multi-actor landscape planning processes, our aim is to explore how responses to information about ecosystem services depend on how the benefits are conveyed, received and interpreted by actors using and adapting the landscape.

Our approach is based on the concept of framing. This concept has been proposed to understand when and how the perspectives or storylines through which information is presented leads to different understandings of the issue and different choices (Kahneman and Tversky, 1984). How the framing of information about ecosystem services interacts with human norms and values and how this affects collective landscape management has rarely been addressed in scientific literature (Reyers et al., 2010; Hubacek and Kronenberg, 2013).

Therefore, the aim of this paper is to explore how information on ecosystem services can be framed and how different frames may be responded to by actors with different attitudes towards the benefits of nature. Because we are convinced that scientific information has a role to play in landscape governance, we focus on information provided by scientists to multi-stakeholder groups involved in adapting local landscapes to future needs. In the following, we first propose a theoretical framework that relates, through intervening factors, three types of ecosystem services (often distinguished in literature) to types of behaviour of planning actors. Through analysis of a simple framing experiment and a collaborative landscape planning process we facilitated some years ago, we illustrate how this conceptual framework may be used to discover how different ways of framing ecosystem services interact with personal motives and attitudes of human actors.

Theoretical framework

We will use the definition of ecosystem services as proposed by Fisher et al. (2009): “Ecosystem services are the aspects of ecosystems utilized (actively or passively) to produce human well-being”. Fisher et al. (2009) pointed out that services must be ecological phenomena, i.e. functionally emerging from processes within the landscape. The definition implies that services may be provided without being utilized actively. Several classifications of ecosystem services have been proposed, the probably most popular one being the classification proposed in the report of the Millennium Ecosystem Assessment panel (MEA, 2005). Based on this report, we distinguish production services (for example food, drinking water), regulation services (for example pollination and water purification), and social services (e.g. spiritual experiences, enjoying popular species). We leave out the category of supporting services as they do not have directly perceivable benefits.

We limit our study to the use of the ecosystem services concept in collaborative landscape planning (Lane and McDonald, 2005; Gruber, 2010). In this application, the bottom-up ambitions of a local community of actors involved in the use and care of the landscape is put central, instead of top-down policy targets. These local ambitions on the future landscape can be expressed in terms of ecosystem service benefits (Termorshuizen and Opdam, 2009). An important step in the collaborative planning process is to decide about how and where adaptations in the landscape would meet with demands for these benefits. Green infrastructure, being the network of semi-natural landscape elements, is considered as the specific physical structure of the landscape which is particularly relevant as the place where most services concentrate (Opdam, 2013). The local community is conceptualized as a social network of actors (Bodin and Crona, 2009) who either demand for services, supply them through intervening in the landscape, or organize a match between supply and demand.

Ecosystem services as a frame itself

The concept of ecosystem services (Daily and Matson, 2008) itself can be considered as a breakthrough frame (Brick and Cawley, 2008): a new and successful way of understanding and representing the relation between humans and nature, with the potential to align economic forces with conservation. It started as a metaphor to describe our relation to nature and build support for conservation, but it has been developed into a full-blown scientific framework, a broadly deployed policy instrument and an elaborate economic valuation tool (Norgaard, 2010). Through the emphasis on the attributes of nature that contribute to human well-being, this framing has a predominantly anthropocentric character, and puts less emphasis on non-human organisms or the intrinsic value of nature (Luck et al., 2012). The economic metaphor depicting ecosystems as (natural) capital, and ecosystem functions as services, frames the relation between humans and nature as an economic exchange relation, implying the equivalence and substitutability of services that are of similar value for people. This frame has been debated fiercely in scientific literature, with arguments including ethical (“nature should not be monetized”) and normative (the “ecosystem services are always good” implication) ones (McCauley, 2006; Schröter et al., 2014). However, in the context of collaborative landscape planning a purely utilitarian logic or a focus on monetary valuation is not appropriate because it prevents other values being considered (Dinnie et al., 2013). When considering value, we will therefore use a broad definition, including all dimensions of well-being.

Apart from reframing the human–nature relationship, the concept has a few other implications (Baker et al., 2013) with respect to collaborative landscape planning. A starting question about what the most important ecosystem services are in a particular area provides a positive way of framing the environment, contrasting with framing the environment as a problem or constraint. Ecosystem services can also function as an integrating concept by implying

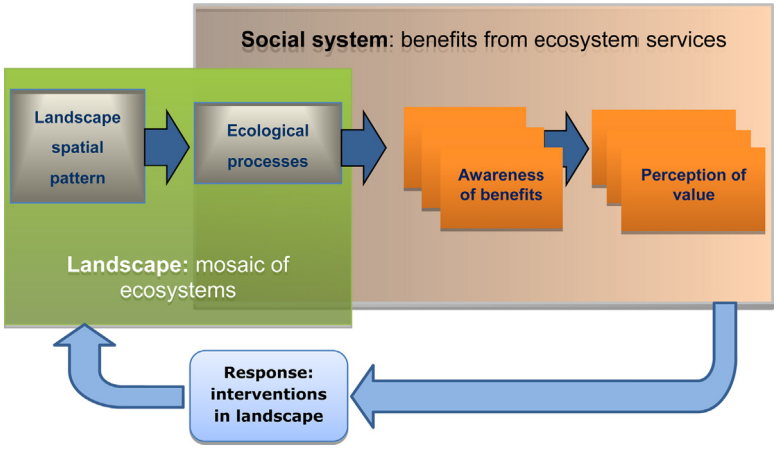

Fig. 1. Representation of the collaborative landscape planning process. The upper part represents the transformation of information about the functioning of the landscape into multiple benefits and values as perceived by stakeholders of the landscape. The lower part represents a response of these stakeholders resulting in interventions that change the use or physical pattern of the landscape.

that one landscape may provide multiple services, thereby fostering understanding of shared benefits rather than conflicts. Through bridging between the domains of ecology and economy, the concept may be of particular value where discussions get stuck in binary arguments between environment and economic development (Baker et al., 2013). All these characteristics of the concept may help to align actors and foster collective action.

Understanding ecosystem services as a frame in itself clarifies some of the characteristics of the concept, but the question remains how to use or frame information about ecosystem services to foster collective action in landscape planning. An important caveat here is that the concept is a pretty complex one and that the term itself does not seem to resonate well with many people (Baker et al., 2013). Alternative terms like "landscape services" (Termorshuizen and Opdam, 2009) have been proposed to remedy this – people may not feel like they live in an ecosystem, but they do recognize living in a landscape – and it is also possible to use ecosystem services as a guiding concept in a planning process without using the term literally.

We are interested in how the role of ecosystem services in landscape planning depends on the way the benefits are framed. Framing has been shown to affect people's decision preferences (Kahneman and Tversky, 1984; Levin et al., 1998). Problems that are formulated in different ways, e.g. in terms of gains versus losses, trigger different preferences even if the underlying problem remains the same in terms of probabilities and expected outcomes. This happens through the setting of anchors, i.e. points of reference against which alternatives are evaluated. Examples of such anchors are the reference to economic prosperity or sustainability, and the use of the time frame (a short-term versus a long-term horizon). Frames can be understood as strong and generic storylines that influence action in practical situations. They allow people to make "a graceful normative leap from is to ought" (Schon and Rein, 1994), because different frames point towards different responses or action strategies.

Frames of ecosystem services

The benefits of ecosystem services to users of the landscape can be framed in various ways. We suggest three possible frames: *an economic frame* emphasizing that ecosystem services provide profits expressed in terms of money (e.g.: it is cheaper to use ecosystem services, you can earn money by selling goods from ecosystems), *a sustainability frame* highlighting the benefits of using natural processes (e.g.: using ecosystem services costs less energy or resources), and a *social–cultural frame*, emphasizing benefits increasing social values (e.g.: using the land for ecosystem services results into nicer landscapes). The distinctions between these three frames resonates with discussions about the different value domains that are used in valuing ecosystem services: the monetary value domain, the biophysical value domain and the socio-cultural value domain (Martín-López et al., 2014; Oteros-Rozas et al., 2013). These different value domains also imply different ways of framing the ecosystem services, through selectively highlighting or obscuring particular values, and thereby leading to different valuations of ecosystem services and trade-offs (Jax et al., 2013; Martín-López et al., 2014). These three frames (Fig. 2) are also congruent with a popular classification of ecosystem services (MEA, 2005). The economic frame parallels the category of p*roduction services*. This category refers to using nature to produce market goods that can be sold to earn income. They relate to values of the profit-oriented *homo economicus*. The category of *social services* represents the social–cultural frame, pertaining to values perceived by humans in direct contact with the natural environment and therefore linked to the value-oriented human being. Such values may relate to land use history assets or the occurrence of wild species of animals that people like to see. The category of *regulation services* aligns with the sustainability frame, and combines both profit and value orientations by referring to the role of natural processes in creating profit or societal value. For example natural regulation of pests in crops can be viewed from the point of view of the profit oriented producer, but also contributes to healthy food. Using less pesticides and using the potential of nature to do the job contributes to sustainability goals. The farmer can switch to natural pest control because he/she believes that this adds value perceived by the society, and because by consequence the farmer will gain a stronger position in society and prepare for an expected increasing demand for sustainable products.

Intervening factors

Receivers of information in collaborative landscape planning may respond differently to framed ecosystem services information. Some respond in line with the framed information and will be activited to respond to the opportunity to gain benefits by intervening in the landscape, while others do not respond at all. This phenomenon is mainly explained by a different interpretation of information, as a result of intervening factors. Based on literature we distinguish three types of intervening factors that might be relevant in this research (Fig. 2).

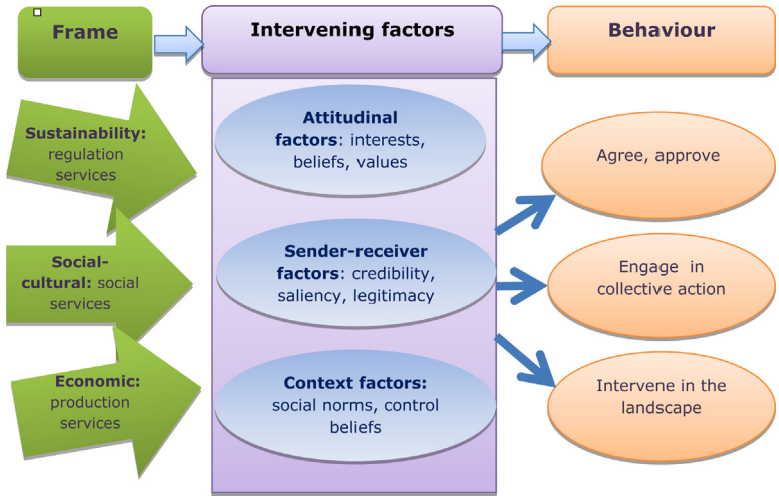

Fig. 2. Framework for analysing the relationship between framed information about ecosystem service benefits and three types of behavioural responses of receivers in three phases of a landscape planning process. Intervening factors interact with the framed information and thereby affects whether or not a response is elicited.

Attitudinal factors. Receivers interpret and disentangle framed information based on their values (Vaske and Donnelly, 1999) and their beliefs (Dake, 1991; Douglas, 1978) related to nature. Actions are often based on routine and habits (Giddens, 1994), so that information that is in line with values and beliefs rooted in the routines or habits is more likely taken into account than information that describes a totally different view. In the latter case, it may even happen that the information is discarded by the receiver because it does not 'match' with his/her presuppositions (Festinger et al., 1956; Mezirow, 1990). For example information suggesting the need for nature protection because of the biodiversity values may be disregarded by people who consider nature as something that can be used and exploited, whereas others with more ecocentric values may respond positively.

Interests also determine how receivers respond to information. Rational choice theory (Homans, 1961) suggests that information implying losses to the receiver is likely to be disregarded. For example, when the information calls for using ecosystem services to generate money, the probability that the receiver will respond positively to the information is higher than in case it will cost time or investment.

Sender–receiver factors, including the willingness as well as the ability to make a cognitive effort to understand the message. These factors pertain to the relationship between the sender (the source of information) and the receiver (the interpreter of information). Cash et al. (2002) describes salience, credibility and legitimacy to be key factors in communicating scientific information across science–practice boundaries. Salience is the relevance or importance of information for the problems at hand. Information can be salient, but not credible: because of the sender, or because of the lack of evidence. No matter how salient the information, if the receiver finds information not credible, the information will most likely not strongly influence their decision making. For example, policy makers who are familiar with or already have a preference for certain research institutes, will be more likely to consider information from these institutes as being credible. Information from another source, perhaps evenly important and contributing to the needed information, is less likely to be deemed credible. Legitimacy refers to the so-called 'fairness' of the information (Cash et al., 2002). A factor that affects legitimacy is the representativeness of parties involved, or the openness about where information comes from and how it is generated. These three aspects of information, salience, legitimacy and credibility, can positively or negatively influence each other: increasing for example salience by adding more informational sources to the message) can decrease another aspect (for example the credibility, because the message will become more diffuse).

Contextual factors: social norms and control beliefs. Even when the receiver is willing to positively respond to a message, it is mainly this third type of factors that determines the attitude to result in actual behaviour (Dahrendorf, 1968; Elster, 1989). In certain situations, like community engagement workshops, it would be strongly appreciated if all participants committed to protect the ecosystem services that were jointly planned in their area, because of the social norm of being thrustworthy. In addition to the above-mentioned factors that determine if the receiver is willing to understand the message, control beliefs (Ajzen, 1991) may hamper actual behaviour when participants doubt whether they have the resources and ability to respond. For instance, when a farmer doubts whether he or she has sufficient knowledge and understanding to carry out ecological pest control.

Behavioural responses

Many classifications of behaviour have been proposed in literature (Jaccard and Blanton, 2005). In the context of this paper, we focus on a classifaction based on the content of behaviour rather than on its determinants or consequences. Both individual level and group level behaviours are relevant. Based on the list of possible behaviours presented by Jaccard and Blanton (2005) and considering the different phases of the landscape planning process (diagnosis, goal setting, design of solutions, implemenation) as well as the behaviours that are relevant in these phases, we propose to distinguish three categories of positive responses to information about the potential benefits of ecosystem services. The first category is to align with the content of the information, which is often an individual response. The second category is to comply with the shared goal of landscape planning and the proposed interventions, express support in deliberations and endorse agreements. The third category encompasses actions of implementation, including taking a role in the implementation process and actually contributing to collective interventions by investing time and/or money. In all categories, there is a zero response possibility. Actors may not respond either because they think the information is not in their interest (attitudinal factor), or because they do not trust the source (sender–receiver factors) or because they consider the suggested intervention in the landscape to be beyond their competence (control beliefs). Thus, we distinguish three categories of

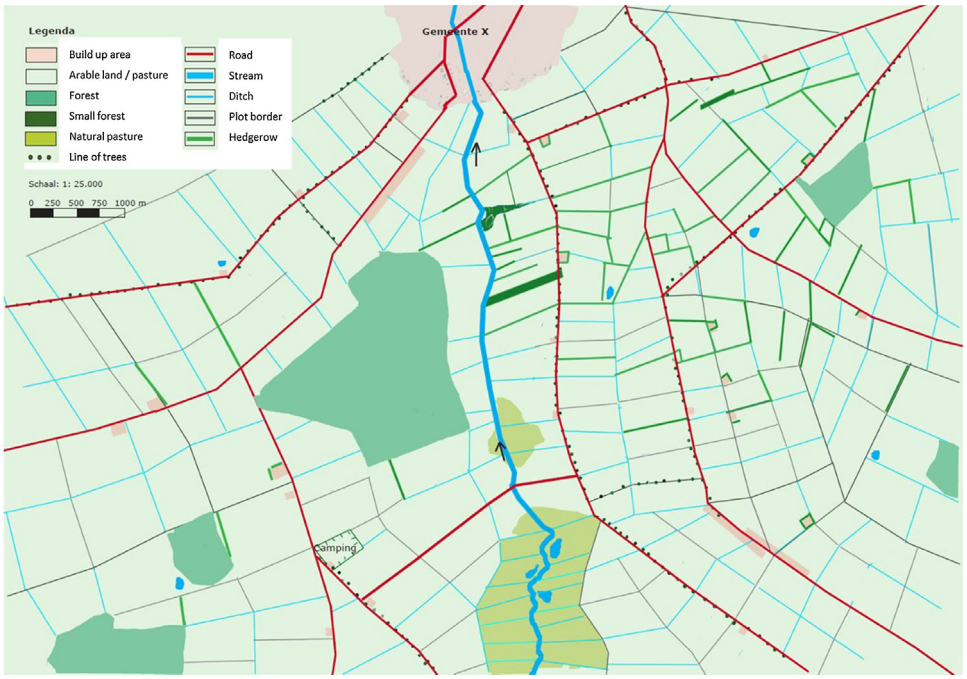

Fig. 3. The landscape used in the framing experiment. Participants were asked to plan a certain amount of green infrastructure in the landscape and to motivate how this would improve different ecosystem functions. The landscape was designed in such a way that it was suitable to strengthen the social–cultural, production and regulating services according to the frames. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

responses to information on ecosystem servcies: agree with the informational content, engage in collective activities concerning goals and solutions, and perform interventions in the landscape (Fig. 2). These three responses together constitute an increasing graduation of engagement, and therefore can be seen as three levels of response.

Illustrating the framework

In this chapter we illustrate how the framework can be used to explore the impact of framing ecosystem services in collaborative landscape planning. The first illustration pertains to an experimental situation which we created during a university course on environmental management, aiming to understand how different frames relate to planning behaviour, as well as the effect of intervening individual attitudinal factors as explanatory variables. The second illustration is a retrospective analysis of a design process conducted several years ago, which focusses on the role of intervening factors. We emphasize that this empirical material can only serve as an illustration. A genuine testing of the framework requires more thorough experiments in real planning situations and a systematic analysis of a series of cases. We mainly provide these illustrations to show how the framework can guide empirical analysis of framing ecosystem services.

Framing ES: An experiment

A paper-and-pencil framing experiment was carried out among 39 international Master students in Environmental Management to explore the effect of framing ecosystem services on green infrastructure planning behaviour. By this behaviour we mean allocating semi-natural landscape elements to an existing ecological network structure in a landscape and allocating budget to different projects. Each of the participants received information related to a particular landscape, described in terms of one of the three different frames that were used to highlight different possible benefits of green infrastructure: (1) a recreation frame (a specification of the social–cultural frame), where green infrastructure contributes to the attractiveness of the landscape and its species, representing social–cultural services; (2) a biomass-production frame (a specification of the economic frame), where green infrastructure contributes to the production of biomass, representing production services and (3) a water-regulation frame (a specification of a sustainability frame), where green infrastructure contributes to the management of water, representing regulation services (see Supplementary material for a full description of the frames).

Subsequently, the participants fulfilled two types of planning behaviour. First, they were asked to plan a certain amount of green infrastructure in the landscape (Fig. 3) and to motivate how this would improve different ecosystem functions (called adding green infrastructure). The (virtual) landscape was designed in such a way that it was possible to add green infrastructure according to each of the three frames. Green infrastructure included (semi-)natural elements in the landscape, such as hedgerows, ditches with natural banks or strips of semi-natural pasture, small patches of natural vegetation (woodlots or pastures) or ponds and other small water bodies. In the second type of behaviour, the participants were asked to divide a budget between six different (landscape) development projects (budget allocation). Three of the projects did represent the social–cultural, production or regulation services of green infrastructure and three projects did not relate to ecosystem services (see Supplementary material). In the analysis two groups of participants were distinguished. The frame-consistent group used one or more arguments in line with the frame or allocated the largest budget to the corresponding ecosystem service. A frame-inconsistent group did not use any argument in line with the frame, nor allocated the largest budget to the corresponding ecosystem service.

Additionally, to understand the influence of intervening factors such as the individual attitude on the two types of planning behaviour, participants were asked to fill in a questionnaire a week prior to the experiment, aiming to reveal their attitude related to the three ecosystem service categories by indicating if they agreed or disagreed with certain statements like for instance ‘In my opinion, natural elements should be used in water management

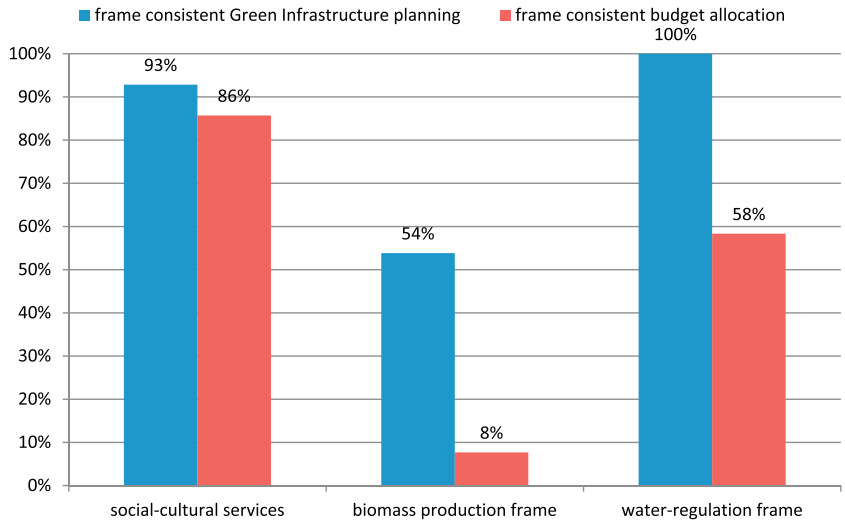

Fig. 4. Percentage of students in experiment showing frame-consistent behaviour, in adding green infrastructure to a landscape map or in allocating budget. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Table 1
Attitudes towards the three different types of ecosystem services distributed over the three frame groups (maximum support is 3 points). Based on 28 questionnaires.

Frame	Attitude towards social–cultural services	Attitude towards production services	Attitude towards regulating services
Social–cultural frame	2.9	1.9	2.3
Production frame	2.7	1.6	2.1
Regulating frame	2.6	1.4	2.2
Mean (all groups)	2.7	1.6	2.2

instead of technical measures to deal with floods and droughts'. The response rate of this questionnaire was 61% (see Supplementary materials for the full questionnaire).

The effect of framing ecosystem services on adding green infrastructure

For the arguments given with respect to adding green infrastructure, the results suggest that the framing affected the decisions about adding green infrastructure. The overall response, for the three frames together, showed that 82% of the participants showed frame-consistent behaviour as they came up with frame-consistent arguments. As shown in Fig. 4, the recreation frame (93%) and the regulation frame (100%) resulted in more frame-consistent planning behaviour compared to the biomass-production frame (54%).

The budget allocation exercise showed a lower overall frame-consistency (51% of the participants). Only the recreation frame encouraged frame-consistent budget allocation, since 86% of the participants assigned the largest proportion of their budget to the project that provided social ecosystem services (Fig. 4). The regulation frame and biomass-production frame less often encouraged frame-consistent budget allocation, resp. 58% and 8% (Fig. 4).

The effect of attitude on ecosystem services planning behaviour

To assess the relation of the green infrastructure planning behaviour with attitudinal factors, we considered the questionnaire results on attitudes towards the three different types of ecosystem services: cultural services, production services and regulating services. Table 1 shows the results on attitudes regarding ecosystem services, illustrating that the students in particular considered social services (2.7 on the maximum of 3) and regulation services (2.2 on the maximum of 3) as being important. Production services were considered less important (1.6 on the maximum of 3). The attitudes regarding ecosystem services were equally distributed between the 3 frame groups (Table 1).

Correlating the mean scores on the three frames with the proportion of arguments allocated to each of the three attitudes categories yielded a very low average correlation ($r = 0.1$), suggesting little or no overall relationship between ecosystem services related attitudes and green infrastructure arguments. Considering the results on budget allocation behaviour, the average correlation between attitude and behaviour is higher but still rather low ($r = 0.2$).

An interaction effect of attitude and frame on planning behaviour?

We can shed some more light on the relation between frames, attitudes and green infrastructure planning behaviour and budget allocation by looking at how average attitude–behaviour correlations differ between the three frames. For green infrastructure arguments little differences can be observed between the frames, but for budget allocations, an average correlation of 0.6 can be observed in the biomass-production frame condition (Table 2), with a close to zero correlation in the two other frames. We have seen earlier that the biomass-production frame did not result in frame-consistent behaviour for budget allocation, and we observe here that, on average, budget allocation behaviour was quite attitude-consistent for the participants in the biomass-production frame.

Table 2
Correlation coefficients of attitude and frame in two types of behaviour: allocating green infrastructure on the map resp. allocating budgets for implementation.

	Social–cultural services	Biomass production frame	Water-regulation frame
Average correlation of attitude and frame in allocating green infrastructure	0.09	0	0.2
Average correlation of attitude and frame in allocating budget	0	0.6	0

This can be understood from the fact that the attitudes towards production services among the participants were not very positive.

Although our experiment has obvious limitations because of choosing students from Wageningen University and the small number of participants, the results show how the combined effect of frames and attitudes on behaviour can be analysed and understood. We suggest that among students from environmental sciences, the cultural and regulating services find more support than the production services. Especially for the production frame arguments other than economic arguments were given, and the allocated budget was also not in line with the frame. This can be explained by assuming that the frame was not accepted as it deviated too much from the internal attitudes of the students. Neither the frames alone, nor the attitudes alone, explain the observed behaviour. It suggests that for understanding the role of information on ecosystem services in collaborative landscape planning, the interaction between framing of the information and the attitudes of the information receivers needs to be known.

Case study Hoeksche Waard

The Hoeksche Waard is an arable farm landscape located south of the city of Rotterdam in The Netherlands (26,500 ha). The landscape is highly valued for its characteristic structure of polders, dikes and network of creeks. By 2005, farmers (both conventional and organic) had formulated a strategic aim to use less pesticides and reduce the input of nutrients and pesticides into the soil and water system. The Province of South-Holland invited Alterra to contribute to the sustainable development of agriculture in the Hoeksche Waard. They wished to introduce biological pest regulation, as a step towards more sustainable agriculture. In three workshops during 2004–2006 researchers facilitated farmer groups to achieve this aim (Steingröver et al., 2010). Below we reconstruct these workshops to illustrate the analytical framework (Fig. 2).

To the farmers involved in the planning process, natural pest control was the main short term aim to achieve, and this frame was used by the researchers as the basis for constructing design guidelines. The researchers introduced the green infrastructure concept as the landscape level structure for managing the pest regulating service. They emphasized that the same infrastructure also represented the landscape identity (featuring dikes and former creeks), consequently sending the message that strengthening green infrastructure was beneficial to both natural pest control and landscape identity. By doing so, the researchers added a second social–cultural frame, targeted at the community's perception of landscape value, which was acknowledged by the national government in the area's status as a national landscape. These two frames were accepted by the farmers that attended the first workshop, and they started to use the frames themselves. They may have accepted the social–cultural frame so readily because it aligned to their values and beliefs as inhabitants of the area (attitudinal factors, Fig. 2). The farmers now shared the goal of the project: to keep the area's agricultural focus, to become a European example for sustainable agricultural practice, to conserve the identity of the landscape and to communicate their role as managers of the landscape. There was a difference in accepting the measures to create a sustainable agriculture among the conventional and organic farmers. The conventional farmers were more afraid of risks in relation to the appearance of protected species in the green infrastructure, potentially interfering with farm management because of European legislation, than farmers that were member of a farmers environmental association. This may be attributed to a difference in control beliefs.

The sender–receiver relationship between the researchers and the farmer groups was facilitated by co-creating design guidelines. The legitimacy and credibility of the design guidelines were increased by the researchers explaining where and how they collected all available scientific information and how they had assembled the design rules, and using local knowledge to improve the guidelines. Also, the researchers engaged the farmers in the degree of uncertainty in the guidelines and let the decision to apply the guidelines and how to deal with the uncertainty to the farmers, thus increasing the salience of the information. Several responses could be observed during the first meeting. First, the farmers responded positively to this challenge and decided to take the risk and monitor the effectiveness of the landscape adaptation. Second, they performed a collective regional design of the preferred future green infrastructure.

In the course of the planning process, the researchers added a second regulatory frame: the purification of water running off the fields resulting from the filtering by the semi-natural strips along the fields and water courses. This extension introduced the water management board as a partner in the design sessions, which aligned with the individual interests and beliefs of farmers, since they expected a lower probability of having to pay tax money for water purification services. The extension also aligned with social norms, because by managing field edges together as a farmers collective they would act as managers of the landscape and contribute to a better landscape for the local community, thereby consolidating and reinforcing their contribution to the community.

Some information may have directly influenced the control beliefs of the main actors. A concern of the farmers was that the new management of the green infrastructure would be costly and time-consuming. In the third workshop the scientists first explained the needed shift in management of the regional network and how management would be cheaper and less labour intensive if farmers and other stakeholders (including the water board) cooperated in the management of the robust elements in the public domain. This information possibly aligned with the control beliefs of the farmers. It prompted an instant negotiation between the environmental farmers association and the representatives of the water board in which the farmers proposed to manage twice the surface area for natural pest control as compared to the current situation. Furthermore, the farmers' control beliefs may have been positively affected by the increase in the level of cooperation within the farmer groups and between the farmers and other landscape managers (including the water board and a local citizen group of landscape conservationists) that resulted from the collective regional planning effort.

In this stage of the process, the response by the farmers was to take action right away and to make sure that the needed organization would be set into place. Some opted for an experiment to apply the concept in practice. Others advocated an extension of the quantity of subsidized kilometres of field margins. The information that the province was willing to contribute to paying the costs of the green infrastructure management may have facilitated this response by affecting the farmer's control beliefs. In the south part of the region a test area was set up paid by the province and the Ministry of Housing, Spatial Planning and Environment. The associated farmers started experimenting with the spatial dimensions of field margins and with different flower mixtures in the field margins, and the appearance of pests and natural enemies was monitored, so that the farmers could decide themselves if and when they would apply pesticides.

Not all participants showed a response. Although the representatives of the local councils were involved and apparently perceived their benefit from the regional design (increased tourism because of strengthening the regional identity), they did not adapt the management of the part of the green infrastructure that was under their control (road sites). The fact that they were not included from the start, and also because framing was directed at the farmers, may have contributed to this lack of positive response.

This analysis illustrates how researchers used different frames of ecosystem services, and combined them during the planning process. The observed responses of the farmers can be interpreted in terms of impacts on attitudinal and context factors. The fact that the planning process was a co-creation of local stakeholders and researchers contributed to the enhanced sender–receiver information flow. The actual behavioural responses that were observed probably were facilitated by the frames aligning with social norms (farmer as landscape manager producing societal value to the local community) and control beliefs (enhancing social bonding in the group of farmers, embedding the farm management in the wider landscape management, payments by the provincial government).

Discussion and conclusions

The concept of ecosystem services received an increasing attention in environmental and economic scientific literature, but so far hardly in policy and spatial planning sciences (De Groot et al., 2010; Opdam, 2013). Stakeholder involvement in ecosystem services assessment is in its infancy (Seppelt et al., 2011). Because the ecosystem services concept is considered as potentially promising to align different views on the human–nature relationship and to help bridging contradictory interests (Termorshuizen and Opdam, 2009; Opdam et al., 2015), the aim was to explore if actors with different interests, values and beliefs perceive the benefits of ecosystem services suggested by scientific information differently. This issue is particularly important in the context of the transition from hierarchical to multilevel governance (Newig and Fritsch, 2009), in which collaboration between actors becomes increasingly important (Ernstson et al., 2008). We also witness an increasing role of information in governance of environmental management (Mol, 2006), raising questions about the possibilities and limitations of governing by information. The significance of our paper is that we show how three often used categories of ecosystem services can be interpreted as three different storylines about ecosystem service benefits which have different impacts on the behaviour of actors in landscape planning, as was illustrated in this paper. Our work contributes to ecosystem services science by offering a conceptual basis for analysing the expected impact of the concept on environmental-significant behaviour.

With our framework we intend to present a theoretical representation of the processes that in the information flow between sender and potential actor, in our case between scientists actively involving in participatory planning processes and actors in a planning group. We applied the framework in two empirical cases mainly to explore how some of the basic assumptions could be investigated in practice, both experimentally and by case studies. These applications of the framework illustrate that to elicit a response, information should align with attitudinal factors. That the production frame (emphasizing biomass production) was poorly accepted by the students can be explained by assuming that the attitudes of students who had chosen for an environmental-significant education matched better with a sustainability frame. Thus, in analysing the role of information in a multi-actor process, the interplay between the frame and the attitudinal factors have to be taken into account. Better understanding of the interaction between frames and internal factors would require an expansion of this experimental approach to other groups outside the university context with more deviating attitudes towards the benefits of ecosystem services. The reinterpretation of the Hoeksche Waard case provided more insight into the potential role of sender–receiver factors and especially of contextual factors. We suggest that the response of the farmers to adapt the use of their land in order to create conditions for natural pest control was enhanced by increasing their control belief, due to the strong emphasis on landscape level collaboration during the planning process.

This paper demonstrates the importance of framing the relationship between ecosystem services and human actors in landscape planning and management. The question is not whether the relationship is framed, but how it is framed. Our analysis illustrates that the influence of information on ecosystem services depends on choosing a frame that aligns with the attitude of planning actors. We believe that experiments with different frames in different planning groups may reveal more insight into the impact of attitudinal factors in influencing actors, and more importantly, how framing may influence collaborative behaviour. Because both social processes and actor responses vary in the course of the planning cycle, it is relevant to gain understanding how framing affects goal setting, designing landscape change and implementation, respectively. This notion implies that the use of frames may be flexible and requires adaptation in the course of the planning process, for example when new actor groups get involved. The Hoeksche Waard case showed how frames were shifted throughout the process. A further issue for future research is how frames are evolving in the planning process as a result of actors starting to use a frame and bending it into a storyline with a different content.

In conclusion, we suggest that framing can be intentionally used by scientists in a planning process to enhance acceptance of information and to facilitate collaborative behaviour, which are key prerequisites for collaborative landscape planning. However, it is plausible that the actor group will represent a mixture of attitudes, which means that there is no such thing as the single best frame. Expressions of attitudes throughout the planning process are important cues for researchers to respond to a change in the aim or the dominant attitude, and to adapt the dominant frame accordingly. For example, in the early phase of the Hoeksche Waard sustainable agriculture was the main focus. A sustainability frame emphasizing regulation services was effective in that phase, rather than an economic frame. Additional frames can be more adequate when the social network needs to be expanded with actors having other attitudinal factors. We expect that our framework will contribute to a better understand how information on ecosystem service benefits turns into action in collaborative landscape planning processes.

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Appendix A. Supplementary data

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