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Evaluation by policy makers of a procedure to describe perceived landscape openness

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In the last decade policy makers have increasingly recognized the need to include people's perceptions in methods for describing landscape quality. At the same time, a third wave of Geographic Information Systems (GIS) has become available that make it technically possible to model landscape quality in a realistic manner. However, as there is often a mismatch between science and policy, it remains unclear to what extent perception-based models developed by scientists can be useful to policy makers. The aim of the present study was to evaluate the usefulness to policy making of a GIS-based procedure for describing perceived landscape openness. To this end, a workshop was organized which was attended by eight Dutch policy makers who acted as representatives of their province (region). The Group Decision Room (GDR) technique was used to elicit the policy makers' evaluations of the procedure in an anony- mous and reliable manner. The procedure was presented to the policy makers using cases from their own province, which they assessed using a mixture of qualitative and quantitative methods. The results show that policy makers rated the procedure as being highly relevant to policy making, scientifically credible, usable by policy makers and feasible to implement in the policy making process. They especially appreciated the flexibility and transparency of the procedure. The policy makers concluded that the procedure would be of most value for monitoring landscape changes and for analysing impacts on landscape openness in land use scenario studies. However, they requested guidelines for proper implementation of the various options in the procedure. In general, the current study shows that explicit and transparent evaluation of the usefulness of GIS-based tools can aid integration at the scienceepolicy interface and help to ensure that both scientists and policy makers are informed of interrelated options
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1. Introduction

The need to protect and enhance landscape quality is now widely recognized and has been put onto European and national political agendas (Antrop, 2004; Council of Europe, 2000; Dramstad et al., 2006; Piorr, 2003; Wascher, 2000). Developments such as urban and infrastructure projects and the expansion of large-scale agriculture introduce many new elements into traditional land- scapes, altering their visual appearance and perceived quality (Antrop, 2004; Nohl, 2001). Openness is often mentioned in policy documents as a key characteristic of traditional landscapes that is under particular threat from spatial transformations (Wascher, 2005). To monitor and evaluate the impacts of ongoing develop- ments on openness and other landscape characteristics, there is an increasing demand for decision support systems that offer infor- mation on the visual quality of landscapes (Scott, 2003; Tress and Tress, 2001).

Although a significant amount of scientific research has been done on visual landscape issues, policy makers are still calling for information that is more useful and relevant to policy-making processes and that can make these processes more effective (McNie, 2007). As McNie has indicated, there is often a mismatch between the information that is produced by scientists and the information that is required by policy makers. In particular, policy makers may need information that is not available, or they may not be aware of existing information that is of use to them. This mismatch, or gap, between science and policy making involves

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differences in the scale at which phenomena are described by scientists and the scale at which information on these phenomena is needed by policy makers (Stevens et al., 2007; Wu and Li, 2006). The aim of the research reported in this paper is to evaluate the practical usefulness of a GIS-based model for monitoring and evaluating perceived landscape openness. This model consisted of a set of GIS-procedures developed specifically to meet the needs of policy makers.

1.1. Bridging the gap: criteria for linking science to policy

How can the gap between science and policy be bridged so that scientific knowledge can be used by policy makers? Analyses of the effectiveness of boundary organizations, which play an intermediary role between science and policy (Cash et al., 2003), have shown that a balance between policy relevance and scientific credibility is an important requirement for bridging this gap (Keller, 2009). In general, assessments are relevant for policy making when they address the questions and concerns raised by policy makers (Keller, 2009). With respect to the quality of natural environments, Jacobs et el. (2005) suggested that the relevance of assessments depends to a large extent on whether scientists are asking and answering the right questions, and whether results are provided at a scale relevant to management decisions. With respect to the relevance of agri-environmental indicators, Cash and colleagues (Cash et al., 2003; Cash and Buizer, 2005) make a distinction between salience, which deals with the relevance of the assessment to the needs of policy makers, and legitimacy, which reflects the perception that the production of information and technology has respected the divergent values and beliefs held by the stakeholders. Scientific credibility is based on the assumption that an assessment is politically neutral (Keller, 2009). In general, scientific credibility increases when information is more authoritative, believable, trusted and accurate (Cash and Buizer, 2005; Jacobs et al., 2005). Scientific credibility requires that information is based on sound science (OECD, 1999) and that data collection and analysis methods should be open to validation and replication (Doody et al., 2009).

For a successful integration between scientific knowledge and policy making, scientists should generate information that is not only politically relevant and scientifically credible, but also usable and feasible. Usable information is unambiguous and easy to understand and communicate (OECD, 1999), and at a level of detail that reflects a balance between simplification and complication (Singh et al., 2009). Moreover, flexibility is needed to adapt the terms and conditions for collecting information to meet local site requirements (Park et al., 2004). The feasibility of implementing information in the policy-making process is to a large extent dependent on current or planned data availability and the cost-effectiveness of data collection (Doody et al., 2009; OECD, 1999). Another important aspect of feasibility is that policy makers should possess the knowledge required to properly use and apply the information.

In summary, there are well-established criteria available for evaluating the usefulness of decision support models at the interface between science and policy making. For the purpose of the current study we selected the four criteria as outlined above: relevance to policy making, scientific credibility, usability for policy makers, and feasibility for implementation.

1.2. A GIS procedure to support decisions on perceived landscape openness

So what do policy makers require from decision support models for monitoring and evaluating visual landscape quality? Two recent developments are of particular interest. First, policy makers have come to realize the need to include the perception of people in the decision-making process. This is illustrated, for example, by the fact that human perception is a central part of the definition of landscape in the European Landscape Convention: ‘Landscape means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors’ (Council of Europe, 2000). Second, environmental policy making is becoming increasingly dependent on a third wave of Geographic Information Systems (Roche and Caron, 2009), which can combine and analyse many datasets in a transparent way. These developments have created a demand for a new generation of decision support tools that are both realistic and technologically advanced.

Recently, Weitkamp et al. (2011) have developed a procedure for monitoring and assessing landscape openness that aims to meet the requirements of policy makers. Landscape openness is a key aspect of many landscape characteristics, such as mystery and legibility (Herzog and Kropscott, 2004), and has often been found to be a predictor of landscape preference (Natori and Chenoweth, 2008). In many European countries openness has been recognized as an important factor in assessing landscape quality (Wascher, 2005). For example, in the Netherlands the National Landscapes have been assigned core values related to their openness (Ministeries van VROM et al., 2007).

The procedure developed by Weitkamp et al. (2011) aims to integrate scientific knowledge on the perception of landscape openness in a Geographic Information System (GIS). The procedure does not include real perception data, but uses geo-data and a Geographic Information System (GIS) to simulate perceived openness. Based on the isovist concept of Benedikt (Benedikt, 1979), the procedure calculates landscape openness variables from the perspective of people’s perception. In doing so, it starts from the basic assumption that the visible space is similar to perceived landscape openness. The procedure consists of five steps: 1) select road network and apply sampling strategy; 2) merge terrain and topographic datasets; 3) identify visual limitations; 4) compute visible space; and 5) select and calculate variables. Each of the steps concern technical proceedings, but more important, choices of locations, datasets, parameters values and variables which are dependent on the mode of perception In the remainder of this paper we refer to this procedure developed by Weitkamp et al. as ‘the procedure’ (see Weitkamp et al., 2011, for a more detailed description).

The procedure combines a high degree of realism and a high degree of generality, and is intended to be used by policy makers for a wide range of purposes. However, it needs to be evaluated to determine how useful it will be to policy makers. The objective of the research described in this paper was to evaluate the usefulness of the procedure for policy makers.

2. Materials and methods

A workshop was organized in which scientists and policy makers were brought together to evaluate the usefulness of the procedure for policy making. Before the start of the workshop, the policy makers were asked to provide an example of an actual case in her or his region in which landscape openness was at stake. Six cases were handed in, which were converted into GIS and used to illustrate the procedure. The procedure was evaluated and discussed in a Group Decision Room (GDR) and the participants rated the procedure in terms of its relevance, usability, credibility and feasibility.

2.1. Cases

The six cases of landscape openness used in the demonstration of the procedure are located in different provinces (regions) of the Netherlands (Fig. 1). The first case is located in Friesland and

Fig. 1. Locations of the cases.

concerns the unplanned, spontaneous growth of vegetation along the shores of several lakes, the Friese Meren, which is causing a reduction in landscape openness. In Friesland, openness is considered important from a cultural and historical point of view, as well as for natural and recreational values. The second case is located in the province of Groningen, near Winschoten, and concerns a very exposed area where the openness is under pressure due to the building of farmhouses. The third case is located in the northeast of the province of Drenthe and concerns various landscape types, each with their own characteristic degree of openness, ranging from enclosed to open. The fourth case is located in Overijssel and concerns the area of Hezingen-Mander, which has an enclosed character that needs to be protected. The fifth case is located in the Ronde Venen in the province of Utrecht and concerns a plan to build dikes in a very open fenland area. Various scenarios for the building of dikes have been developed, each with different impacts on landscape openness. The sixth case is located in the Krimpenerwaard in Zuid-Holland and concerns an area where proposed restoration of natural habitat projects will affect the openness of the area due to the growth of shrubs and bushes.

2.2. Participants

Eight policy makers (two women and six men) participated in the workshop. They were selected on the basis of three criteria. First, all the participants had to be professionally involved with landscape policies in the Netherlands. Second, these landscape policies had to be at the provincial level. In the Netherlands, where regional interests are paramount, regional authorities such as the provincial councils are to a large extent free to determine their own course of action. For example, they are responsible for drawing the boundaries of the National Landscapes and for implementing the policies and regulations that apply in these protected areas (Ministerie van VROM et al., 2007).

A third criterion was that the competences and responsibilities of the policy makers should include policies concerning landscape openness. Six of the eight policy makers were provincial employees at Groningen, Friesland, Drenthe, Overijssel, Gelderland and Zuid-Holland provincial councils. The other two participants were employed at the head office of the Government Service for Land and Water Management (DLG), located in the province of Utrecht. Thus, the participants' work field covered 7 of the 12 provinces of the Netherlands, which represent all Dutch landscape types except loess landscapes (only present in the province of Limburg, the utmost southern part of the Netherlands).

2.3. Group discussion methodology

The workshop was held in a Group Decision Room (GDR). This GDR is an 'electronic meeting room' that enables fast and efficient stakeholder dialogue with real-time exchange of opinions, feedback of results, brainstorming and discussions (Wardekker et al., 2008). In a GDR, the participants are seated behind computers connected through a network and arranged in a U-shaped single row. The chairs face a large-screen video display at the front of the room. This arrangement enables equal participation by all those involved, anonymous answers and responses to questions and propositions, and structured feedback on the answers. Moreover, all the typed input is collected and saved. Several studies have demonstrated the usefulness of GDRs (Rouwette et al., 2000). The workshop was led by a team of three supervisors: a researcher whose main role was to explain and clarify the method, a senior researcher who moderated the discussion, and a facilitator whose job was to ensure the proper functioning of the GDR equipment.

2.4. Evaluation method

The workshop consisted of four parts:

1 Introduction and definition of openness: At the start of the workshop, the participants were asked to introduce themselves and to give a personal description of the concept of landscape openness. This made clear to what extent the participants agreed on the meaning of the term and highlighted the complexity of assessing landscape openness.

2 Presentation of the procedure: The procedure was explained to the participants in a PowerPoint presentation, which showed six aspects of the procedure, each of which includes various options. Each aspect was illustrated using images and data from the cases provided by the participants. Some examples are shown in Figs. 3, 4 and 6. For each case study, a Google Maps image of the area was presented, with an oral explanation of the situation related to landscape openness. The following aspects were presented:
  - Modes of perception: view from a point, view from a route, view of an area;
  - Variables of openness: size of the visible area, longest line of sight (the highest recorded value), distance to the closest object;
  - Visual limitations: horizontal viewing angle, maximum line of sight (maximum viewing distance), eye level;
  - Representation of the physical environment: digital elevation model and topographic dataset. Two Dutch datasets were used: the digital elevation map of the Netherlands (AHN) and Top10vector, a countrywide vector-based topographic dataset;
  - Parameters of openness: average openness, variation of openness, exceptional openness;
  - Applications: description of the current state, monitoring change, comparing planning scenarios.

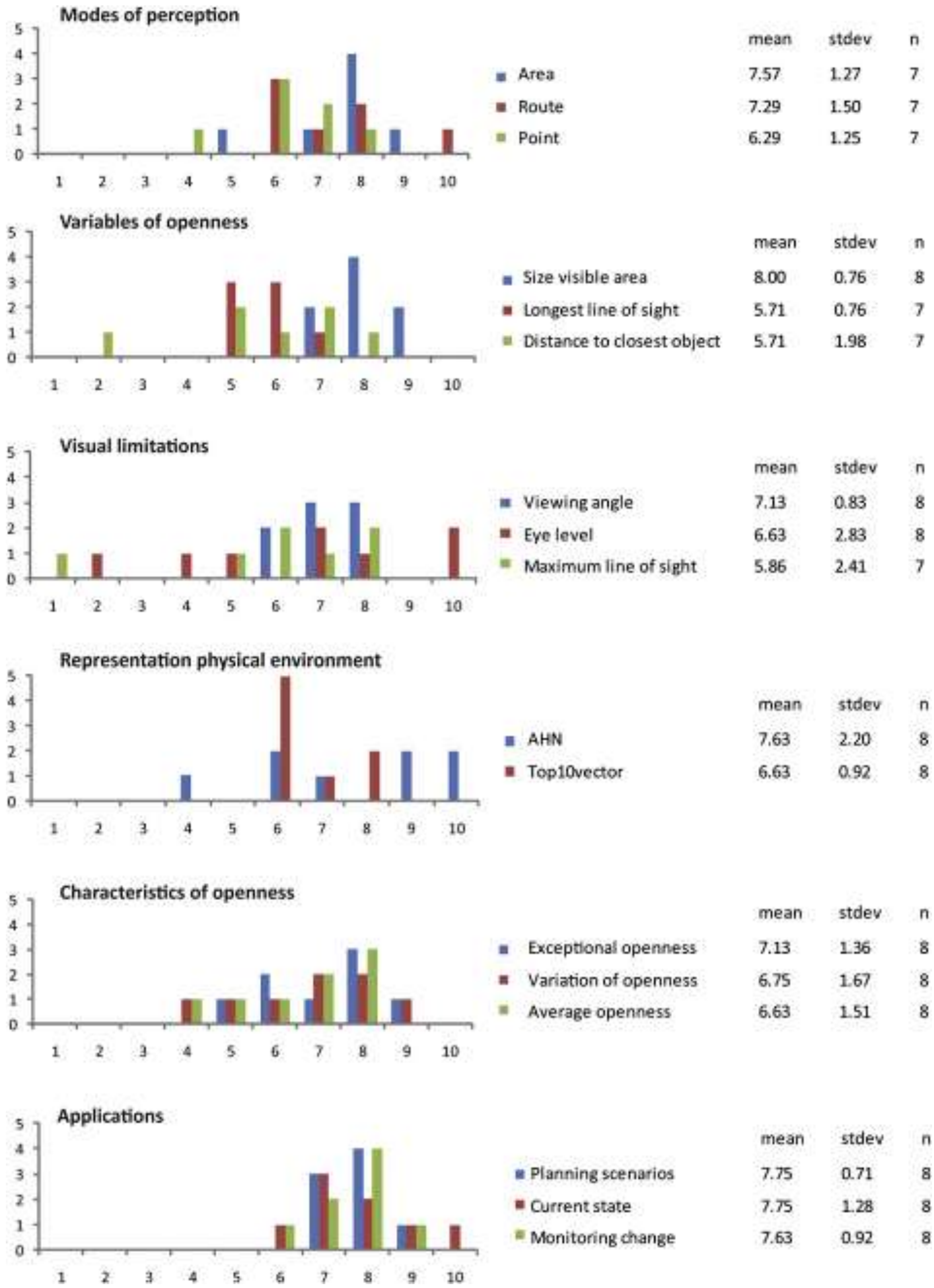

Fig. 2. Mean ratings (1e10), with standard deviations, of the usefulness of the six aspects of the procedure. The graphs depict the frequency distributions of the ratings (x axis) for each option.

See Weitkamp et al. (2011) for a more detailed description of these aspects of the procedure.

3 Evaluation of the aspects: Directly after the presentation the participants were asked to rate the usefulness of the six aspects on a scale ranging from 1 (not useful at all) to 10 (extremely useful). They were then each given the opportunity to explain their ratings anonymously. These ratings and explanations were displayed on the screen. The participants could react on these ratings and explanations.
4 General evaluation of the procedure: After the independent ratings of the various aspects and possibilities, the procedure as a whole was evaluated against the four selected criteria.

e Relevance: does the procedure offer information that is relevant to policy making?
Credibility: does the procedure provide a valid representation of landscape openness?
Usability: is the information unambiguous, and is it easy to use, interpret and communicate?
Feasibility: are there opportunities to implement the procedure in your organization, and are there any constraints on its implementation?

The participants were asked to rate the procedure against each of the criteria on ascale ranging from 1 to 10, where 1 is not relevant, usable, credible or feasible at all and 10 is extremely relevant,

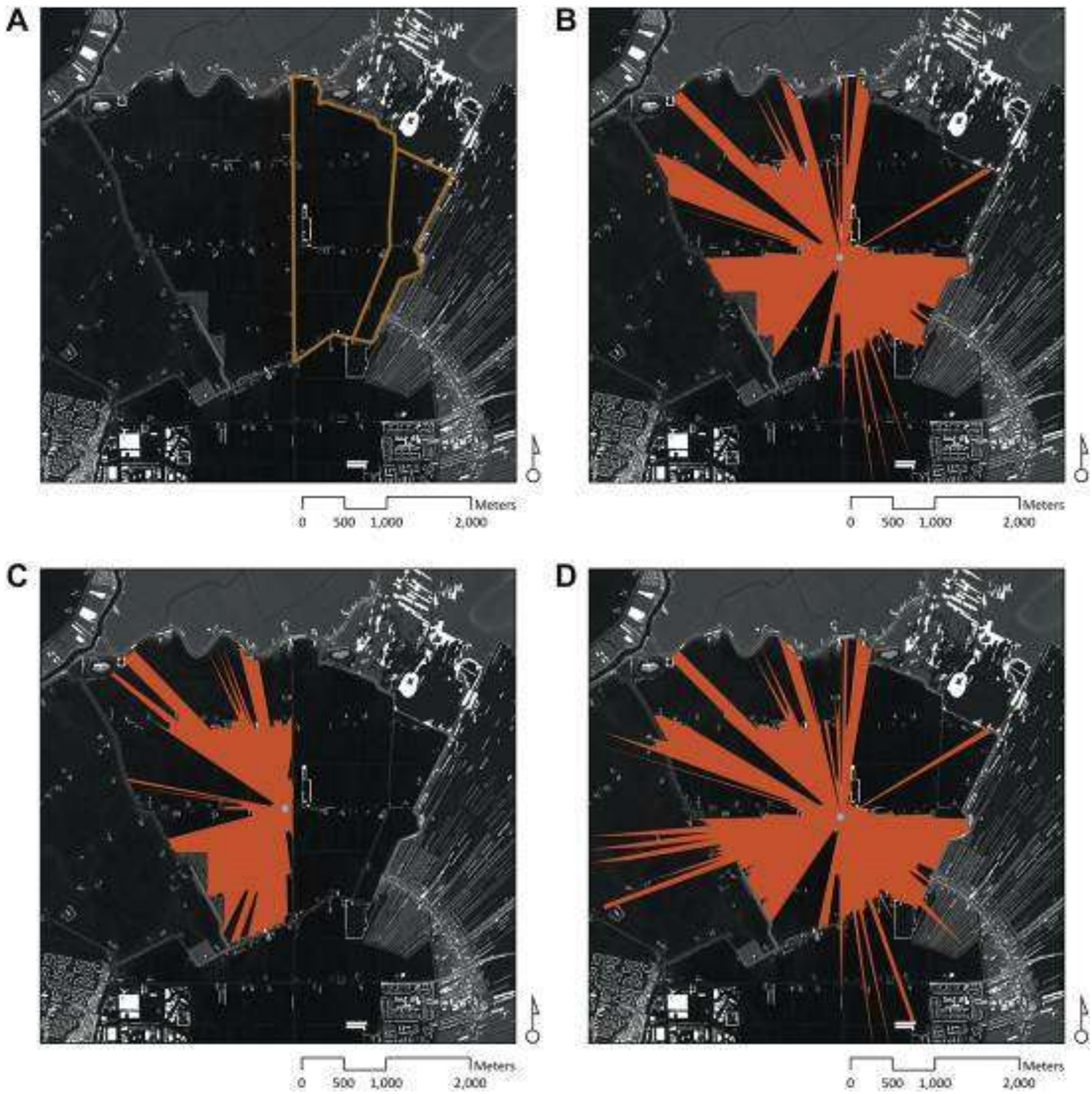

Fig. 3. The case study area of Ronde Venen, Utrecht, is characterized by its polders, which have a high degree of openness. The development of natural habitats will require the construction of dikes to regulate the water table. Various scenarios for the location of dikes have been developed, one of which is shown in (A). The background shows the height model of the landscape, the whiter areas representing higher height values and the darker areas representing lower height values. The policy question is how the dikes affect the openness of the landscape. The visible space from one viewpoint on the road, in the centre of the polder, is shown for the current situation in (B). The viewing angle is 360 and the maximum line of sight is 3000 m at an eye level of 1.6 m. In the possible new situation the same viewpoint is located on the planned dike and the visible space is therefore larger than in the current situation (D). However, the visible space decreases dramatically when located on a road next to the dike (C). This example illustrates that the exact location of the viewpoint is important when drawing conclusions about the effect on openness.

usable, credible or feasible. The participants were then given an opportunity to explain their ratings and discuss their answers.

The duration of the workshop, including a break, was about three and a half hours.

3. Results

3.1. Definitions of landscape openness

The participants held widely differing opinions on what openness is. Some emphasized the experience of tranquillity and spaciousness, or the perception of vistas. Others emphasized the physical environment, where landscape openness is the configuration of elements in space. Most of the participants qualified landscape openness as a characteristic that is valued depending on its context. It was mentioned that landscape openness is hard to assess, partly because it covers a broad category of issues and functions. Landscape openness was considered to be an umbrella term that encompasses many meanings and is often used without being specified. There was discussion about the question of whether landscape openness could be applied not only to natural and rural areas, but also to urban and peri-urban areas. Another point of discussion was the character of enclosed and small-scale landscapes. Are these landscapes that possess a low degree of openness, or landscapes with a different characteristic than openness? The differences in the conceptualization of openness between the participants were reflected in the cases, which emphasized different interpretations of openness.

3.2. Evaluation of the usefulness of the aspects of the procedure

The results of the evaluation of the six aspects are presented quantitatively in Fig. 2 and qualitatively by summarizing the comments of the participants for each aspect (below). In general,

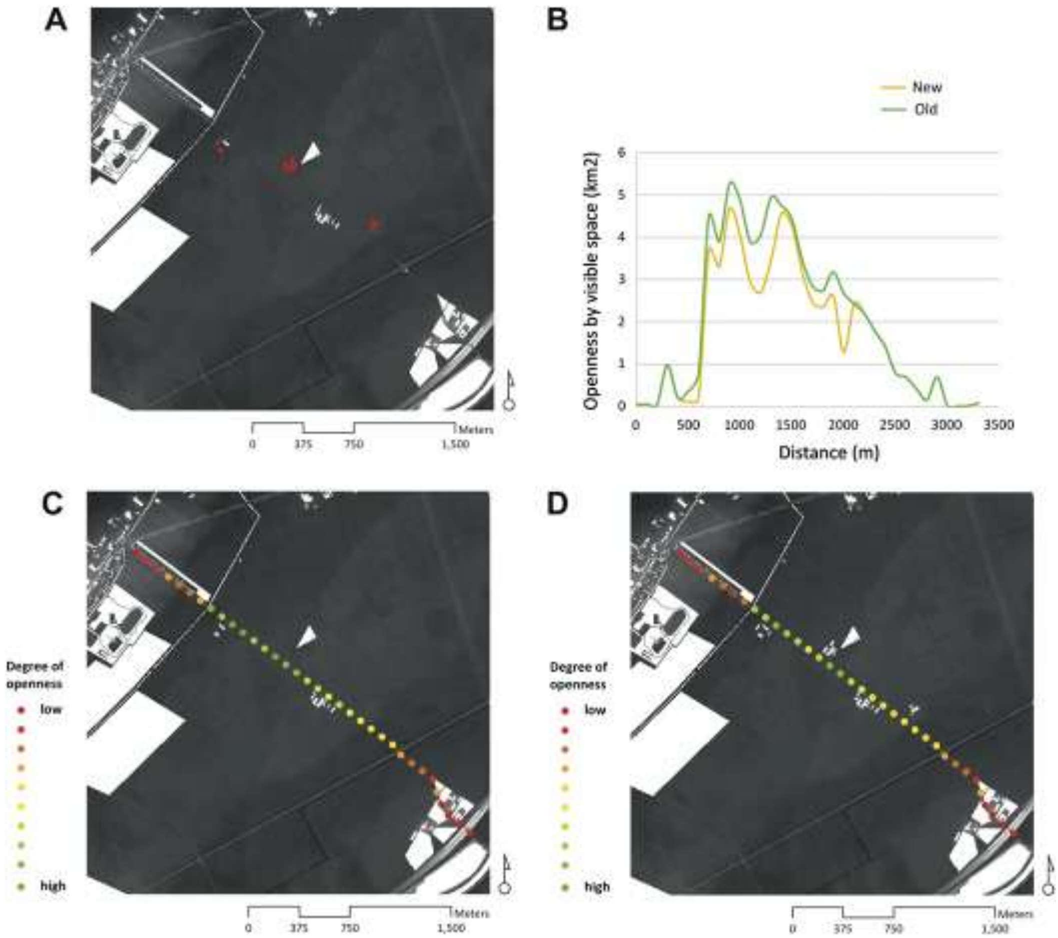

Fig. 4. The case study area of Winschoten, Groningen, is characterized by a contrast between large-scale open landscapes and enclosed landscapes. The open character is under threat, one of the reasons for this being the relocation of farm buildings from small settlements to the open agricultural areas. (A) shows an example of recently built farmhouses. The provincial policy makers want to know the effect these buildings have on landscape openness. The calculation of the visible space is based on views from the road along which the buildings are located. To simulate the perception of openness during movement, viewpoints were fixed at 100 m intervals along the road in the old situation (C) and the new situation (D), with the viewing angle set at 120 in a southeasterly direction. The difference in visible space between the old and the current situation is shown in (B). The difference is not big, partly because there were already some buildings and a patch of forest located along the road. The differences in openness at other locations on the road are even smaller because the road starts and ends in an enclosed area. The contrast between the enclosed areas and the open area along the road decreased slightly, but would still be perceived.

the explanations that were provided for the ratings were given from two perspectives. Some participants took the applicability and usefulness of the procedure for policy making as a starting point; others based their comments on the accuracy of the simulation of the perception of users. In summarizing the discussions, we have tried to accurately represent both perspectives.

3.2.1. Modes of perception

The usefulness of each of the three modes of perception was rated well above the mid-point of the scale. According to the participants, the degree of usefulness depends primarily on the context in which landscape openness needs to be assessed. The view from a point received the lowest mean score, which was 6.29, with a standard deviation (SD) of 1.25. This mode of perception was considered to be of limited applicability because it can be used only for very low-level local tasks. An example is given in Fig. 3. The view from a route received a mean score of 7.29 (SD ¼ 1.50). The modelling of openness based on movement was considered to be important because landscapes are usually viewed while walking, cycling or driving. It was suggested that this mode would be used for analysing recreational routes or when planning new infrastructure. The view from a route was considered to be especially useful if the variation in openness is important. An example of the view from a route mode is given in Fig. 4. The view of an area received the highest score of 7.57 (SD ¼ 1.27). This mode of perception was thought to be useful for generic purposes. Moreover, it was considered useful for recording openness for administrative units, such as municipalities, or landscape units, such as polders. An example of the view of an area is given in Fig. 6. The usefulness of assessing the view of an area was questioned by one of the participants, who considered it to have limited validity because people are unable to perceive an entire area at once. Another participant questioned the method of deriving the view of an area from the view from a point and view from a route modes because the number of choices that have to be made for each of the aspects related to perception introduces a high degree of uncertainty.

3.2.2. Variables of openness

The usefulness of each of the three ways to model openness was also rated above the mid-point of the scale. The size of the visible area was clearly considered most useful. It received a mean score of 8.00, with values ranging from 7 to 9 (SD ¼ 0.76), reflecting a large degree of consensus. The participants considered the size of the visible area to be the most intuitively appropriate representation of openness and easy to communicate to other stakeholders. Another

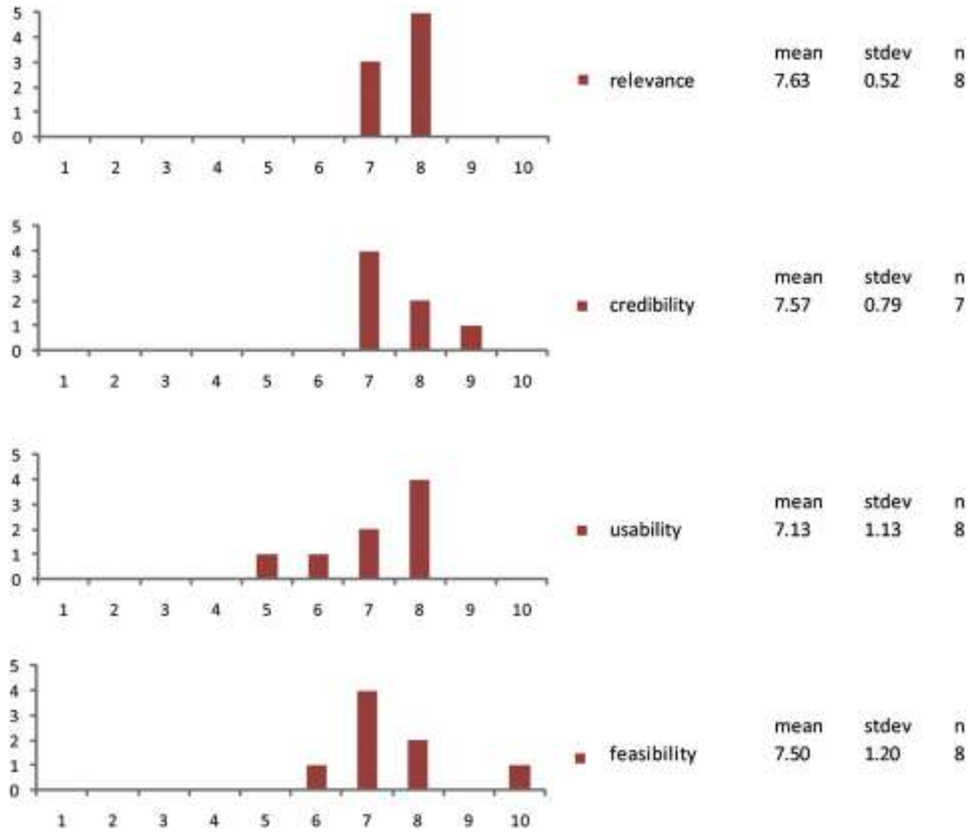

Fig. 5. General evaluation of the procedure for relevance, usability, credibility and feasibility. The graphs depict the frequency distributions of the scores.

advantage that was mentioned was that the size of the area indirectly includes the other two variables (longest line of sight and distance to the closest object). Most participants indicated that the longest line of sight was only incidentally useful. Its mean score was 5.71 (SD ¼ 0.76). One participant suggested using it for evaluations of landscape plans. For landscapes with small-scale openness, the longest line of sight was considered useful for detecting unwanted gaps. However, according to some participants this variable is too sensitive to accidental high values that do not reflect landscape openness per se. A similar complaint was made about accidental low values for the distance to the closest object. This method of modelling openness received a mean score of 5.71, but with values ranging from 2 to 8 (SD ¼ 1.98). Some participants judged it to be too abstract for use in a policy report, but others considered it to be a useful addition to the size of the visible area for assessing openness.

3.2.3. Visual limitations

The participants considered the viewing angle method of modelling visual limitations to be the best, awarding it a mean score of 7.13, with values ranging from 6 to 8 (SD ¼ 0.83). A limited viewing angle could be used in cases in which perceptions of openness are required for different activities in the landscape, such as walking, driving a car or travelling by train. For example, a viewing angle of 120 was used in the Groningen case (Fig. 4). One participant noted that with a limited viewing angle, such as 120 , the remaining angle (240) could still affect the perception of openness. A weighting of angles was therefore suggested. The function for selecting different values for eye level when modelling visual limitations received a mean rating of 6.63, with values ranging from 2 to 10 (SD ¼ 2.83). For some participants it was highly relevant to accurately simulate the actual field of view of people in the landscape. Values for eye level can be related to specific activities to analyse the impact of these activities on landscape openness. This is illustrated by the Friese Meren case (Fig. 6). Other participants did not consider eye level to be relevant because the impact of changing the eye level on perceived openness was assumed to be negligible. The option of setting a value for the maximum line of sight was, on average, not found to be very useful (mean score ¼ 5.86, SD ¼ 2.41). One reason for the low score was that the participants did not see a clear reason for accurately simulating the limits of the maximum perceived distance. The possible added value for policy making was also unclear. Some participants thought it would be useful for design rather than policy making.

3.2.4. Representation of the physical environment

The digital elevation model AHN (mean score ¼ 7.63, SD ¼ 2.20.) and the topographic dataset Top10vector (mean score ¼ 6.63, SD ¼ 0.92) were both considered to be useful for measuring landscape openness. The Dutch topographic dataset Top10vector does not include elevation information, therefore the added value of using the elevation model AHN was appreciated for hilly areas (as far as these are present in Dutch landscapes). There was no agreement on the impact of micro relief on openness. Some participants thought it would have no impact at all, while others found it very important for the perception of openness.

Top10vector was considered the best topographic dataset currently available. The dataset was judged by the participants to be reliable for large features such as forests, although they felt that the precision and accuracy of some elements need to be improved. For example, landscape elements such as electricity masts, reed and shrubs, and temporal crops such as maize are not recorded, and in the Friese Meren case it was not possible to derive a representation

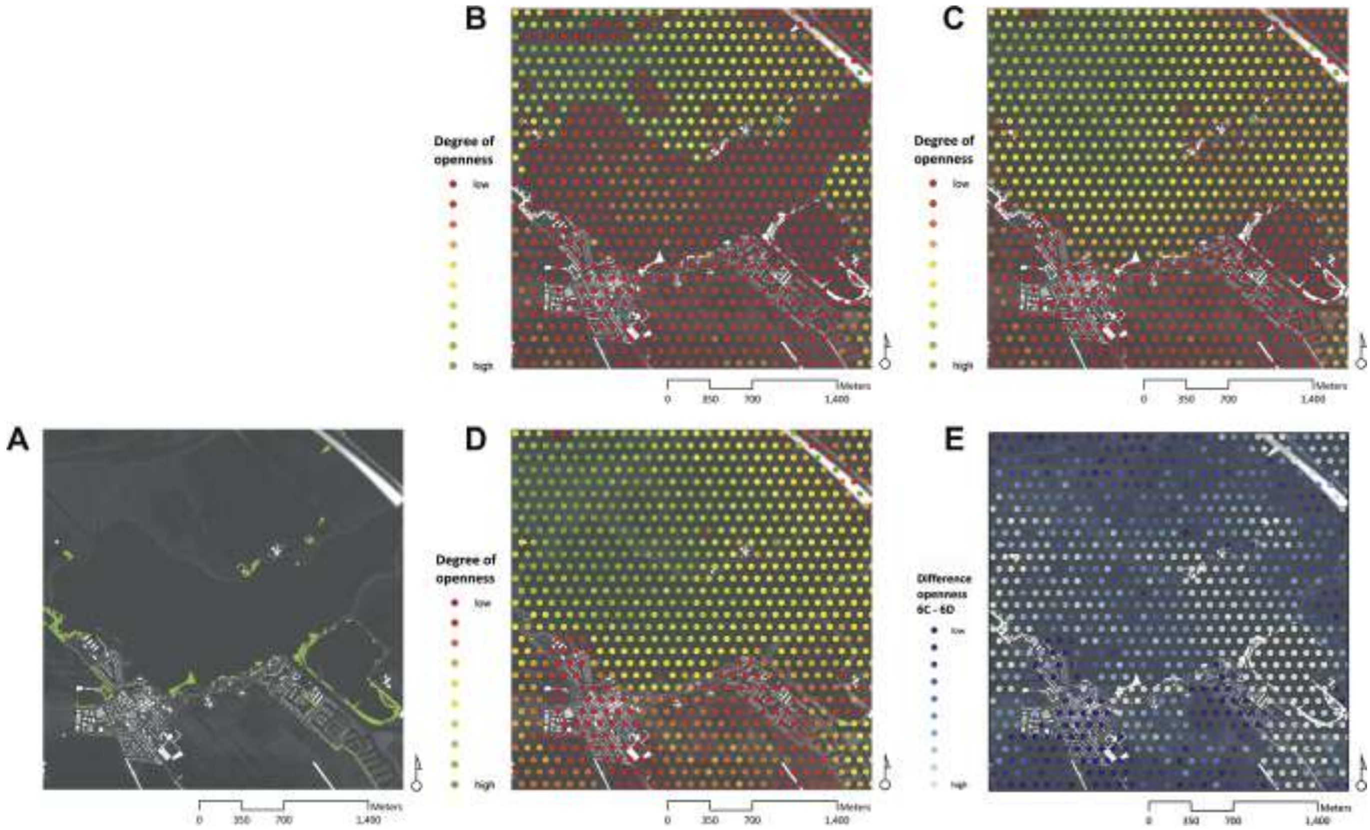

Fig. 6. The case study area of the Friese Meren in the province of Friesland is characterized by its open landscapes. However, the spontaneous growth of vegetation around the lakes is reducing the openness of the landscape. The effect of the vegetation growth has to be assessed. The exact locations of the vegetation growth were not known, and the Top10vector may not show all this vegetation. We selected the vegetation within 50 m of the shores of the lakes and designated it as spontaneous vegetation (A). We calculated the visible space for every location in the area based on a 100-m grid. The viewing angle was set to 360 and the eye level was set to 1.6 m on the land and 1 m on the water (B). A change in eye level can have a large effect on the openness. For example, the values for openness change dramatically when the eye level on the water is raised to 2 m (C). The effect of the vegetation on openness can be seen by comparing (C) with (D), in which the vegetation has been removed. The difference between the openness with vegetation (C) and without vegetation (D) is shown in (E).

of spontaneous vegetation growth using only the Top10vector (Fig. 6). Moreover, information about the transparency of objects such as tree rows is missing. In general, the data produce crisp and regular boundaries, whereas these are irregular and fuzzy in the real world.

Some participants indicated that in their daily practice they used aerial photographs to compensate for the information not contained in the Top10vector data. However, all the participants agreed on the need for field visits. Even if better data will become available in the future, they agreed that field visits will still be inevitable at some stage in the process of landscape planning and policy making.

3.2.5. Parameters of openness

The participants found the mathematical basis of the parameters of openness to be useful for the development of standards and thresholds to decide whether to allow certain landscape changes or not. All three possibilities e average openness, variation of openness, and exceptional openness e were rated similarly, with mean scores of 6.63 (SD ¼ 1.51), 6.75 (SD ¼ 1.67), and 7.13 (SD ¼ 1.36), respectively.

The average openness was considered useful for distinguishing and assessing landscape types. The average openness for views from roads depends on which roads are selected, which the participants considered subjective. Average openness was also seen as a characteristic that is easy to communicate to others. According to one of the participants, average values do not relate to perceived quality of openness and are therefore not suitable as a guideline for openness. The average values were not considered to be useful for monitoring changes because small changes do not affect the average value of a large area; the scale of the changes would not be compatible with the scale at which the average values are applied.

Variation of openness was found to be especially useful for routes and it was considered important for simulating the experience of landscape openness. Assigning fixed values to the variation of openness was thought to be difficult, though. For some, the variation of openness was most important, while others considered it to be only useful for specific purposes, such as visual reports.

Exceptional openness was thought to be useful for visualizing specific cases, such as tourist attractions with an exceptional view. It was also considered useful for analysing the impact of landscape change. The participants said it would also be useful for detecting locations with a prominent value of openness. Some participants suggested that exceptional openness could be used in both planning and design.

3.2.6. Applications

The three proposed applications received relatively high scores from the participants. For planning scenarios the mean score was 7.75 (SD ¼ 071). For current state the mean score was 7.75 as well, but with lower consensus according a higher SD value of 1.28. The score for the monitoring changes was 7.63 (SD ¼ 0.92).

Some participants considered the procedure to be very useful for describing the current state in order to define characteristics and make an inventory of the characteristics of an area. Other participants said they would only use a description of the current state in combination with aerial photographs or field visits. Two participants preferred to use other methods to describe the current state, such as pictures or field visits. One of the characteristics of openness is that it gradually changes, which is not easily noticed in reality, and when these changes are eventually noticed it is too late for policy makers to take action. This instrument was therefore considered to be important for monitoring changes. Moreover, the participants thought it would be helpful for evaluating policies and for clearly visualizing the effects of a plan. According to one of the participants its usefulness depends on the time scale. There was general agreement that scenarios are useful for analysing and visualizing the effect of various changes.

3.3. General evaluation

The entire procedure was rated quantitatively and qualitatively for relevance, usability, credibility and feasibility. The mean ratings for each criterion (with their standard deviations and frequency distributions) are presented in Fig. 5. The qualitative comments provided by the participants are summarized below. These comments were collected from the entire workshop because some comments during the first part of the workshop were related to the four criteria.

3.3.1. Relevance

Of the four general evaluation criteria, relevance was rated the highest, with a mean score of 7.63 (SD ¼ 0.52).The comments and discussion on the relevance of the procedure led to the identification of five ways in which the procedure meets the criterion of relevance.

First, the relevance of assessing landscape openness itself was recognized. All the participants, including three who mentioned that they already used other methods, felt the need to assess openness. This was confirmed by the cases they submitted for the workshop, which specifically concerned landscape openness issues which they were not able to address properly. According to one of the participants the relevance of assessing openness is also recog- nized by national and international authorities. Openness is defined as one of the core qualities of Dutch national landscapes, and many other European countries also consider it relevant to measure openness. The participants were aware that measuring a single landscape characteristic, such as openness, is insufficient for capturing the entire landscape quality; naturalness, accessi- bility, and cultural and historic elements contribute to landscape quality as well.

The second aspect of the procedure which makes it relevant is the fact that people's perceptions are explicitly taken into account. The participants indicated that such procedures are currently not available to them, although the Dutch government highlights quality of perception as one of the four key dimensions of landscape quality, besides cultural and historical quality, accessibility and natural quality. Some participants used the 'zero measurement' method from the Compendium voor de Leefomgeving (Environmental Data Compendium) to assess openness. This method measures the degree of openness by counting vertical landscape elements in each square kilometre (Dijkstra and Lith-Kranendonk, 2000). The inclusion of people's perception in the measurement of landscape openness was considered to be an improvement.

Third, the procedure was thought to be relevant because it can be used to develop valuation standards for openness. Although the procedure does not provide predefined standards for determining whether there is 'enough' or 'too little' openness, the participants agreed that the procedure would be helpful in developing these. They also noted that it was not acceptable to have a computer program create these valuations because this depends strongly on the context. There was a discussion on whether valuations should be included as a standard element in a procedure. This could increase the relevance of such a procedure, but may also decrease its credibility.

Fourth, the procedure was judged to be relevant for linking functions to perception. The procedure makes it possible to identify perceived openness for activities such as driving a car and enjoying the view from a viewpoint, which is useful for policy making. The modes of perception and visual limitations functions were generally appreciated by the participants because they make the procedure flexible enough to be applied to local situations. They also agreed that guidelines based on scientific research were indispensable for its proper use.

The fifth reason for the relevance of the procedure is the fact that it can be used for various applications. This not only allows policy makers to get a better grasp of the effect of changes on openness, but it was also expected to support the communication of information about openness to stakeholders, such as other governmental organizations at different levels. The procedure was also considered to be useful for participatory planning because it is easy to generate visual impressions of openness and the effects of certain landscape changes on openness.

3.3.2. Credibility

The mean credibility score was 7.57 (SD ¼ 0.79), with all scores 7 or higher. The comments and discussion on the credibility of the procedure can be summarized in four points.

First, the procedure was considered to be credible because it was clear and transparent. Participants considered the procedure much more credible than multicriteria analysis, for example, which was compared with a 'black box'.

Second, the isovist technique which is used to calculate the visible space was considered to be an intuitively good representation of landscape openness. Some participants did not think that the longest line of sight and distance to closest object were related that much to openness. The parameters used to simulate various modes of perception and visual limitations were appreciated as a useful way to include perception in policy making.

Third, the input data, the AHN and Top10vector, were the best data currently available, but are not yet detailed enough to accurately represent some elements. Although some improvement is possible, the participants agreed that the procedure could never entirely replace other methods of collecting information, such as field visits, no matter how accurate and precise the input data. However, because policy makers are likely to differ in their landscape perceptions from the general public, the use of more representative tools that can make policy makers aware of their biases was considered to be very important.

Fourth, some participants indicated that the credibility of the procedure could be improved by including parameters related to people's cultural background or living environments. These parameters would primarily affect their preference for a certain degree of openness. Among the participants of the workshop there was general agreement on the complexity of developing a procedure for assessing preferred openness.

3.3.3. Usability

The usability of the procedure was awarded a mean rating of 7.13 (SD ¼ 1.13), ranging from 5 to 8. The comments and discussion on usability can be summarized in three points.

First, the procedure is a usable instrument because of its transparency, which makes it possible to interpret the outcomes in an unambiguous way. The measured visible space is a usable basis for communicating landscape openness with other stakeholders because it is based on a simple and clear concept.

Second, the flexibility of the procedure, which allows for the selection of various modes of perception and other parameters for the visual limitations related to various activities, contributed much to its usability. However, a guideline on how to make use of these options was considered to be necessary for proper use.

Third, some participants observed that the map visualizations of openness need some improvement. Interpretation of the information in the proper context would be improved by the addition of clear visual markers to pick out landscape features such as roads or city boundaries. A point of discussion was the design of symbols and the information given in the legend. Some participants wanted a standardized value for openness to enable better comparison, for example between high openness in one case with high openness in another case.

3.3.4. Feasibility

The participants awarded the procedure a mean score of 7.50 (SD ¼ 1.20)for feasibility. The comments and discussion on the feasibility of the procedure can be summarized in three points.

First, the procedure employs widely used software and data and fairly simple techniques within GIS to do the measurements. This was appreciated by the participants. However, the whole process was not yet automated and ready to be implemented in ArcGIS, the GIS software in use at the organizations where the participants are employed. The participants indicated that there is sufficient knowledge of GIS in their organizations to use the procedure if it could be implemented in ArcGIS. As their organizations do not have the necessary knowledge about landscape perception, and therefore about parameter values such as the viewing angle and the maximum line of sight, a guideline for the proper use of all the options related to different types of perception is required.

Second, the data used for the procedure, the AHN and Top10- vector databases, were available to the participants. If such a procedure were to be used at the European level, data availability would be a major issue, because at this level such high resolution topographic datasets and elevation models are not available.

Third, having enough time and money is also a precondition for the feasibility of the procedure. The participants indicated that this would not be a problem, given that information about openness can be generated relatively quickly and at low cost. This is especially true in comparison with other procedures for including perception in policy making, such as surveys.

4. Reflection

4.1. Reflection on the evaluation results

The results of the workshop show that landscape openness is a relevant characteristic for Dutch policy makers. Measuring a single landscape characteristic, such as openness, instead of the entire landscape has been criticized because people do not experience the distinctive aspects of landscapes separately, but as a whole (e.g. Coeterier, 2000). We acknowledge that it is necessary to use complementary measurements to grasp the entire character of the landscape. Landscape openness is related to a number of experiential qualities, such as legibility (Herzog and Leverich, 2003), mystery (Lynch and Gimblett, 1992), tranquillity (MacFarlane, 2005), and visual accessibility (Herzog and Kropscott, 2004). The procedure could be adapted and extended to include such experiential characteristics.

The way in which the procedure facilitates the inclusion of landscape perception into policy making was appreciated and found to be relevant. This is in line with the definition of landscapes in the European Landscape Convention, which also includes perception (Council of Europe, 2000). The perception-based, bottom-up approach of the procedure needs to be linked with top-down interpretations based on European data (Wascher, 2003). However, as yet there is no clear method of integrating perception-based openness at local and regional levels with national and international levels. A current method that describes landscape characteristics covering the whole of Europe, LANMAP (Mucher et al., 2010), does not include perception-based data.

The procedure enables the flexible use of data, allowing decision makers to use raw data directly and adjust the analysis to meet their specific needs. Although we expected that the participants would prefer predefined classifications of openness, they actually appreciated the flexibility and adaptability of the procedure. However, guidelines are needed to enable users to make proper use of the various options and flexible parameter values. For example, policy makers may not know which angles of view are appropriate for specific activities. Not only are such parameter values not predefined in the procedure, but the valuation of openness is also not included in the procedure. Although valuation is an important aspect of decision making (Termorshuizen and Opdam, 2009), the participants did not mention it as a requirement for the procedure. They found the procedure helpful as an input to the process of formulating openness values. Furthermore, they said they would question the credibility of the procedure if values of openness were predefined.

The information derived from the procedure was considered to be useful for compiling descriptions of the actual openness of landscapes: what is the current state of openness, how is openness changing, and what is the impact of certain landscape change on openness? When answering the last question, the procedure was not considered to be easy to use for scenarios where there is no explicit spatial input available. For example, in the Krimpenerwaard case (Zuid-Holland), the scenarios show a 5 or 10 per cent increase of bushes and trees, without indicating where these are located. As the procedure requires exact locations of physical objects, random locations were used in this case. The procedure works well for scenarios with explicit spatial information, such as the develop- ment of dikes in de Ronde Venen (Fig. 3).

The procedure can be used to improve communication between stakeholders. Definitions of landscape openness are often not clear, which makes communication about openness complex and fuzzy. Moreover, openness is a key feature for many qualities and functions of landscapes (Fry et al., 2009). For example, in Friesland, landscape openness is important for birds, recreation, and cultural and historical values. The procedure is expected to be useful for all the aspects and therefore an appropriate instrument for integrative use. The procedure may also add value to participatory planning processes by improving communication between policy makers and the public. The visualizations are easy to understand and will probably be usable by the public as well.

The workshop participants clearly stated that they would use other sources of information as well as information derived from the presented procedure to assess openness. The added value of using various sources of information on visual impacts is underlined by other research, for example by Gulinck et al. (2001) and Ode et al. (2010).

4.2. Reflection on the evaluation method

Within the scientific domain, few evaluations of methods used to support decision-making concerning the visual landscape have been based on the input of end users. Methods for monitoring landscape change (Dramstad et al., 2002), viewing quality ratings of landscapes (Germino et al., 2001), mapping landscape values

(Gulinck et al., 2001), developing indicators for assessing changing landscape character (Van Eetvelde and Antrop, 2009), evaluating visible spatial diversity in the landscape (Palmer and Lankhorst, 1998), characterizing natural landscapes (Brabyn, 2005) and assessing the public perception of landscape (Scott, 2002) have all been developed by scientist for end users, such as policy makers and planners, but have not yet been evaluated using input from end users. We were not able to find scientific papers describing evalu- ations of similar procedures, methods or models by policy makers. Such evaluations probably do exist, but if so they do not appear to have been presented to the scientific community in peer-reviewed journal articles. Although some of the previously mentioned methods have been evaluated using expert knowledge, these evaluations tend to be too generic and do not provide much useful feedback for improving the methods.

Involving policy makers in the process of developing procedures by scientists has an added value for several reasons. It increases trust between policy makers and scientists, which is one of the preconditions for improving the interface between science and policy making (Tress et al., 2005). It also increases the accessibility of scientific knowledge to policy makers, and makes them more aware of the current possibilities and limitations. By communicating with policy makers, scientists may also become more aware of the requirements and needs of policy makers (Holmes and Clark, 2008). Effective communication between the two groups was stimulated in the present workshop by asking the participants to submit a case representative for openness issues within their own work. This enabled the authors to become acquainted with concrete practical issues, and allowed the participants to evaluate the procedure directly, based on their own cases.

Although the cases were provided by Dutch policy makers, the procedure is believed to be relevant for the international context as well. Openness appears to be an important landscape characteristic, not only for the Netherlands but for many European countries (Wascher, 2005). Ambiguity about the definition of openness may even be stronger in other, larger and/or more geographically and culturally diverse countries than in a small country such as the Netherlands. The need for a generic method that generates results, applicable to any landscape seems urgent. Moreover, more linkages are needed by combining top-down approaches (e.g. existing European datasets such as LANDMAP) and bottom-up approaches (e.g. assessment of perception issues). The workshop was held in a Group Decision Room (GDR), which encouraged all the participants to respond. This anonymity presents an advantage of electronic surveys, because participants do not influence each other and do respond. Although the workshop was structured by asking participants to rate the procedure electronically according to certain specified aspects and criteria, the participants also had the opportunity to discuss the results and their explanations. This is an advantage over electronic surveys, which do not permit interaction between participants. We are aware of the small number of participants, which may not be representative of the general population of Dutch (regional) policy makers. However in the current evaluation study the participants acted as "stakeholders" who represented eight of the Dutch provinces.

The workshop yielded qualitative and quantitative results. The qualitative results, based on recorded statements, discussions and verbal explanations, were summarized and analysed by the authors, but not analysed using a systematic and objective protocol, such as content analysis. The quantitative results, based on the ratings, were objectively summarized and analysed to produce descriptive statistics. The combined interpretation of the qualitative and quantitative results provided more objective information to support the rather subjective qualitative information.

The moment of evaluation of the procedure had consequences for the design of the workshop. We decided to evaluate the procedure immediately after its development, but before implementation in the policy making process. This enabled us to involve policy makers in the development of the procedure before implementation, which increases their trust in the quality of the procedure and introduces additional possibilities for improving the procedure before implementation. At the same time however, testing a prototype of the procedure before it was fully implemented may have made it difficult for the policy makers to evaluate its feasibility (or user-friendliness).

The results of this exploratory first evaluation indicate the need for further, more refined evaluations. For example, more thorough evaluations are needed to ensure that the participants understand the whole procedure and know all the advantages and disadvantages. These could include a 'hands-on' workshop in which participants actually apply the procedure to their own cases. In addition, a post-implementation evaluation could be held to analyse the benefits of the presented procedure compared with currently used procedures and models.

In general, the current study shows that explicit evaluations of the usefulness of GIS-based tools can aid integration at the scienceepolicy interface and help to ensure both scientists and policy makers are fully informed of all the scientific and societal options and requirements. It shows a shift from a classic approach where first the scientist defines a new concept or application followed by the implementation by policy makers, towards an approach where scientists and policy makers are both involved in the process of implementation. This approach may include the following steps: 1) develop a research prototype-application, 2) evaluate the application with scientists and policy makers, 3) adapt the application based on evaluation results, 4) implement the application, 5) evaluate the implemented application. Although the proposed GIS- based tools aims at the integration of science and policy making, the independent contributions and interests of scientists and policy makers should be respected.

5. Conclusions

The policy-making value of a GIS-based procedure for assessing perceived openness was evaluated in a workshop with policy makers. The procedure was considered to be relevant, credible, usable and feasible to implement. The application of these criteria resulted in a pragmatic and realistic approach which is capable of representing essential aspects of perceived landscape openness. The results confirmed that it is useful to include perception in landscape policy making. Landscape policies often require information about the interaction between people and their environment to be available when assessing landscape characteristics. The participating policy makers did not yet have suitable instruments available to achieve this. The presented procedure was considered to be a starting point in obtaining the required information. Furthermore, the results supported the idea that landscape openness is a relevant landscape characteristic for policy makers, but that its meaning is not unambiguous. The cases show a wide variety of situations in which openness is important. Although these cases were all tied to the Dutch context, the procedure was designed for application in a wide range of contexts, including other countries and regions outside the Netherlands. The general applicability of the procedure was widely appreciated. The policy makers who participated in the workshop also appreciated the flexibility of the procedure, which provides options for measuring openness for various modes of perception. Instead of using predefined generic openness values, users of the procedure are encouraged to define values themselves for specific cases.

The procedure could be useful for participatory planning and communicating with other stakeholders because the concept of measured visible space intuitively corresponds to openness. Moreover, openness can easily be visualized. The information derived from the procedure is therefore suitable as a starting point for discussions on the effect of landscape changes on openness or discussions about planning scenarios with stakeholders.

According to the policy makers, further research could explore the possibilities for using alternative datasets that can provide more detailed inputs, the development of guidelines for the proper use of openness values, and the development of procedures for other landscape characteristics The procedure can aid integration at the scienceepolicy interface and help to ensure both scientists and policy makers are fully informed of all the scientific and societal options and requirements. Eventually, this may help to provide greater transparency and accountability in environmental decision making.

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