The planning of fit

A GIS study of scale challenges in community-based planning for landscape services in South Holland.

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Cover photo: A slope model of the border between the municipalities Leiden and Zoeterwoude. In the generally flat landscape of South Holland, minor changes in elevation become pronounced, giving a highly detailed image of the landscape. The image was made in ArcGIS 10.2, using the Slope tool on the AHN2 dataset.

Abstract

Community-based planning is used globally to manage landscapes and natural resources. The approach promises many advantages over top-down planning. One weakness of community-based planning is the reliance on the local scale, foregoing planning at the regional or higher levels of scale. This thesis examines two key scale challenges, the problem of fit and the plurality of relevant scales. Through GIS, I studied the demand from local actors for three landscape services and the scale necessary to supply them, using a planning process in the Netherlands as case study. Both scale challenges were found to be prevalent in the study area. The combination of multiple problems of fit and many relevant scales results in a significant planning challenge that is unlikely to be tackled through community-based planning alone. This thesis suggests that planning should be integrated across multiple levels of scale, and that guidelines based on multi-scale governance theory can aid in resolving these problems.

Keywords: community-based planning, scale challenges, GIS, landscape services, multi-scale governance

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Summary

Community based landscape planning is a practice that finds significant popularity across the world. However, efforts at community based planning to bring about sustainable landscape solutions encounter many challenges. The external effects that local communities impose on one another mean that effective management requires planners to operate on multiple levels of scale and in fact on multiple scales. This creates a need for integrated, multi-scale and –level problem solving. Within that framework, community-based planning can be a valuable tool to manage and plan landscapes.

In this study, I have looked at the case of a planning project in the Dutch province of South Holland, where provincial planners employed bottom-up methods to set goals for a regional plan. The provincial government of South Holland has recently collaborated with a number of municipalities within the province to organize workshops, called 'Dream sessions' to set planning goals for the region. Participants in these workshops were encouraged to collaborate on making their personal dreams for the landscape a reality. These dreams are formulated in a local context and illustrate issues that are experienced on that level, with less concern to issues that play at regional or national levels.

Scale theory presents two challenges that are crucial to community based planning: mismatch and plurality. The mismatch challenge is also known as a problem of fit: the scale at which actors operate and devise solutions to encountered problems is not the same as the scale at which the problem is produced. The plurality challenge means that, rather than simply finding the right level of scale, it is often necessary to act on multiple levels.

The purpose of the study was to identify problems of scale that arise out of a focus on the community level of scale. Specifically, I looked at the mismatch and plurality challenges, and the planning challenges that they result in.

In order to assess the scale challenges of mismatch and plurality, I have compared three elements: 1) the demand for landscape services, as expressed by communities and individuals during the dream sessions, 2) the demand expressed by municipalities in their policy documents, and 3) the existing landscape's potential to supply these services. I selected three landscape services for this study, which differ in the way they scale up or down; outdoor recreation, pollination and water purification. After this comparison, I ranked the dream session participants and municipalities by their capacity to provide the service within their respective domains, and their demand for it. A synthesis of the mismatch and plurality issues for the three services was made to see where the mismatch and plurality challenges coincide. Finally, I have compared the results to policy recommendations from theory on multi-scale governance.

This study identified two types of mismatches: at the regional level, there is a problem of fit between the scope of ecological networks and the scope of both municipalities and dream sessions. At the local level, there is a mismatch between supply and demand of services. The landscape has a lot of potential supply for each of the three studied services. The results also indicated a lack of shared interests between the dream session participants and their respective municipalities. Dialogue between dream session participants and municipalities, with the purpose of social learning, could help to avoid conflicts between these actors. Whether the lack of shared interests is the result of differences in (spatial) scale remains uncertain.

The results indicated that for each of the three studied services, a different institutional arrangement seems appropriate. Planning thus requires tools to manage the landscape across levels of scale and sectional boundaries. Two approaches to multi-level governance highlighted a number of issues that planners in the study area will have to address. In accordance with this study, these are: inclusiveness of potential participants, building capacity and commitment among involved actors, responsibility and accountability across boundaries, social learning and a system of conflict mediation.

In this thesis, I presented a method for studying both the mismatch and plurality scale challenges. I encountered several problems, which limit the applicability of the method to services which are in high demand and behave predictably. Aside from recognizing these limitations, three general improvements of the method are required: 1) further quantification; 2) clear delineation between actual and potential supply; 3) further specification of landscape services.

Introduction

Community based planning: problem of scale

Community based landscape planning is a practice that finds significant popularity across the world: from North America (Colvin 2002) to Africa (Blaikie 2006) and Australia (Lane & Corbett 2005). This popularity can be ascribed to a number of advantages that community based planning is considered to have, when compared to more traditional top-down planning: First, it is making use of indigenous or local knowledge, rather than dismissing it. Second, it is sensitive to local context and inclusive of local priorities. Third, it enhances the planning capacities of communities through social learning processes. Fourth, through these advantages, it is able to make effective use of local planning resources (Gray et al. 2001; Lane & McDonald 2005).

However, efforts at community based planning to bring about sustainable landscape solutions encounter many challenges. One of the most pervasive problems is the matter of scale; these communities operate on a local scale, as people show far more interest in decisions that regard their immediate surroundings than those established in regional or national policies (Held, 1987). At the same time, local decisions can have wider consequences, either imposing change elsewhere or being a response to change effected by external sources, if not both (Berkes 2006).

The external effects that local communities impose on one another mean that effective management requires planners to operate on multiple levels of scale and in fact on multiple scales. Environmental systems operate on different spatial and temporal scales, which may not correspond to existing scales of jurisdictions, management and networks (Cash et al. 2006).

According to Lane and McDonald, challenges for community based planning lie on the spatial, jurisdictional and temporal scales: without a wider gaze, communities are likely to implement short term and small scale solutions in the limited jurisdictional space available to them (Lane & McDonald 2005). In the terminology of Cash et al., this results in the scale challenges of mismatch (problem of fit) and plurality. Since community based planning tends to operate on the local scale only, it seems unable to cope with these challenges.

Connecting local efforts at community based planning to regional landscape planning.

This creates a need for problem solving at multiple levels and scales, though that does not preclude community based planning as a valuable tool to manage and plan landscapes. Lane and McDonald also point out that Community based planning is not independent from state and other actors at wider levels of scale: "CBEP [Community Based Environmental Planning], as used in this paper, refers to the deliberate, programmatic decentralization of authority and resources to communities for the purposes of environmental management and planning." (Lane & McDonald 2005) and argue that communities may need to be fostered and supported in order to develop the necessary problem solving capacity to be effective. All in all, community based planning does not operate independently, and it shouldn't.

The challenge is then to establish cooperation and coordination between actors at various scales. Ideally, a large variety of scales should be incorporated, but for community based planning, the most immediate challenge is connecting to the regional scale, both in physical and jurisdictional space. This one step up may already be able to resolve a number of scale challenges.

Scale as a planning problem

The concept of scale is commonly accepted in planning and ecology literature, often to the point that it remains an abstract concept without clear meaning. Many studies use the term, often in their title, as an indication of the spatial scope of the study (Throgmorton 2003; Selman 2004; Phua & Minowa 2005; Trepel & Palmeri 2002; Pressey & Bottrill 2009). In these examples, terms such as 'landscape scale' or 'regional scale' are rarely clarified. That does not mean that scale is never discussed (Trepel & Palmeri 2002; Cox 1998) or actively studied (Girvetz et al. 2008; Klein et al. 2009; Born & Purcell 2006). However, in these cases, scale challenges are intricately linked to one specific topic, such as habitat fragmentation (Girvetz et al. 2008) or food production systems (Born & Purcell 2006). As such, while scale challenges are recognized and studied, there does not appear to be a clear means of studying scale challenges outside of a specific context.

In this study, I have looked at the case of a planning project in the Dutch province of South Holland, where provincial planners employed bottom-up methods to set goals for a regional plan, thus fitting perfectly in the above-mentioned definition of community-based planning. The aim of this study was to identify problems of scale that arise out of this focus on the local level. The method developed for this study was geared to assess scale challenges directly, without reliance on any specific context. The study focused on the two scale challenges of mismatch and plurality. Mismatch was measured as a discrepancy between local, community-based goal-setting and the physical landscape's capacity to meet those goals within the local setting. Plurality was measured as the difference in planning goals between community-based efforts and municipal policy documents. I have selected the landscape services of outdoor recreation, pollination and water purification. As each of these responds differently to scaling up from the local level, this made a wide range of challenges identifiable.

Case study: South Holland

The provincial government of South Holland has recently collaborated with a number of municipalities within the province to organize workshops to set planning goals for the region (Figure 1). In these workshops, citizens were invited to discuss issues they experienced in the landscape and to formulate solutions and improvements in the form of dreams; an idealized and highly personal image of what the landscape should be, and what services it should offer.

While participants in these workshops were encouraged to collaborate and make their dreams a reality, these dreams also serve as input for a regional plan. Collecting every individual dream from each workshop has generated a large body of wishes and ideals that can be read as a societal demand for landscape services (Termorshuizen & Opdam 2009) and can be used to formulate regional planning goals that are in line with the concerns and wishes of inhabitants of the region.

However, this does not resolve the issue of scale. Dreams are formulated in a local context and illustrate issues that are experienced on that level, with less concern to issues that play at regional or national levels. Both the province and municipalities have responsibilities that workshop participants may not even consider. In fact, both prefer to play a facilitating role, enabling participants to make their dreams a reality while only spending a minimal amount of their own resources. This leaves these dreams as firmly local, small scale planning actions.

Figure 1: The study area, as situated within the Netherlands

Problem description and research questions

As outlined above, scale theory presents two challenges that are crucial to community based planning: mismatch and plurality (a third challenge, ignorance, may be relevant but is not inherent in community based planning). To this, we can add a planning challenge.

Mismatch challenge: the scales of dreams versus the scales of landscape functions.

The mismatch challenge is also known as a problem of fit: the scale at which actors operate and devise solutions to encountered problems is not the same as the scale at which the problem is produced. An obvious example is climate change: local efforts to mitigate or adapt may contribute, but global action is required to really tackle the problem. Problems of fit can also occur in the other direction (Cash & Moser 2000).

For community based planning, the main challenge would be scaling up, rather than down. In South Holland, dreams offer a lot of local ideals, though of varying scale and ambition. Reading these dreams as demands for specific landscape services raises the question of the (potential) supply of these services. As such, the problem of fit becomes essentially a problem of supply and demand. The scales of landscape service demand and supply can vary widely: an individual farmer cannot decide to replace pesticides with natural pest control, this requires a landscape service supply at a regional scale (Steingröver et al. 2010).

Plurality challenge: regional planning, municipal planning and local action.

Rather than simply finding the right level of scale, it is often necessary to act on multiple levels. In the previous example of climate change, local and regional action can contribute to a global solution (Ostrom 2010). In the case of natural pest control, it required individual farmers to contribute to a regional network (Steingröver et al. 2010).

In the South Holland case, we can identify roughly three levels of scale in both physical and jurisdictional space: a regional, managed by the province, a local, managed by municipalities, and a site, managed by land owners. As dream session participants were encouraged to collaborate and realize their own dreams, we can expect planning and/or action to occur at all three levels. The plurality challenge is then to coordinate plans and actions across these levels. In this particular case, the province builds its plans, at least partially, on the collective input of dream session participants throughout the region. Therefore, the main divergence of planning goals can be expected between the dream sessions and municipalities.

Planning challenge: designing a process to effectively manage multi-level, cross-scale linkages and interests.

The combination of mismatch and plurality leads to a complex planning challenge. The scales appropriate for dealing with one problem of fit might not match those appropriate for another. However, due to possible synergies between landscape services, it would be preferable to develop an integrated plan that addresses all relevant services. As a result, such a plan may need to include many different levels of scale as well.

The planning process will also need to address differences in service supply and demand among involved actors. These differences could lead to mutually beneficial trade, but also to dominating positions of power, where one is dependent on another for the delivery of important services.

These challenges lead to the following set of research questions:

- What is the mismatch between the scales of dreams and the scales of landscape services required to realize them?
    - How is the demand for landscape services spread over the study area?
    - How is the potential supply for landscape spread over the study area?
    - Where do the demand and potential supply overlap?
- How does the plurality of planning goals across levels of scale create potential for conflict and cooperation?
    - How do the municipal demands for landscape services compare to those of dream session participants?
    - How can the differences in supply and demand establish distinct roles for actors in a multi-level planning process?
- How could the planning process in South Holland be made more effective in dealing with scale issues?
    -

Theoretical framework

Scale theory: multi-level, cross scale linkages

Landscape planning occurs across a variety of levels, and a variety of scales. In the Netherlands, planning occurs formally at the national, provincial and municipal levels. Within the formal provinces, Municipal and provincial governments also create regional planning agencies to bridge scale issues (Cash & Moser 2000). Individuals and non-state organizations also engage in planning activities, ranging from operational management to national, long term strategies.

Cash et al. (2006) identify seven different scales of human-environment interactions:

1. Spatial: from small to large areas;
2. Temporal: from slow and long to fast and short durations;
3. Jurisdictional: from local to inter-governmental administrations;
4. Institutional: from operating rules to constitutions;
5. Management: from tasks to strategies;
6. Social networks: from family to trans-society;
7. Knowledge: from specific and contextual to general and universal.

Human-environment interactions can operate on multiple levels within one of these scales, but also across scales themselves. It is easy to assume that levels on various scales correspond: a national government develops long-term plans for the whole country and sets broad rules, using general knowledge. A municipality develops local, short term plans and sets operational rules, using contextual knowledge. However, a national government may dominate planning at a small area when it is of particular relevance (Young 2006) or form a short term solution to an emerging problem. At the same time, municipalities may also develop long term plans, use general knowledge and build social networks beyond the municipality's borders. The myriad of possible combinations leads to a complex situations where multi-level and cross-scale interactions may be difficult to identify or comprehend.

According to Cash et al., this complexity leads to three challenges: 1) Ignorance of cross-level and cross-scale interactions, such as a farmer that is unaware of the eutrophication caused downstream by excessive use of fertilizer; 2) Mismatch of the scale of human institutions with biogeophysical processes, such as governments trying to manage water quality in a transboundary river; 3) the Plurality of scales and levels that needs to be considered in effective problem solving.

Relating to community based planning, specifically the latter two challenges are relevant. By adhering to a local scale, problems of fit (mismatch) and plurality occur almost automatically, regardless of whether participants are ignorant of these problems.

Community based Planning within a social network

Community based planning builds on the premise that by focusing on local interests in, and (indigenous) knowledge of the environment, a more sustainable and effective management of the environment can be achieved. This relies on the concept of stewardship (Gray et al. 2001): A community of place depends on the environment it inhabits for its wellbeing, and therefore has an immediate interest in the preservation of this environment and the products and services it provides. Such a community also has specific knowledge and experience that is crucial for effective management.

Community-based planning further relies on inclusive participation of stakeholders, a holistic approach of community and environment, monitoring and adaptive management through social learning and capacity building (Colvin 2002). However, social learning and capacity building often require external input from non-local agents: scientific knowledge, government support and private investment may all be necessary to provide the necessary tools (Gray et al. 2001; Lane & McDonald 2005). As such, communities need to connect to agents at different scales of space, knowledge and jurisdiction.

Lane and McDonald (Lane & McDonald 2005) expand on this challenge: communities are not completely homogenous entities, but are comprised of people with various, potentially conflicting, ideas and interests. As such, the decentralization of environmental decision-making may actually disempower local minorities (Lane & Corbett 2005). And even when a community is free of internal conflict, local interests may conflict with actors operating at wider scales.

This highlights that from the point of view of scale challenges, communities cannot and should not plan fully independently. Communities necessarily operate on a small spatial scale and a small jurisdictional scale, using experiential knowledge. Since the environmental systems that provide important landscape services tend to require a larger spatial scope, there is a need to coordinate plans with neighbours and government agencies operating on wider spatial scales. Governments also need to give communities the jurisdictional space and foster their capacity to implement plans. Further, experiential knowledge may not be enough when planning for the future, which means that scientists, able to offer more fundamental knowledge, may need to be consulted (for example, see: Steingröver et al. 2010).

The result is that a range of actors needs to be involved. As such, the adaptive management element of community-based planning should be expanded into adaptive co-management (Olsson et al. 2007; Armitage et al. 2009): combining monitoring and social learning with collaboration and communication. This requires a multi-level, social network of communities, governments, knowledge institutes and interested private enterprises.

Social-ecological networks from a community-based planning perspective

A central argument in favour of community-based planning is that local communities have knowledge of what benefits the landscape provides, and an interest in sustaining this provision. In other words, communities are supposedly more aware of the supply and demand of landscape services. Local, immediate users of services are likely the first to experience changes in quality or quantity. This trait is useful for monitoring the landscape and identifying problems, but not necessarily for solving them (Lane & McDonald 2005).

Areas of landscape service supply and demand often occupy a different space, such as any service based on flowing water (Fisher et al. 2009). Thus, environmental changes felt within a community may have a source outside its sphere of influence. Furthermore, the supply of desired services can require an ecosystem of a larger scope and require planning at a regional level of scale (Ernstson et al. 2010). This not only underscores the need for a multi-level, social network, but also the inclusion of the ecological network.

The ecological network as a planning concept (Opdam et al. 2006) allows a community of landscape users to establish ecological targets that meet their demand for landscape services, while allowing the physical, ecological network to take a variety of shapes. This flexibility is an important element of adaptive co-management: it offers room for negotiations among different interests and allows for a social learning process through experimentation (Armitage et al. 2009).

The social network and the ecological network together make up a social-ecological network. Such a network illustrates the ways in which users of services interact with the landscape, with each other and how different elements in the landscape are connected. Janssen et al. (2006) focus on two network characteristics: connectivity and centrality. A higher connectivity, defined as the number of existing connections, relative to the maximum number of possible connections, creates a more resilient network; the loss of certain connections does not immediately isolate nodes in the network. Centrality is defined as the existence of hubs, or nodes that have more connections than average. A high centrality indicates that certain nodes are of crucial importance to the functioning of the network, while others are much less so.

In terms of landscape planning, a high connectivity among ecological nodes would indicate a need for coordinated action, while a high connectivity among social nodes could indicate the existence of coordination among actors. Centrality then defines the key landscape features, or key actors in the planning process. However, the interactions implied in connections can take a variety of forms. For example, between social nodes, there can could be support and agreement, but also influence or domination (Young 2006). As such, the nature of the connection is as important as its existence.

Bodin and Tengö (2012) take a slightly different approach by comparing all the different networks that could be established in a simple network of two social and two ecological nodes. However, here too, different degrees of connectivity and centrality are established. Yet one important criterion they perceive for the use of this framework is scale matching: "Matching scale implies that the interdependent social actors and the ecological resources should both be defined at such scales that their ability to impact on each other is comparable in strength." (Bodin & Tengö 2012, p.434). At the same time, they consider the framework to be applicable at different scales. As such, the one thing that seems to be missing is vertical connectivity.

Conceptual framework: scale dependency of landscape services

Within the social network, a demand for landscape services can be established. The ecological network is capable of supplying the demanded services. However, services rely on different processes, which in turn operate on a variety of scales. While it may not yet be feasible to identify specific levels of scale for individual services, it is possible to broadly define their scale dependency.

The scale of the ecological network indirectly impacts the delivery of services. Larger natural areas are able to provide habitat to a greater variety of species and species richness in turn can improve the reliability and effectiveness of service delivery (Vos et al. 2014). However, not all services require a large scale network to function: a wheat field does not require an ecosystem to maintain a wheat population. As a result, such services can be produced at both a small scale and a large scale.

Other services, such as pollination, do rely on specific populations. Consequently, the effectiveness and reliability depends on the maintenance of a minimum viable population of certain species (Opdam et al. 2006). The result is that there is a minimum scale required for the delivery of the service.

A third form of scale dependency relies not so much on the persistence of specific species or the size of the ecological network, but the ability of human beings to experience the service directly, for it to have any benefit. This is the case for many cultural services such as landscape aesthetics and recreation. This accessibility constraint can be roughly translated into a distance constraint. Rather than a minimum scale, this results in a maximum scale, beyond which the service offers little added benefit.

This establishes three basic types of scale dependency for landscape services: 1) scale independent services, 2) minimum scale services and 3) maximum scale services. In an area where we recognize three different scale levels, for example, local, regional and provincial, this allows the following basic assumptions:

1. Scale independent services can be provided at any level of scale.
2. Minimum scale services can only be provided at levels of scale above the local.
3. Maximum scale services can be provided on a local and perhaps regional level, but not beyond.

Table 1: conceptual scale dependency

Scale	SI services	Min scale services	Max scale services
Local			
Regional			
Provincial			

Methods

In order to assess the scale challenges of mismatch and plurality, I have compared three elements: 1) the demand for landscape services, as expressed by communities and individuals during the dream sessions, 2) the demand expressed by municipalities in their policy documents, and 3) the existing landscape's potential to supply these services. The dream sessions, as a form of community-based planning, and the municipalities operate on a different level of scale, both in terms of space and jurisdiction. Yet they are actors in the same social network when it comes to providing a supply for certain desired landscape services.

As it was not possible to assess these elements for each relevant service in the study area, I selected three; one to represent each type of scale dependency. Within these categories, I have selected the service that was the most popular in the dream sessions, and is not a tradeable commodity. This last criterion ensures that the service could not be easily produced elsewhere and then imported, as that would make it impossible to properly assess the supply and demand within the study area.

To each of the three selected services, the same three-step analysis was applied: First, the scale mismatch from the community-based planning perspective: comparing the dream session demand with the landscape's potential supply. Second, the plurality in demand: comparing dream session demand with municipal demand. Third, ranking the dream session participants and municipalities by their capacity to provide the service within their respective domains, and their demand for it. This indicates whether these actors would be service providers, dependent beneficiaries or both (effectively having the capacity to meet their own demand).

Following this approach for each of the three services, I have conducted a synthesis of the mismatch and plurality issues for the three services, to see where issues overlap, creating a potential for both conflicts and synergetic solutions.

Landscape service demand: dream sessions

In the area, 13 dream sessions were held. Five of these are so-called 'thematic sessions', dealing with a specific theme for the whole area. The remaining 8 are site-specific: they deal with a wide range of themes regarding the landscape, but for a (vaguely) specified area (Figure 2). As a result, these 8 sessions illustrate local dreams, interests and problems. Participants were asked to formulate a dream for the landscape: a described image of what the landscape would ideally be. While this is not a literal demand for landscape services, I interpret a demand for landscape services from it.

A previous classification of dreams to landscape services is used as the basis of my current demand interpretation. However, I have made two significant adaptions. First, I have adopted the classification and selection of landscape services that was also used in the planning process, in order to stay as close as possible to the information presented to dream session participants. Second, I have attempted to make my classification more objective and reproducible by including a coding process (Creswell, 2009): rather than going through the dream session results and assigning landscape services to each dream based on personal interpretation, I have noted down recurring keywords and their meaning. These keywords then establish which service demands are established in each dream (e.g. "Cycling paths" translates into the service 'outdoor recreation'). In a few cases, I have deviated from this coding, as the context of the keywords implied something else (e.g. "No additional cycling paths"). Yet overall, the results can be traced to the coding.

I have selected three of the most frequently demanded services for further study, since it is infeasible within the scope of this thesis to map the supply and demand of all relevant landscape services. For this selection I have used three criteria. The first criterion is scale dependency. A landscape service can have a clear minimum threshold, for example when it relies on a population of specific species to maintain its effects: when that or those species go locally extinct, the service is no longer provided. This translates into a minimum amount of suitable habitat space required, without which the service would be lost. Services can also have a maximum scale: they only have an effect when human beings are present to make use of the benefits, in which case service delivery deteriorates rapidly with distance or inaccessibility. Other services are mostly scale independent: though economies of scale may apply, they can be provided effectively from a single plot to a landscape level.

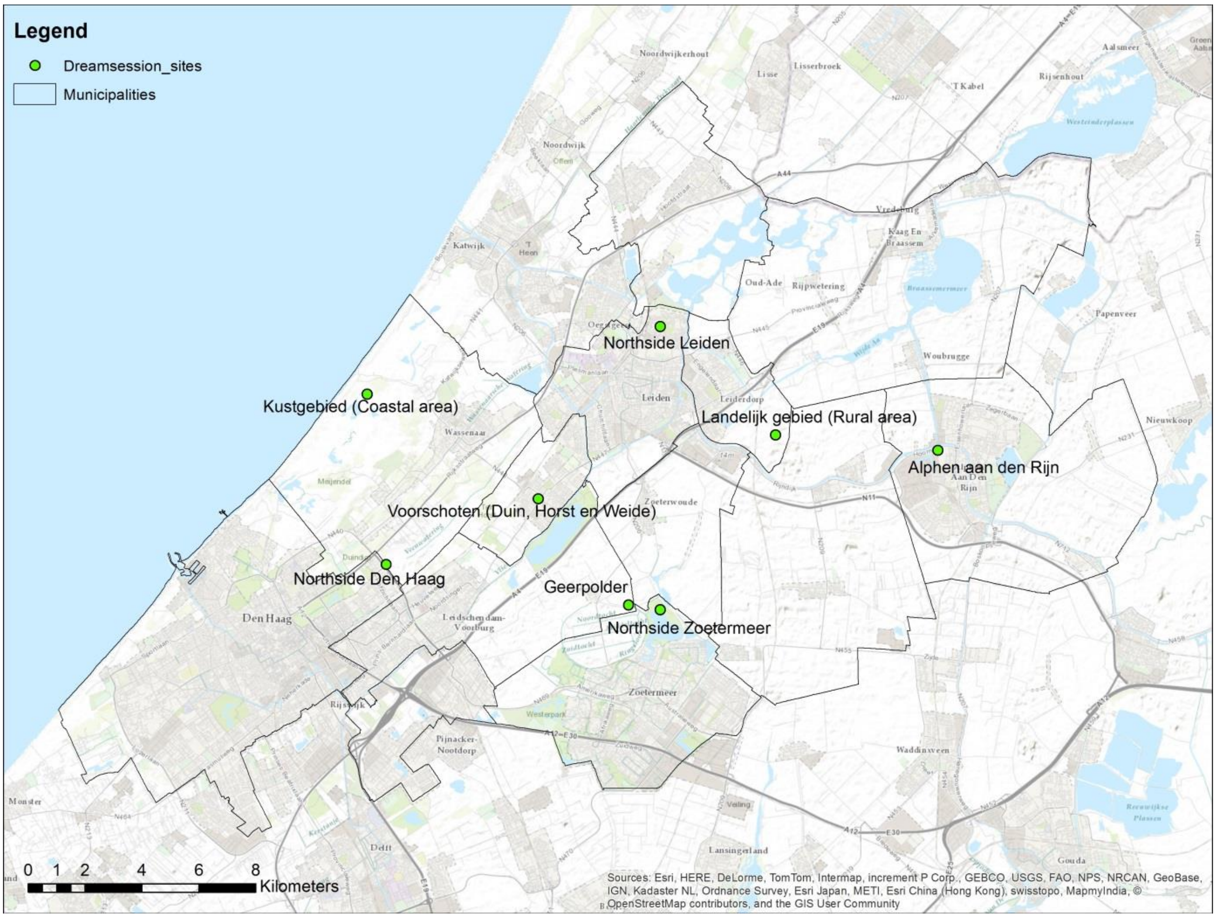


Figure 2: Dream sessions within the area (source: www.mijngroenonsgroen.nl)

Within these three categories, I have selected services that must be maintained within the study area. That is, they are not tradeable goods that can be produced elsewhere. From this selection, I have taken the service with the highest demand in the dream sessions. This has resulted in pollination (minimum scale), outdoor recreation (maximum scale) and water purification (scale independent). As outdoor recreation represents a broad range of leisure activities, I have narrowed this down to the two most prevalent ones: hiking and cycling.

Mapping the dream sessions

In order to map the demand for services in the area, I needed to interpolate the dream session sites into areas. The residency of participants has not been recorded, leaving as primary indication the invitations that were sent out to various local organizations for each session and other forms of promotion, such as local newspapers (Table 1). With inhabitants of a single municipality participating in up to four different dream sessions, the lines between the dream sessions are rather blurred. In order to come to a map, I have made a few simplifications.

Table 2: participation of Dream sessions

Dream session	Location	Participants from other municipalities
Duin, Horst en Weide	Voorschoten	Wassenaar, Leidschendam-Voorburg
North-side Leiden	Leiden	Teylingen, Kaag en Braassem
Zoetermeer	Zoetermeer	Zoeterwoude, Rijnwoude
Rural area	Leiderdorp	Kaag en Braassem, Zoeterwoude, Rijnwoude
Alphen aan den Rijn	Alphen aan den Rijn	-
Coastal area	Wassenaar	Den Haag, Leiden, Leidschendam-Voorburg
Den Haag	Den Haag	Wassenaar, Leidschendam-Voorburg
Geerpolder	Leidschendam-Voorburg	Zoeterwoude

First, I have eliminated the Geerpolder session. The Geerpolder is a small area that is easily encompassed by the other sessions. Given its size, this session's scale is sub-municipal, unlike the other sessions. As such, I can easily eliminate it without negatively affecting the map.

Second, I have established a 'primary municipality' for each session. This is the municipality in which the session was held. Therefore it is where I expect most participants to come from and where the spatial focus of the session lies. The remaining four municipalities can then be split among the dream sessions where inhabitants participated (Table 2). I have divided these four municipalities by distance to the primary municipality of their respective dream sessions.

Table 3: Division of municipalities over dream sessions

Municipality	Dream sessions
Kaag en Braassem	North-side Leiden, Rural area
Leiden	North-side Leiden, Coastal area
Rijnwoude	Rural area, Zoetermeer
Zoeterwoude	Rural area, Zoetermeer
Leidschendam-Voorburg	Voorschoten, Coastal, Den Haag

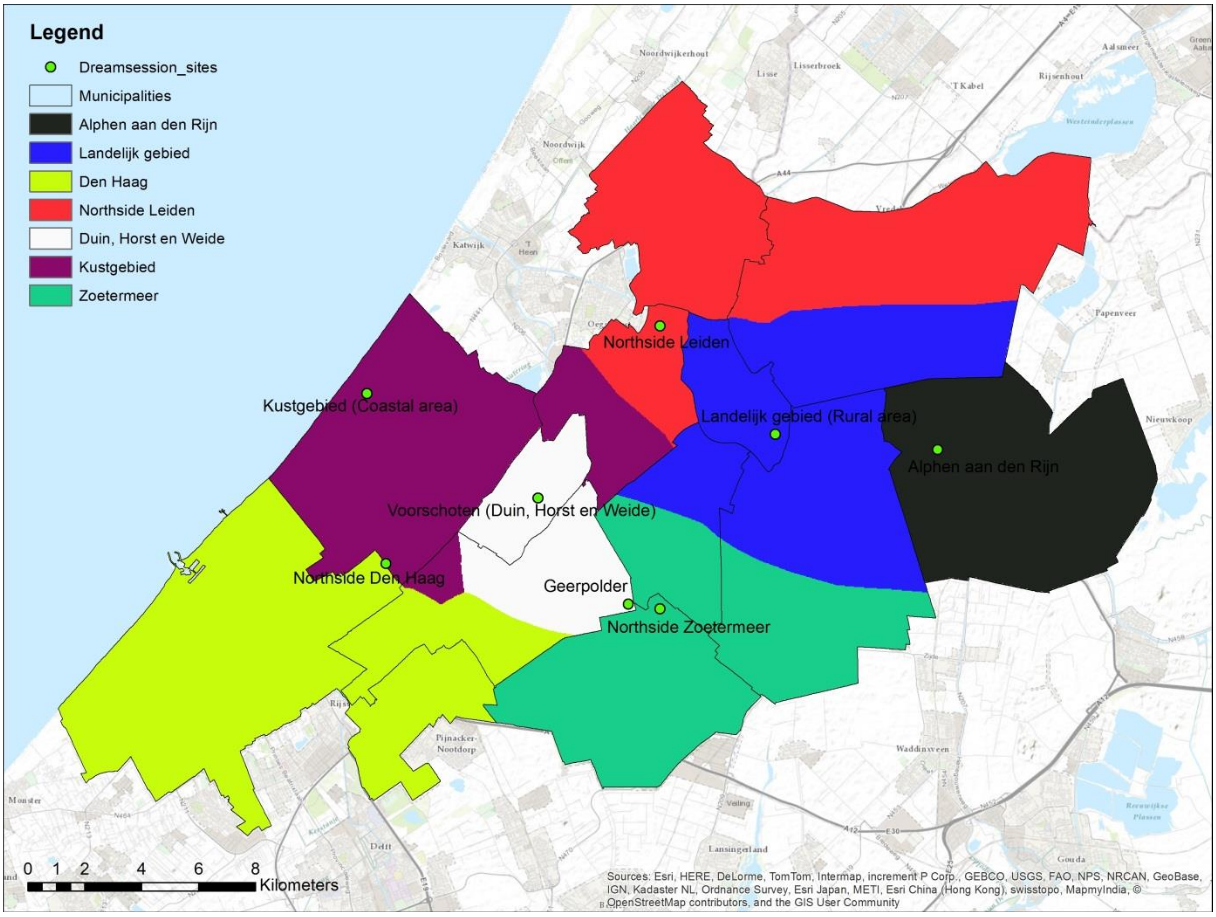


Figure 3: Spatial allocation of Dream sesions

In this, I have made one exception to the rule: the session 'North-side Leiden' was held in Leiden, but I assigned its northern neighbour Teylingen as its primary municipality for two reasons: 1) the dream session specifically discusses the north of Leiden, and thus have a strong focus on Teylingen and its eastern neighbour Kaag en Braassem; 2) This session is the only one where inhabitants from Teylingen participated, while inhabitants of Leiden and Kaag en Braassem were involved in other sessions as well. Thus, this shift allows Leiden to be divided over two sessions, which is a more accurate representation (whereas Teylingen wouldn't be divided in the first place).

The result is a map (Figure 3) that divides the entire study area over the 7 dream sessions, establishing clear boundaries between them. While the reality of the matter is probably a more gradual transition, with overlap between the different sessions, this simplification gives a basic indication of the area that each dream session represents.

Value Corrections

The seven dream sessions had varying numbers of participants, each with a varying number of dreams. Because of this variation some dream sessions produced more dreams than others. 14 dreams about outdoor recreation on a total of 134 dreams (North-side Leiden) gives a different indication of the demand for this service than a session with a similar number of dreams about recreation, but a much smaller total of dreams (16 out of 102; Zoetermeer). With the difference in number of dreams ranging from 57 to 134, it is necessary to correct the values of the different services for the total number of dreams in a dream session.

These corrections lead to some notable changes (table 3). For water purification, the changes are minor, with values of one remaining at approximately one and only North-side Leiden's 5 significantly decreasing. It's still by far the highest demand for water purification in the area. Pollination and Outdoor recreation show greater changes. For pollination, especially when comparing Alphen, Rural area and North-side Leiden. For outdoor recreation, Alphen is suddenly on par with North-side Leiden, while Zoetermeer actually scores much higher in comparison.

Table 4: corrected values for dream session results

Dream session	Outdoor recreation	Outdoor recreation corrected	Pollination	Pollination corrected	Water purification	Water purification corrected
Alphen	6	10.53	2	3.51	0	0.00
Den Haag	23	23.00	9	9.00	1	1.00
Coastal area	22	21.15	1	0.96	1	0.96
Rural area	4	5.63	3	4.23	0	0.00
North-side Leiden	14	10.45	3	2.24	5	3.73
Voorschoten	31	32.63	1	1.05	2	2.11
Zoetermeer	16	15.69	10	9.80	1	0.98

Outdoor recreation: 5 km buffer zones

For outdoor recreation, as a maximum scale service, I have taken an additional step: I have limited the demand to a distance of up to 5 km from population centres within the study area, taking into account single day leisure activities of both hiking and cycling (Willemen et al. 2010). As such, this does not include tourism or overnight stays (such as camping) and assumes that people initiate their trip either directly from home, or from the edges of their home town. This corresponds with the frequently expressed dream of starting a hiking or cycling trip 'from the doorstep'.

Landscape service potential supply

The methods to map potential supply of landscape services differ per service; each has different landscape requirements for an effective service delivery. Outdoor recreation requires hiking and cycling paths, along with an attractive landscape, while pollination depends on various species of bees, hoverflies and butterflies, each with their own specific habitat. Water purification requires sites that are suitable for a constructed wetland.

Outdoor recreation: coupling landscape attractiveness with hiking and cycling route density

The landscape's potential to enable hiking and cycling as leisure activities has two important criteria. First, paths or roads, suitable for hiking and/or cycling must be present. Second, these paths and roads must lead to and through a landscape that people find attractive.

To identify which paths are suitable, I have used South-Holland's provincial database of hiking routes and cycling routes. These routes do not include all suitable paths, but they do list a large amount of recommended paths and probably avoid, as much as the infrastructure allows, the less suitable roads. To measure the suitability of the landscape in this regard, I have calculated the average route density, including both cycling and hiking routes, over a 1 km radius.

Landscape attractiveness has already been measured for the entire Netherlands, using a model, calibrated with landscape attractiveness ratings from a national survey (De Vries et al. 2007). To combine these two criteria, I have placed both on a scale from 0-4 (Table 4) and multiplied them, resulting in a hiking and cycling suitability ranking of 0-16, with an average rating of 4 (2x2).

Table 5: Ranking route density and landscape attractiveness.

Hiking and Cycling route density (m)	Landscape attractiveness rating	Outdoor recreation Ranking
0-51	Low (<6.5)	0
51-131	Fairly low (6.5-7.5)	1
131-198	Average (7.5-8.5)	2
198-272	Fairly high (8.5-9.5)	3
272-522	High (>9.5)	4

Pollination: ecoprofiles

The service delivery of pollination depends entirely on the presence of pollinator species, such as bees, butterflies and hoverflies. At least one, preferably more, of these species must maintain a stable population within the area. In order to identify the potential supply, I applied ecoprofiles: groupings of species with similar habitats and spatial requirements (Opdam et al. 2008). For pollination services in the study area, I found that three ecoprofiles are relevant: 'Hommel', 'Zweefvlieg' and 'Pionier' (resp. bumblebee, hoverfly and pioneer; van Rooij et al. 2014). Each of these ecoprofile provides a clear set of landscape criteria that determine which places are, or could potentially, harbour a stable population (Table 5). This serves as an indicator of potential service supply.

Water purification

For constructed wetlands to provide effective water purification services, a couple of different criteria must be met, of which two stand out: 1) the inflow of water must be slow and even, in order to give the wetland ample time to remove pollutants and 2) the wetland must have an impermeable soil layer, preventing pollutants from leeching down into the ground water (Wamelink, 2015).

The effectiveness of a constructed wetland further depends on the concentrations of pollutants and the design of the constructed wetland: the size, shape, chosen techniques and the intended concentrations after purification all matter (Joly 2013). The intended concentrations after purification provide a particular challenge, as a higher degree of purification would require more time, or more space (allowing more water to be treated simultaneously). It means that the potential supply of water purification is directly affected by the desired cleanliness, the demand. Since such distinctions in the demand for water purification were not registered in the dream sessions or the structuurvisies, it was infeasible to measure any form of quantitative difference in potential supply in the study area.

This leaves only the two aforementioned criteria: 1) the inflow of water must be slow and even and 2) the wetland must have an impermeable soil layer. Space requirements are not significant. While larger wetlands may be more efficient, constructed wetlands of smaller than 1 ha are not uncommon (Joly 2013, p.10).

Table 6: Pollinator ecoprofiles (van Rooij et al. 2014)**.**

Ecoprofile	Feeding habitat	Nesting	Maximum distance between nest and feeding habitat
Hommel Forest and shrubs, combined with dry grassland and open spaces, free of vegetation.	10 ha within 1 km2, of which at least 1.5 ha forest or shrub land and at least 5 ha flower-rich grassland with open spaces.	10 suitable sites on grassland with open spaces.	500m
Zweefvlieg Mosaic of wet and dry grassland.	10 ha flower-rich grassland, of which at least 2 ha dry and 2 ha wet grassland.	10 suitable sites with varying degrees of moisture.	500m
Pionier Dry grassland with open spaces, free of vegetation.	10 ha dry, flower-rich grassland.	10 suitable sites on dry grassland with open spaces.	500m

Mismatch between supply and demand

I assessed the mismatch between supply and demand by overlapping the supply and demand maps per service. I deliberately did not establish a formulaic procedure for assessing this mismatch. Mismatch as a scale issue is more than a discrepancy between the supply and demand in a given place: it is a community's inability to develop or sustain the desired service delivery, as the potential supply relies on areas beyond their sphere of influence (Cash et al. 2006). Overlapping supply and demand maps focuses primarily on spatial differences, while the spatial spheres of influence of dream session participants are fuzzy. As such, the results of this assessment are indicative of potential mismatches, rather than definitive answers.

Plurality and municipal demand for landscape services

The dream sessions reveal a certain degree of plurality in scale: participants are not homogenous and may be individual citizens, representatives of an interest group, land-owning farmers, etc. The results show this through their varied and possibly conflicting ideals and demands. However, the results cannot be used to link this variety back to differences among the participants. However, there are other actors beyond the dream sessions as well. The most prominent of these would be the municipalities, who, with zoning plans, have a lot of power in spatial developments.

In order to assess the plurality of landscape service demands, I have compared municipal landscape demands with the demands as determined from the dream session, using the same method. The input for this is the municipal 'structuurvisie', a policy document that establishes the municipality's ideal image of itself as a target to work towards. This ideal image is very similar to 'dream' that dream session participants were asked to describe, and can thus be interpreted in the same fashion. Following the same procedures here makes the method consistent and its inaccuracies will be the same. Therefore, the results are comparable.

However, compared to the dream sessions, the structuurvisies have a very different structure and also a different, more formal, use of language. The coding applied to the dream sessions did not include certain words of phrases used frequently in the structuurvisies. I have therefore expanded to the coding to include these.

Furthermore, the structuurvisies are lengthy documents, discussing not only the desired future itself, but also ongoing developments, detailed descriptions of different areas within the municipality and policy measures proposed for the realization of the vision. In order to come to comparable results, two adaptations were necessary. The first step I've taken in this is to eliminate all the non-relevant chapters, leaving only the part that describes the municipality's 'dream'.

The second problem is the matter of counting dreams. A vision does not contain a group of clearly delineated dreams for an area. Rather, it is a single, coherent text. Even after eliminating the non-relevant chapters, it is usually still several pages long. Technically, it could be seen as a single dream. However, for the sake of counting the demand for different services, I am treating every sentence as a single dream (e.g. clean air mentioned twice within one sentence counts as one demand for that service. Two sentences mentioning clean air counts as two demands for clean air).

Often, these visions make frequent use of bulleted lists. For these, I count the whole list as a single sentence and thus one dream. I have made an exception for the (frequent) occurrence where a bulleted list form is used, but each entry contains a full sentence (or more than one). Here, I once again count separate sentences as individual dreams.

Finally, I do not count headers, references to other chapters (e.g. "see chapter 4; nature and landscape") or the titles of documents, plans and names that the text refers to.

Variation in the visions

Even with these guidelines in place, interpreting the visions fairly is a challenge: each municipality structures their vision differently, places a different focus and writes either lengthy or brief documents. Some municipalities integrate multiple policy sectors into a single vision, other discuss each sector separately. This means that interpreting the above guidelines is a little different for each municipality. I have indicated these differences in Table 7.

Table 7: selection of chapters and text from each Structuurvisie

Municipality	Document	Chapter(s)	Pages	Notes
Alphen aan den Rijn	"De Stad van Morgen; Structuurvise Alphen aan den Rijn 2031"	1	12-17 (6)	-
Den Haag	"Wereldstad aan zee; Structuurvisie Den Haag 2020"	3.1	25-29 (5)	-
Kaag en Braassem	"Maatschappelijk Ruimtelijke Structuurvisie 2025"	4-9	22-55 (34)	Chapter 3, 'Structuurvisie' does not contain any significant text to use.
Leiden	"Structuurvisie Leiden 2025"	4	33-41 (9)	Not including chapter 4.1, as this focuses on existing qualities.
Leiderdorp	"Toekomstvisie Leiderdorp 2025; Samenwerken en verbinden"	All	3-14 (12)	In each chapter, only the sections 'Uitdagingen', 'Overwegingen' and 'Koers'.
Leidschendam-Voorburg	"Structuurvisie Ruimte voor Wensen 2040, herijking 2012"	3	25-31 (7)	Not including subchapters 3.1 and 3.3.
Teylingen	"Structuurvisie 2030; Duurzaam bloeiend"	2	17-21 (5)	-
Voorschoten	"Structuurvisie Cultuurhistorie 2013-2023"	2	16-21 (6)	Voorschoten does not have a (published) broad vision for spatial planning, only a vision on cultural heritage.
Wassenaar	"Toekomstdroom Wassenaar in 2025"	-	1 (1)	Wassenaar is currently building their structuurvisie, supposedly using the 'toekomstdroom' that was the result of the dream session as primary input.
Zoetermeer	"Programma Duurzaam Zoetermeer 2030"	2	8-17 (10)	Not including implementation/monitoring of policy.
Zoeterwoude	"Structuurvisie Buitengebied Zoeterwoude"	5	57-65 (9)	Not including site-specific visions.
	"Structuurvisie Dorp/Zuidbuurt"	3	9-15 (7)	Only the headers "Toekomstige situatie" (Future situation).
	"Structuurvisie Zoeterwoude-Rijndijk"	3	9-16 (8)	Only the headers "Toekomstig" (Future situation).

Actor involvement ranking

I have ranked municipalities and dream session participants (with the simplifying assumption of a homogenous group) on importance for involvement in a regional planning process for each of the three landscape services. This ranking is based on whether actors have influence over a significant portion of the potential supply and whether they have a significant demand. This results in four broad categories, which, in order of importance are:

1. Key players: municipalities or dream session participants that have both a potential supply and a demand. This makes them both service providers, whom others depend on, and beneficiaries, with the motivation to establish or maintain the service's benefits.
2. Service providers: actors who are able to offer a significant supply, but have little interest in it themselves: they have something that others want, which puts them in a position of power over beneficiaries. However, they might not actually provide the service unless something is offered in return.
3. Beneficiaries: actors with a demand for the service, but no means of creating a supply independently: they must rely on service providers and key players to provide. This makes them the most likely to initiate an attempt at regional planning.
4. Others: those with neither a strong supply nor a demand are the least relevant actors. They might not be completely without a supply and/or demand, but do not have much to offer, or to gain. They might simply sit on the side-lines, or join a regional planning process once the groundwork has been laid and participation does not include a significant investment.

I have mapped this actor ranking, providing an indication of what a regional network of supply and demand could look like.

Synthesis

To complete the study, I have brought the results on the three landscape services together. The aim was to understand how the scale challenges, as identified for the services separately, interact with each other. I summarized the results on mismatch, plurality and the actor ranking for each service and compared these results with the other services. Through this comparison, I searched for further challenges that could arise out of the identified scale challenges coinciding. However, I did not find any clear interactions between the scale challenges. Instead, I found different suitable levels of planning scale for each of the services.

Outdoor recreation

Results

Dream session demand

Outdoor recreation is, save for landscape aesthetic values, the most frequent landscape service in the dream sessions. However, the demand for outdoor recreation seems to be incredibly unevenly distributed; it ranges from only four mentions to thirty-one. This variation is not random, with the demand for outdoor recreation concentrated in the south-western corner of the study area and comparatively little demand in the north-east.

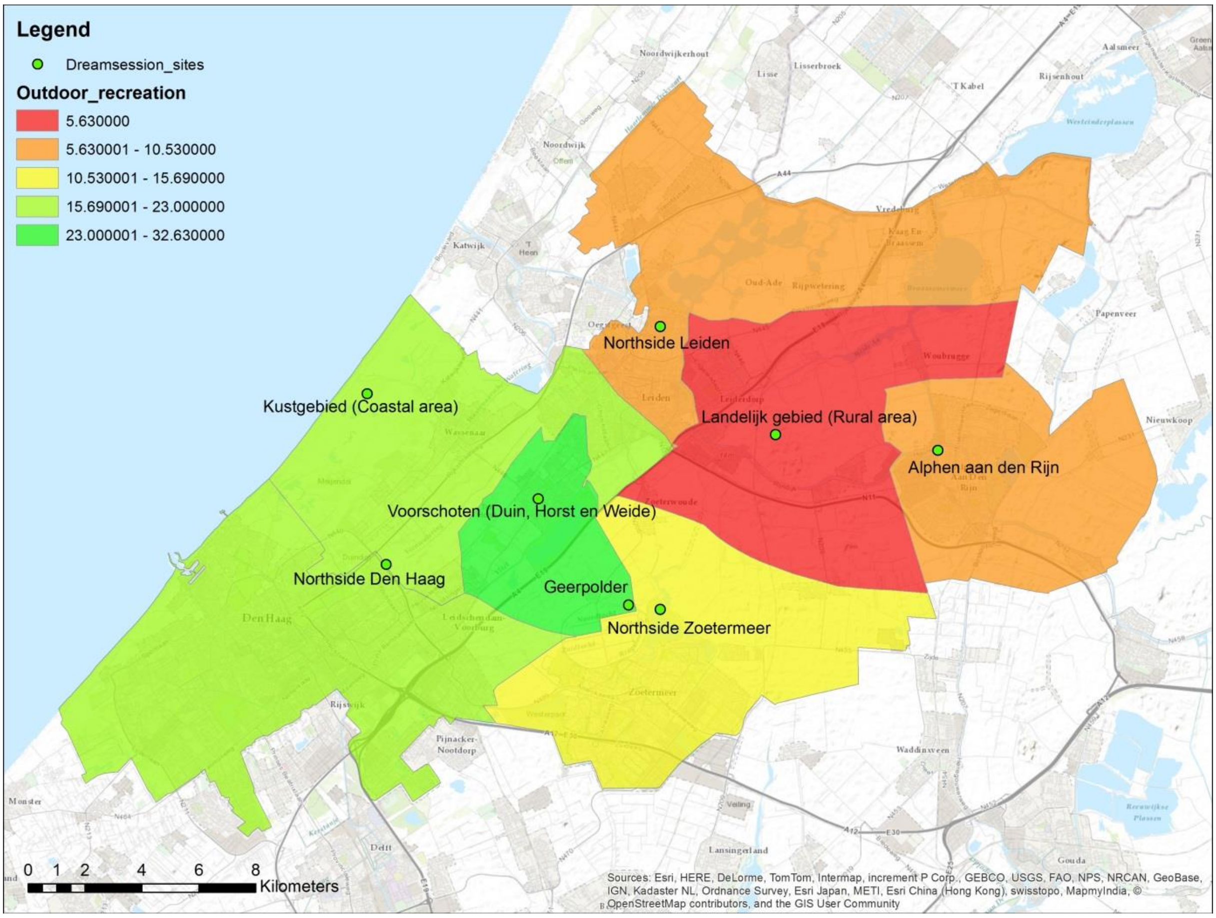


Figure 4: Demand for Outdoor Recreation per Dream session

The dream session results highlight a demand specifically for leisure options in the immediate surroundings of people's homes. Therefore, I have put the threshold at a 5km distance from the edges of towns in the area, taking into account single day leisure activities of both hiking and cycling (Willemen et al. 2010). As such, this does not include tourism or overnight stays (such as camping) and assumes that people initiate their trip either directly from home, or from the edges of their home town. In the larger cities, such as Leiden and Den Haag, this simplification means that vehicles can be used to bring people from the city centres to the city fringes.

As this is a densely populated area, the 5km radius easily covers the entire study area and spills over into places outside the boundaries of the study area. Each individual buffer also crosses municipal boundaries and spills into the areas assigned to other dream sessions. This indicates a clear mismatch issue in outdoor recreation, but it doesn't help to differentiate the potential supply within the study area. Figure 5 couples the dream session demand with the 5 km buffers, resulting in a stacking demand in areas where the buffers overlap. This results in a large, mostly continuous band of overlapping buffers. This continuity is interesting because it permits a supply for longer distance trips while maintaining the 5km constraint. As such, the highlighted area is multifunctional in the sense that it is capable of providing not only the leisure space for multiple towns in their immediate surroundings, but can also facilitate other forms of recreation, such as longer distance cycling.

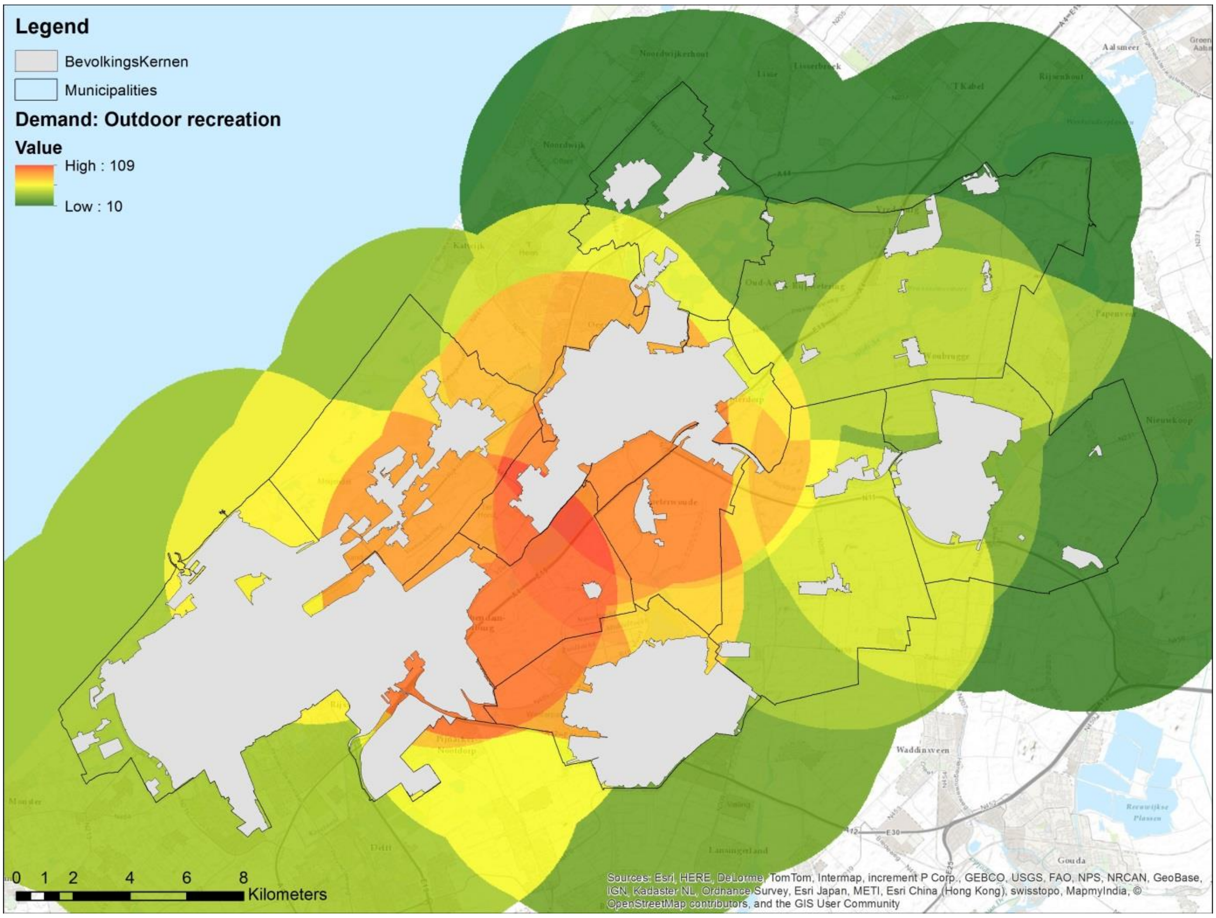


Figure 5: 5 km buffers, weighted by Dream Session values for Outdoor recreation

Municipal demand

Municipalities do not show the same transition from south-west to north-east in terms of demand. Instead, there is a bit of a patchwork (Figure 6). Zoetermeer and Voorschoten stand out, having a corrected demand of 0, though outdoor recreation is one of the most popular services overall. Voorschoten's unusual results can easily be explained: the municipality has a vision dedicated entirely to cultural heritage, with most other services receiving no mention at all. Zoetermeer's vision is dedicated to the threat of pollution and noise disturbance. Yet for a vision with such as strong focus on the health of its residents, it is curious that any demand for recreation is lacking. On the other hand, the nearby areas which are suitable for outdoor recreation lie outside the municipal borders, which would explain why the municipal vision does not discuss them.

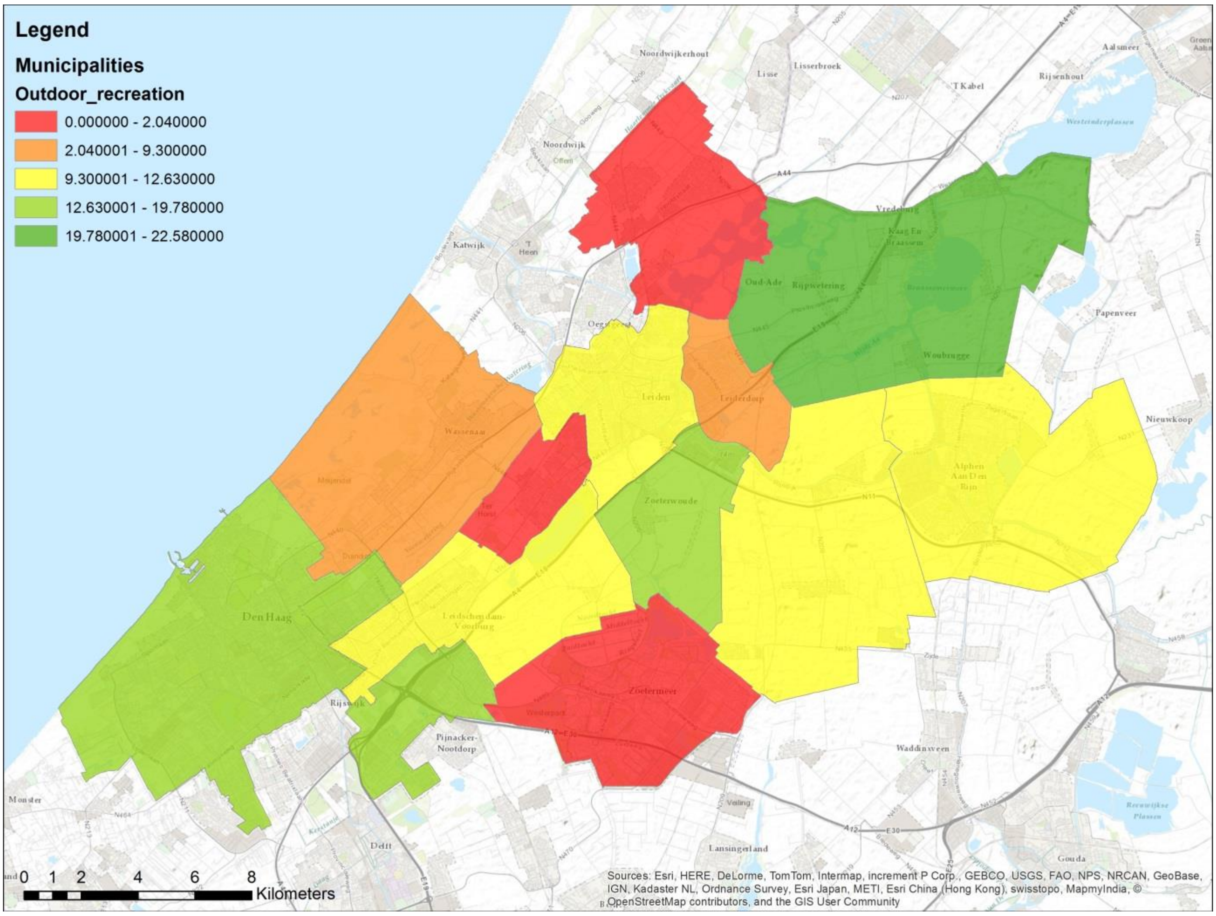


Figure 6: Municipal demand for outdoor recreation services.

Potential supply

The potential supply of the landscape to provide opportunities for outdoor recreation (in the form of hiking and cycling) depends mainly on two aspects: Landscape attractiveness and a suitable infrastructure.

Landscape attractiveness is a vague and subjective element. Despite this, a landscape attractiveness model has been built by De Vries et al. (2007). They used six GIS indicators (Naturalness, Relief, Historical distinctiveness, Urbanization, Skyline disturbance, Noise level) to model the landscape attractiveness of the Dutch countryside. The result for the study area is shown in figure 7a.

There are many hiking and cycling routes within and through the area (Figure 7b). It is important to note that these routes do not only make use of specifically designated hiking and cycling paths, but also regular roads; without these, it would probably be impossible to have a well-connected network. As such, I use not so much the paths as the official routes. Ideally, I would have data on both the routes and the paths, but the latter simply isn’t available. This means I exclude many paths that local users might be aware of. On the other hand, it means I do not exclude any (non-cycling/hiking) roads that are important for the network and allow accessibility to attractive areas. Additionally, signs would direct people towards these routes, making them probably the more used paths in the network.

The relative potential for hiking and cycling recreation within the area is shown in figure 8. The highest scoring area lies between Leiden and The Hague, combining an attractive landscape with a high route density. The dunes north of The Hague provide the most consistently attractive landscape, but a lack of routes limits the area’s potential. Increasing the number of routes through the dunes would enable more recreation in the area. However, this might cause conflicts with the other functions in the area: water purification, coastal defence and nature reserve.

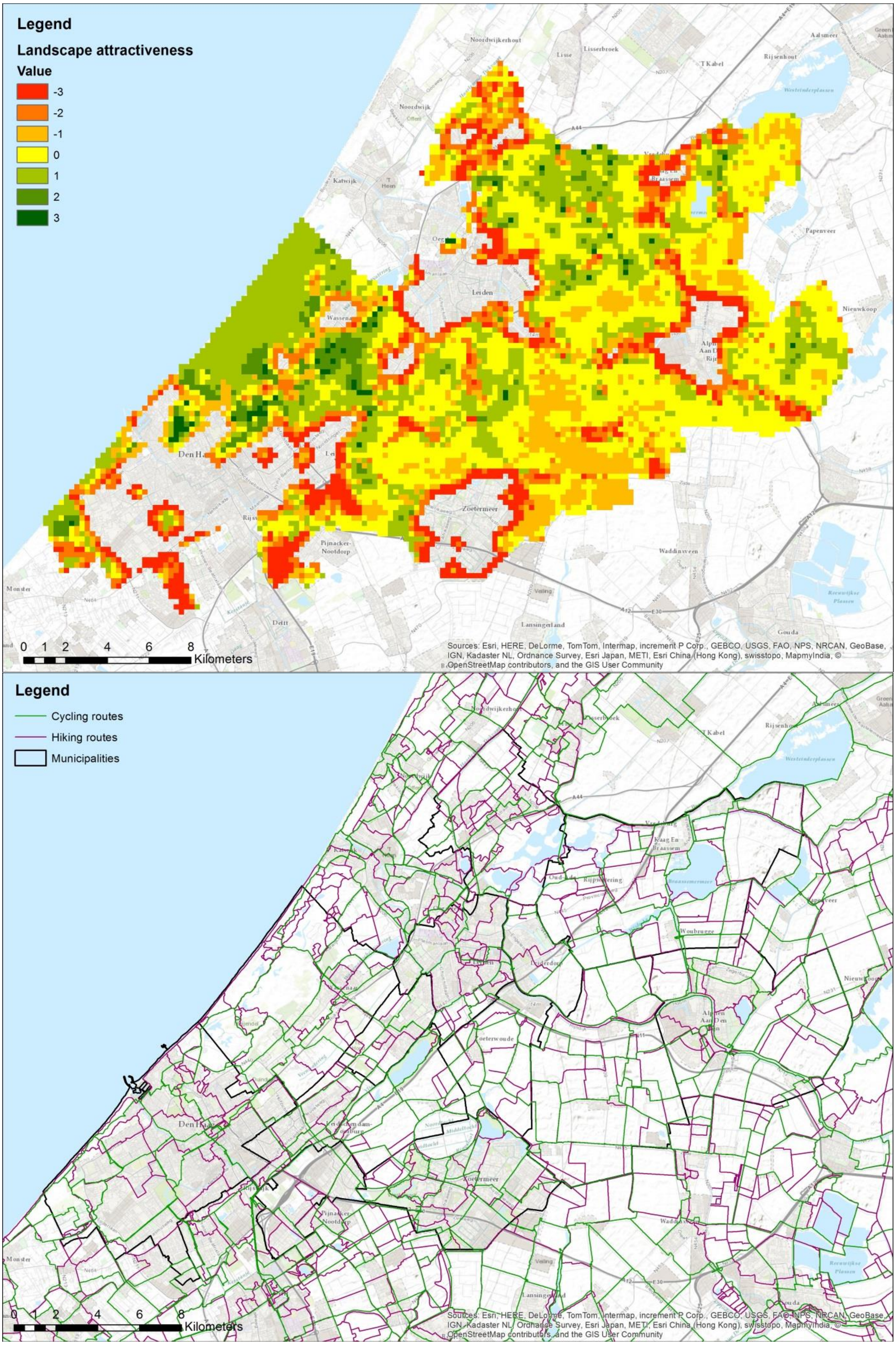


Figure 7: Landscape attractiveness (De Vries et al. 2007) and hiking and cycling routes (bottom).

Another high-scoring area lies north-east of Leiden, and north-west of Alphen aan den Rijn. There is a large, fairly attractive landscape, with a fairly high route density. This means that for each of the four major towns in the area, a suitable hiking and cycling area is nearby. However, the areas between Alphen aan den Rijn and Leiden, as well as Alphen aan den Rijn and Zoetermeer, score poorly, both in landscape attractiveness and route density.

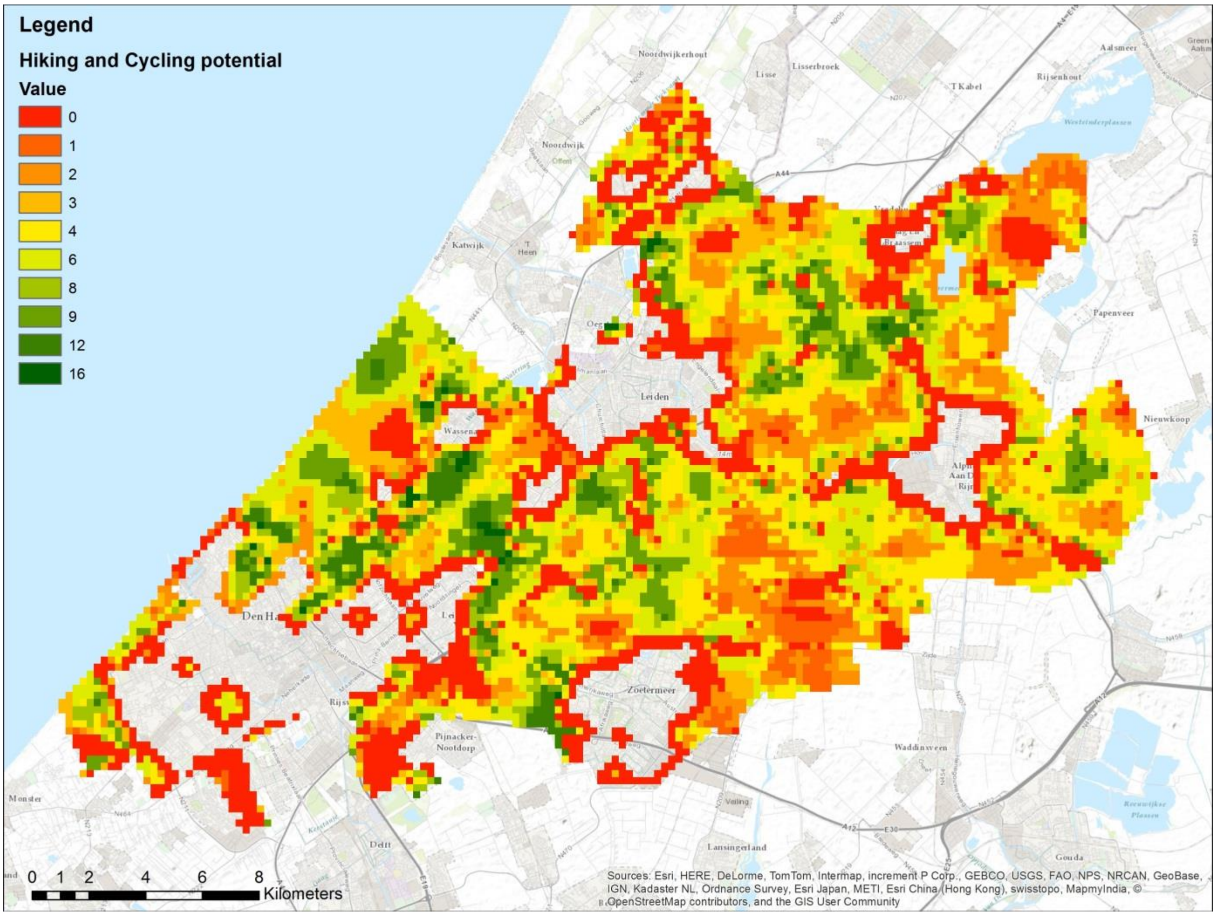


Figure 8: potential for hiking and cycling recreation.

Discussion

The variation in demand for outdoor recreation among the dream sessions could be explained by the higher degree of urbanization in the south-west of the study area and the resulting reduction in open (rural or natural) space. Another explanation is that the south-western sessions include the coast, where the beach and dunes are used for recreation, but also as nature reserve and natural water filtration system. This makes the use of these areas for outdoor recreation a topic of debate, implying that the frequent occurrence of the topic in the dream sessions is not so much an indication of demand, but of discussion. Nevertheless, such discussions do imply that there is indeed a demand for suitable leisure areas, which may not be fully met due to the other functions that these areas must also provide.

It is also important to keep in mind that the south-west of the study area had a higher density in dream sessions. With the 5km buffers used, this leads to a greater overlap and thus, a greater accumulated demand. As such, the used method for measuring demand influences where the demand accumulates. However, the south-west is also the most densely populated area, which justifies the higher density of dream sessions. Further, when looking at the individual dream sessions results, the south-west clearly scores the highest. Thus, while the applied method has a bias towards this area, the individual dream sessions already reveal a strong preference for outdoor recreation, compared to the rest of the study area.

Conclusions

Mismatch

For both the demand and supply of outdoor recreation, the space between Leiden, The Hague and Zoetermeer is the key area. Both the potential supply and demand are highest here (Figure 9). There appears to be a correlation between supply and demand: the dream sessions where demand for outdoor recreation was low (Zoetermeer and Rural Area) also score poorly in potential supply, while dream sessions where demand was high (The Hague, Coastal Area, Voorschoten) also show a high potential for outdoor recreation.

A simple explanation is that with an increasing population density, increasing numbers of people make the demand for leisure space rise, while increasing urbanization reduces the availability of such space. This would indicate that the space between Leiden, The Hague and Zoetermeer suffers from crowding: The landscape is attractive and the infrastructure facilitates hiking and cycling well, yet there is demand for more. The poor rating of the landscape directly south of The Hague and Zoetermeer (De Vries et al. 2007) further indicates that the demand for outdoor recreation in these cities is mostly met at their north sides.

This is a problem because there is little room for improvement in the area. A possible solution would then be to expand the size of the area. However, this brings up the mismatch challenge: to expand the area is to operate on a larger scale, and outside the areas of the dream sessions where there is a strong demand for outdoor recreation services.

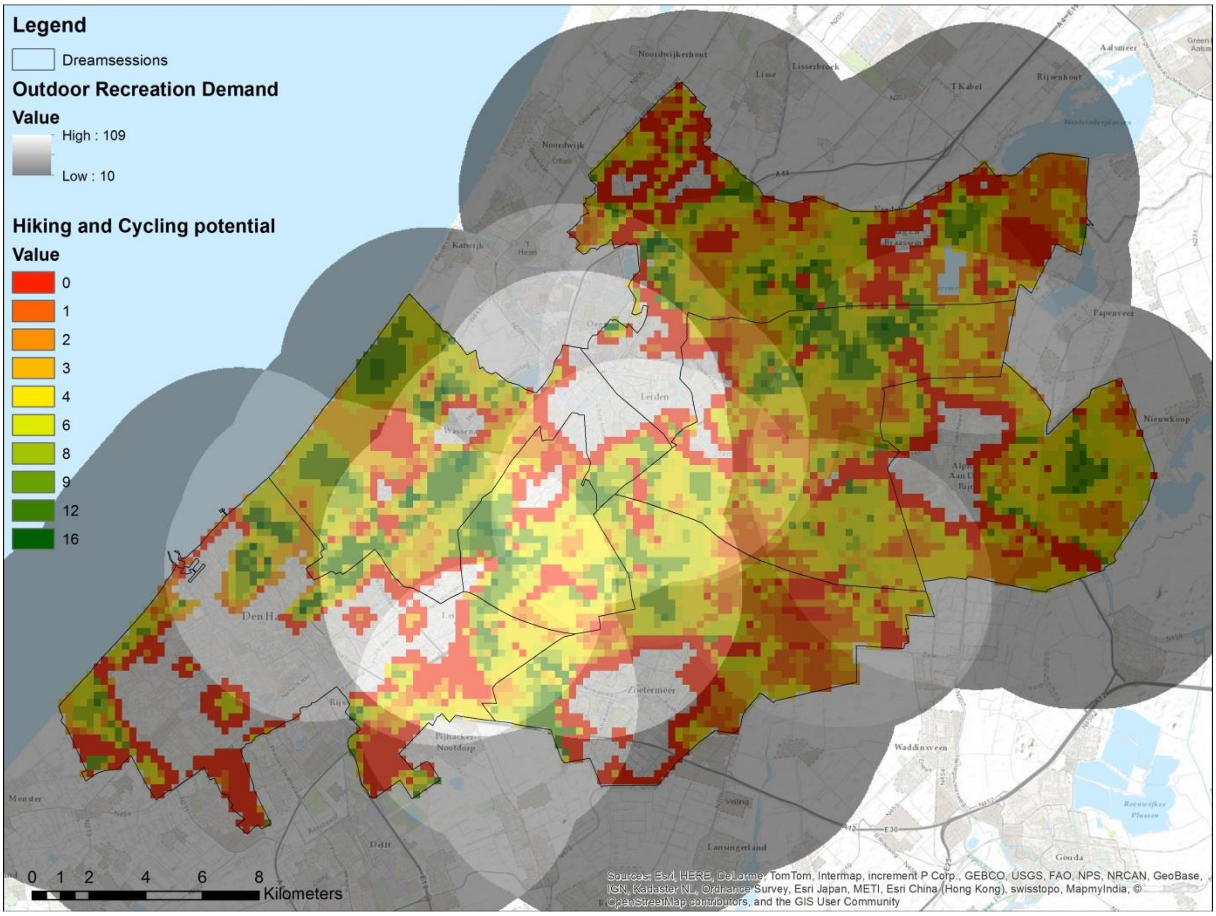


Figure 9: Potential supply and demand of hiking and cycling recreation.

Plurality

Figure 10 illustrates the difference between the demand expressed in the dream sessions with that of the municipal visions by subtracting the municipal demand from the dream session demand. Three areas stand out in this map: the municipality Kaag en Braassem, in the north-east, the northern half of the municipality Zoeterwoude and the Voorschoten dream session area (which includes the municipality Voorschoten).

Residents from Kaag en Braassem were involved in two dream sessions: North-side Leiden and the Rural area. Both these sessions expressed a comparatively low demand for outdoor recreation. Among municipalities, on the other hand, Kaag en Braassem has the highest demand for outdoor recreation services. The municipality Zoeterwoude is a similar case: residents were involved in the dream sessions in the Rural area and Zoetermeer. Neither had a particularly high demand for outdoor recreation, but it takes a significant place in the municipal vision of Zoeterwoude. Both these municipalities have spaces with some of the highest potential supply of outdoor recreation, while neither have a large urban population. This could hint at tourism, originating from the nearby cities: as an economic activity, it is interesting to the municipality. At the same time, it also explains why there would be little demand for recreation opportunities by the residents.

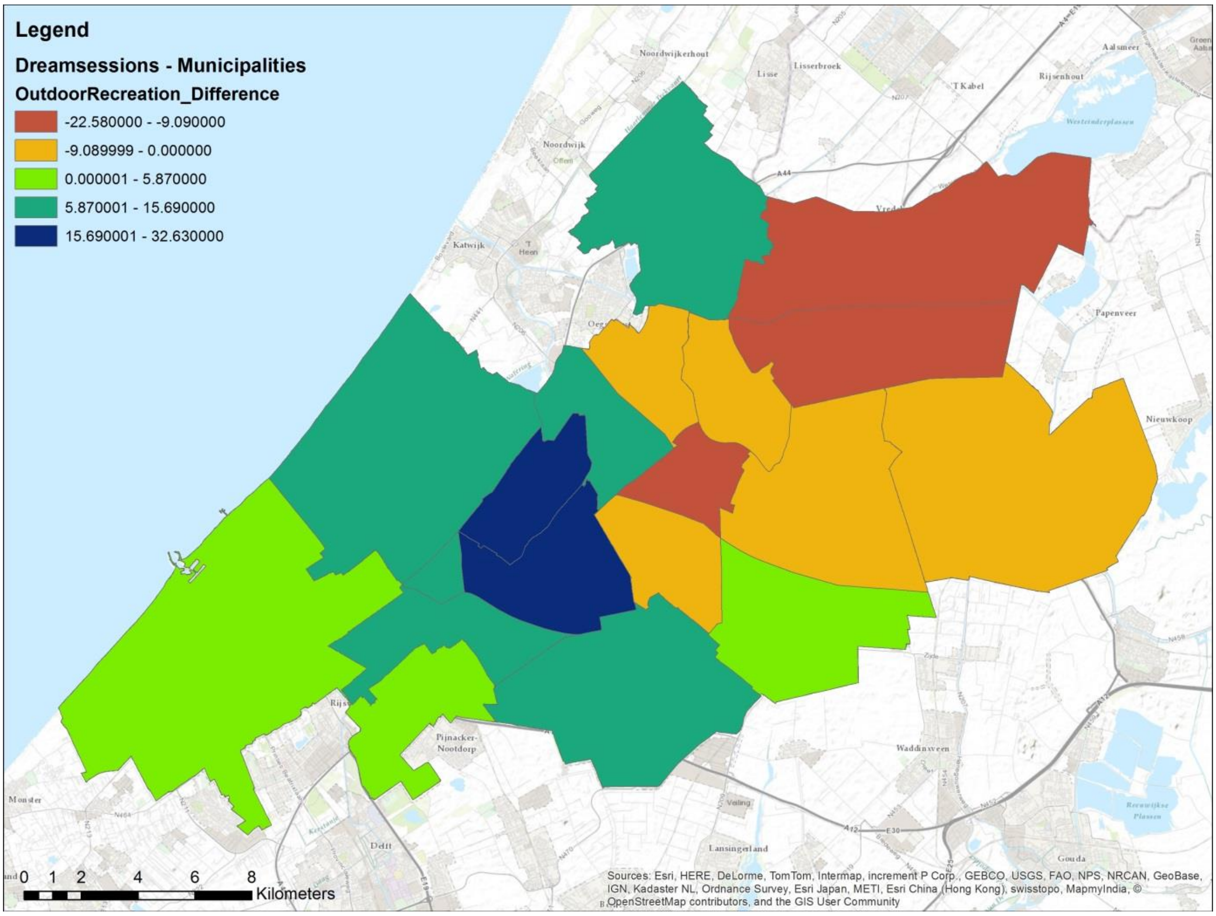


Figure 10: Difference in demand for recreation as expressed in dream sessions and municipal plans. Positive values indicate a higher demand in the dream sessions than the municipalities, while negative values indicate the opposite. Values around zero mean that the dream session and municipal visions result in similar service demands

In the Voorschoten dream session, the opposite has occurred: this is also an area with high potential for hiking and cycling, but it also features the highest demand of all dream sessions. Voorschoten's municipality, as mentioned, shows no interest in outdoor recreation at all. The dream session also involved people from Leidschendam-Voorburg. Other dream sessions that included Leidschendam-Voorburg (The Hague, Coastal area) also expressed a high demand for outdoor recreation services. Leidschendam's municipal interest in outdoor recreation is much more modest.

Actor involvement

Figure 11 shows the average potential supply for each of the sub-regions in the study area, indicating where the municipality and dream session participants could make a significant contribution. It further highlights the south-west of the study area, as well as a smaller area in the north (part of the municipality Kaag en Braassem and the dream session Rural area) as key areas for the potential supply of hiking and cycling recreation. This map, together with the demand maps (figures 4 and 6), establish the importance of different actors (table 8).

Table 8: ranking involvement in outdoor recreation.

	Key players	Service providers	Beneficiaries	Others
Dream sessions	Coastal Area, The Hague, Voorschoten	Rural area, Zoetermeer	-	North side Leiden, Alphen aan den Rijn
Municipalities	Kaag en Braassem, Zoeterwoude, Leidschendam-Voorburg	Voorschoten, Wassenaar	Leiden, The Hague	Alphen aan den Rijn, Leiderdorp, Zoetermeer, Zoeterwoude

Dream session participants throughout the south-west can be considered key players, specifically land owners, whose management decisions can influence the landscape attractiveness. The same cannot be said for municipalities in the same areas. The Hague has a demand, but there is hardly any potential supply within the municipal borders. Wassenaar and Voorschoten both have a large potential supply, but show little interest in using it. Leidschendam-Voorburg, on the other hand, is a real key player, with both the potential supply to provide the service and a demand to motivate action. It is also no surprise that the most urban municipalities (The Hague and Leiden) are beneficiaries, with no potential supply of their own.

The dream sessions actor ranking (Figure 12) supports the idea that, in order to meet an increasing demand for hiking and cycling recreation, Zoeterwoude is essential; on a dream session level, it is a service provider, with a low internal demand, but a high demand from neighbouring towns. On a municipal level, it is already a key player. Possibly, the municipal structuurvisie is anticipating an increasing interest from Leiden and Zoetermeer. The areas further east rapidly decline in relevance: they offer much less potential supply, and are too distant from the major sources of demand.

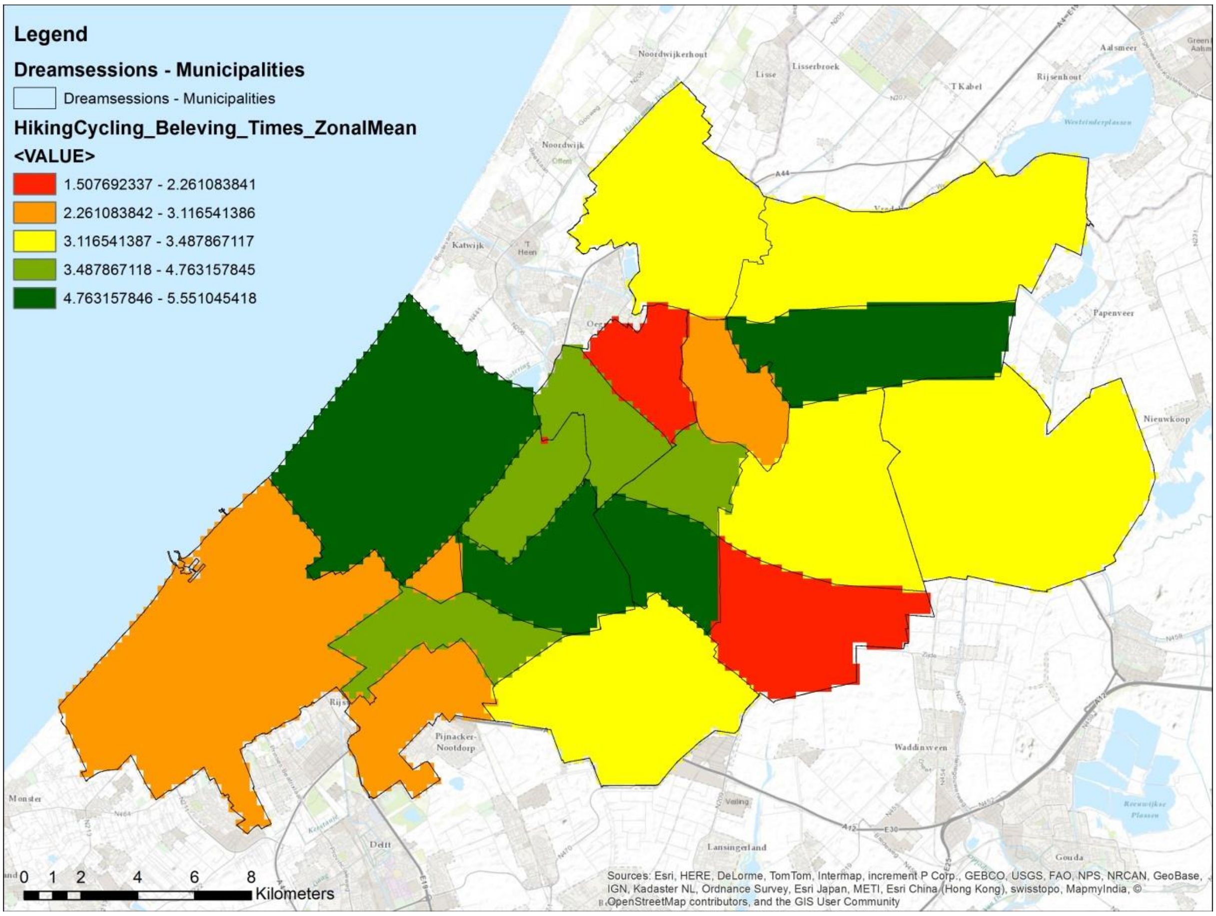


Figure 11: Average potential supply of hiking and cycling recreation.

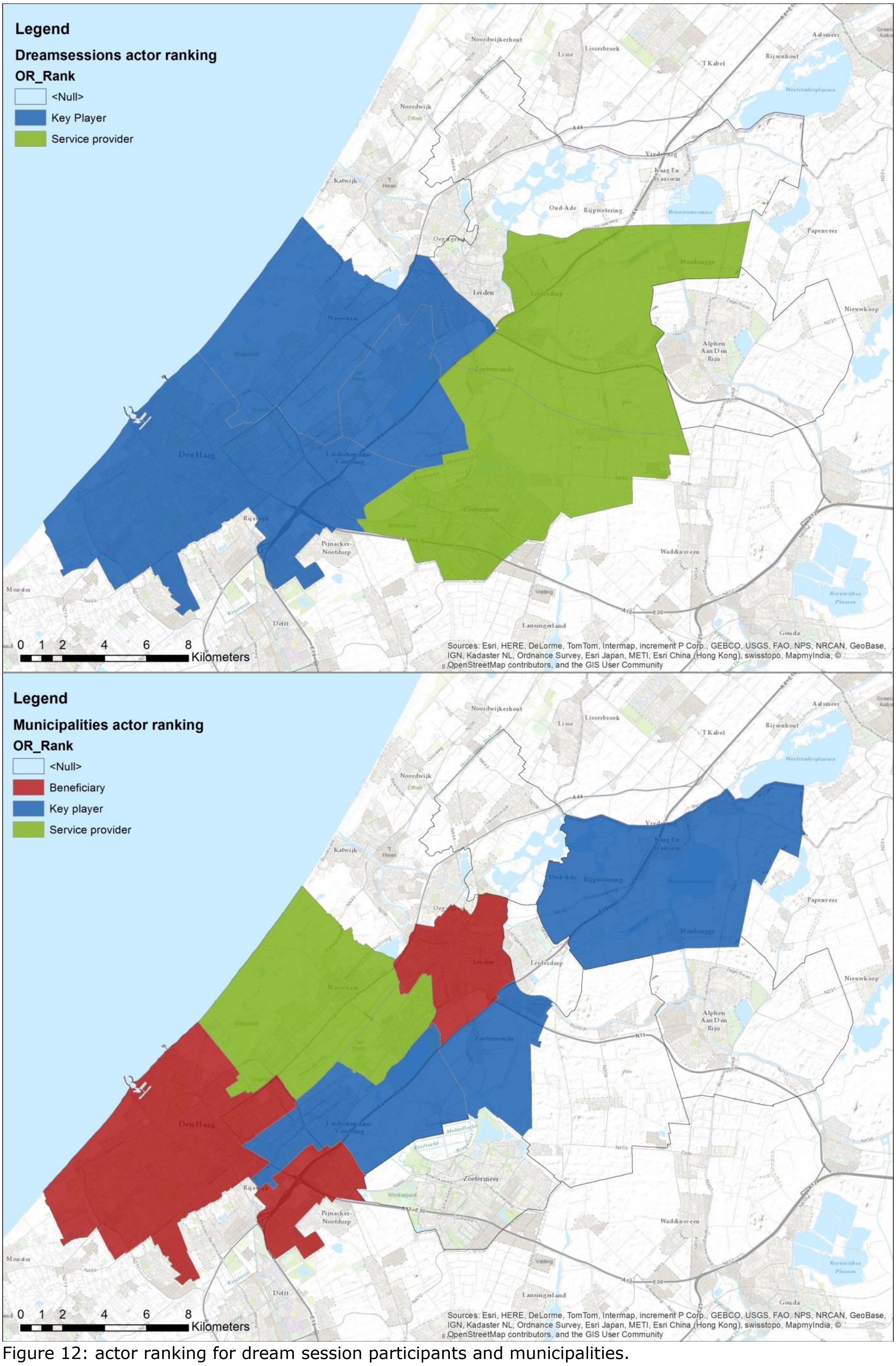


Figure 12: actor ranking for dream session participants and municipalities.

Pollination

Results

Dream session demand

There is a very strong difference in demand for pollination between the dream sessions (Figure 13). Demand for pollination ranges from 0.96 to 9.80, roughly a factor 10. While all regulating services score very low, compared to provisioning and especially cultural services, demand for pollination peaks in The Hague (9.00) and Zoetermeer (9.80); the highest value among all other regulating services is 6.00. Another unique feature of pollination is that it's the only regulating service with at least some demand in all of the seven dream sessions.

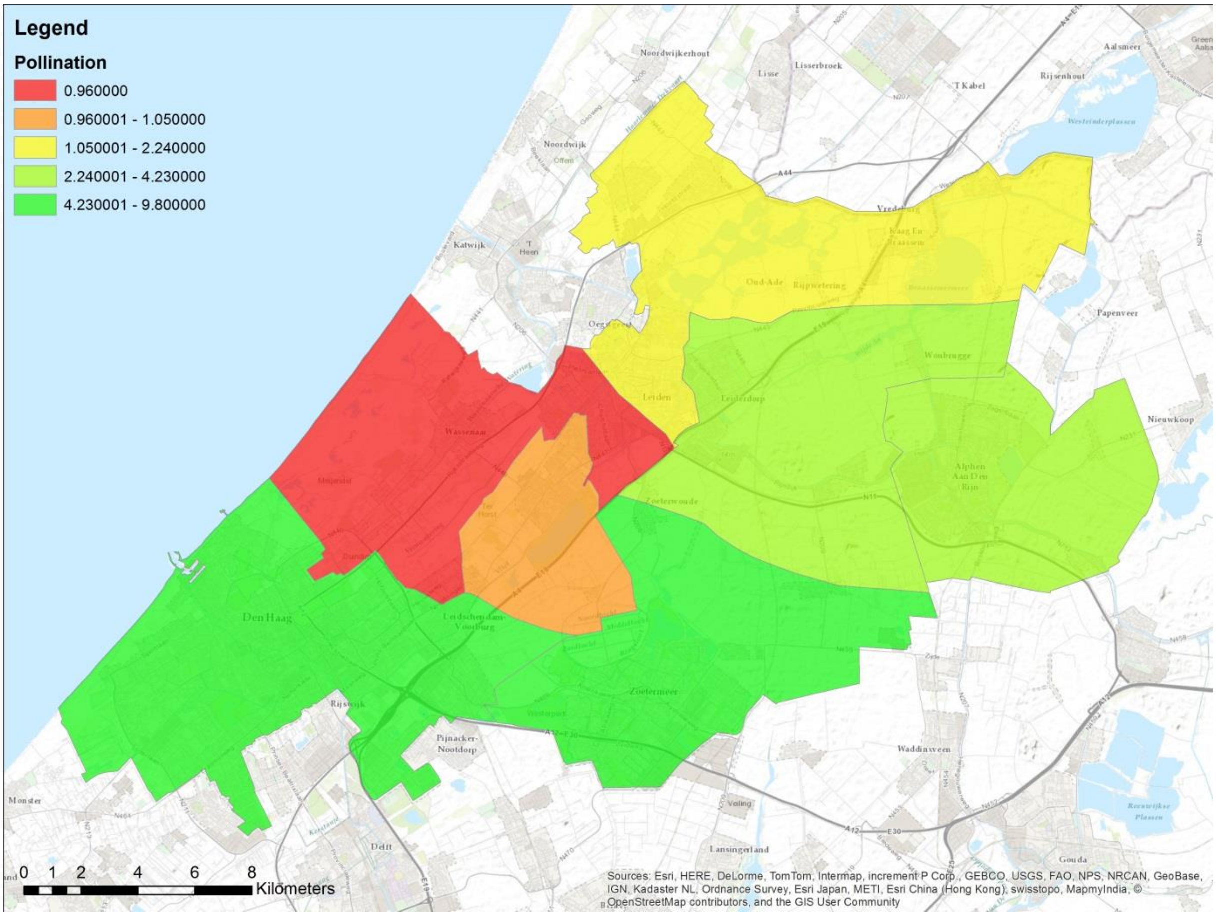


Figure 13: demand for pollination services

There is a clear link between pollination and landscape aesthetics, overall the most popular service in the dream sessions. The most direct human benefit of pollinators is the production of honey. However, it also acts as a supporting service: pollination of crops and flowers support agricultural production and landscape aesthetics, respectively. The most frequent keyword in the dream sessions for pollination is 'flowers', often in conjunction with a linear landscape element such as roadsides or ditches, and the word 'colourful'. In The Hague, there's also an interest in butterfly houses. Zoetermeer is the only dream session where the word 'honey' was used and the Rural Area has a single mention of agricultural fields. As such, there is a very strong indication that the demand for pollination is strongly associated with a demand for landscape aesthetics.

Municipal demand

The municipalities in the study area appear to have little to no interest in pollination. In the documented visions, no mention whatsoever is made of pollination, bees, flowers, etc. This absence could mean that the municipalities do not consider themselves responsible for pollination, or do not consider it at all. Either way, it sends a clear message that municipalities are not likely to involve themselves much in any efforts to make the landscape more flower-rich or pollinator friendly.

Potential supply

The provision of pollination by the landscape depends entirely on the presence of certain pollinator species, most notably bees and butterflies. In order to benefit from these pollinators, a stable population must be maintained. This in turn places specific demands on the landscape; suitable nesting grounds and sufficient sources of food in the vicinity.

The pollinator species relevant for the study area have been grouped into three ecoprofiles: groups of species with similar habitats (Opdam et al. 2008). These three ecoprofiles are 'Hommel' (bumblebee), 'Zweefvlieg' (hoverfly) and 'Pionier' (pioneer; van Rooij et al. 2014) The areas of currently suitable habitat (natural grasslands only; grazed pastures are not as suitable) and potentially suitable habitat (including all grasslands, grazed or not) are shown in figures 14 and 15.

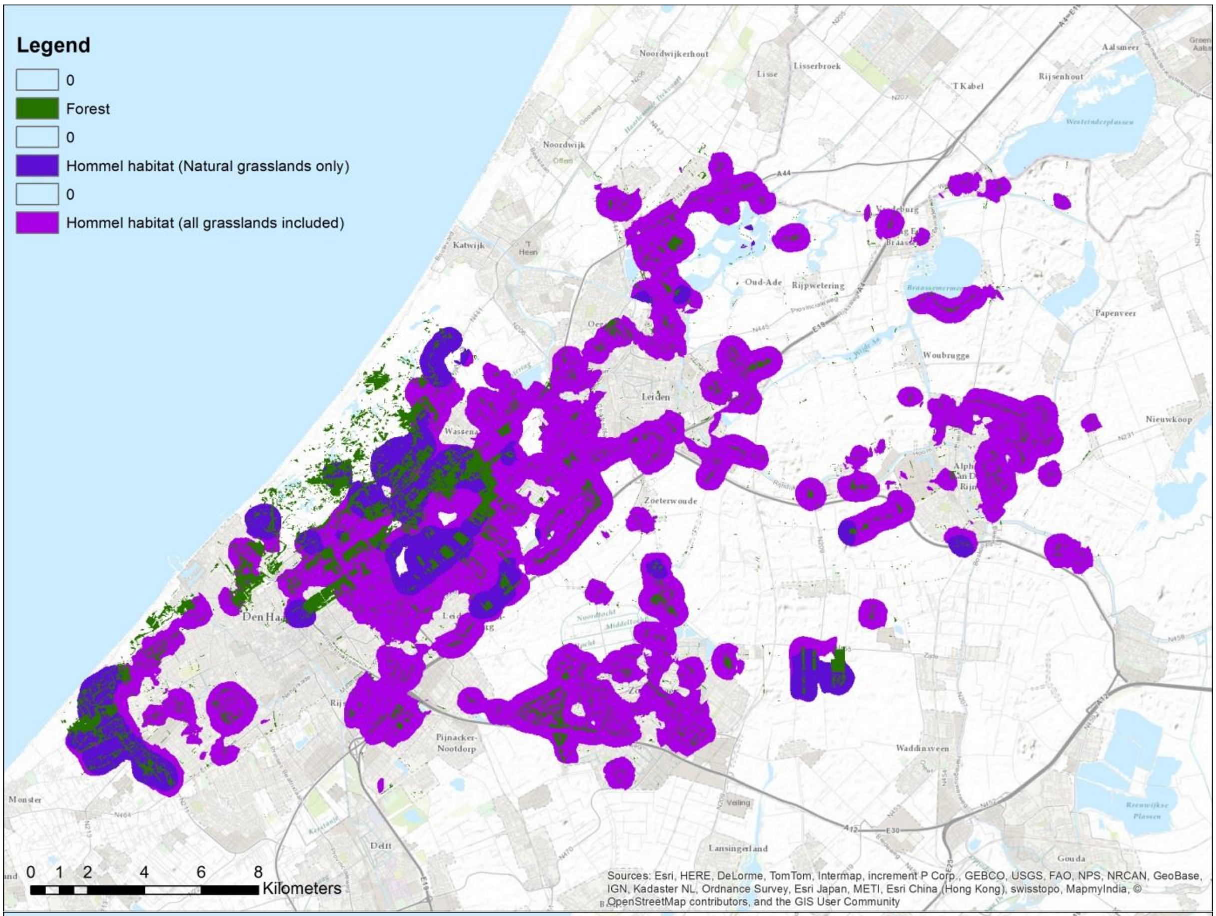
Hommel has the largest amount of suitable habitat (Table 9), thanks to a forested area near Wassenaar and Voorschoten, combined with an indifference for foraging in wet or dry grassland. Zweefvlieg and Pionier both need dry grassland, which is scarce in the area. This is the reason their suitability maps overlap so much. Due to Pionier's greater need for dry grassland, its suitable habitat often fits within the contours of the Zweefvlieg's habitat (figure 16). The need for dry grassland puts the vast majority of their suitable habitats around Zoetermeer and Alphen.

When looking only at natural grasslands, which all three ecoprofiles prefer over grazed pastures, the suitable habitat of each diminishes significantly. Hommel still retains a reasonable space within the forested area, but the suitable habitat for Zweefvlieg and Pionier both become very scarce, with Zweefvlieg suffering the most (table 1). The habitat for Zweefvlieg and Pionier also cease to overlap; there are a few natural grasslands on dry soil, where Pionier can survive, while the Zweefvlieg's need for both dry and wet grassland means that only those natural grasslands that lie exactly on the transition areas from dry to wet soils provide a suitable habitat.

Another consideration is the use of roadsides. Due to the soft peat soil in the area, major roads are often built on levees of sand, resulting in elevated roads and steep roadsides, which can be identified with a slope model in the otherwise flat landscape. These sand levees provide dry, nutrient-poor soils, with grasslands suitable both as foraging and nesting grounds. This is especially true for the Zweefvlieg ecoprofile, which can thrive on relatively small patches of dry grassland in a landscape of mostly wet grassland (Figure 17). Including these roadsides more than doubles the amount of potential habitat for Zweefvlieg, to 18633 ha. For Pionier, the roadsides simply do not offer enough foraging space and for Hommel, there is a lack of trees and shrubs. However, even for these ecoprofiles, these roadsides still provide important corridors.

Table 9: total suitable habitat

Ecoprofile	Suitable habitat, all grasslands (ha)	Suitable habitat, natural grasslands only (ha)
Hommel	19108	3565
Zweefvlieg	7955	255
Pionier	6723	608



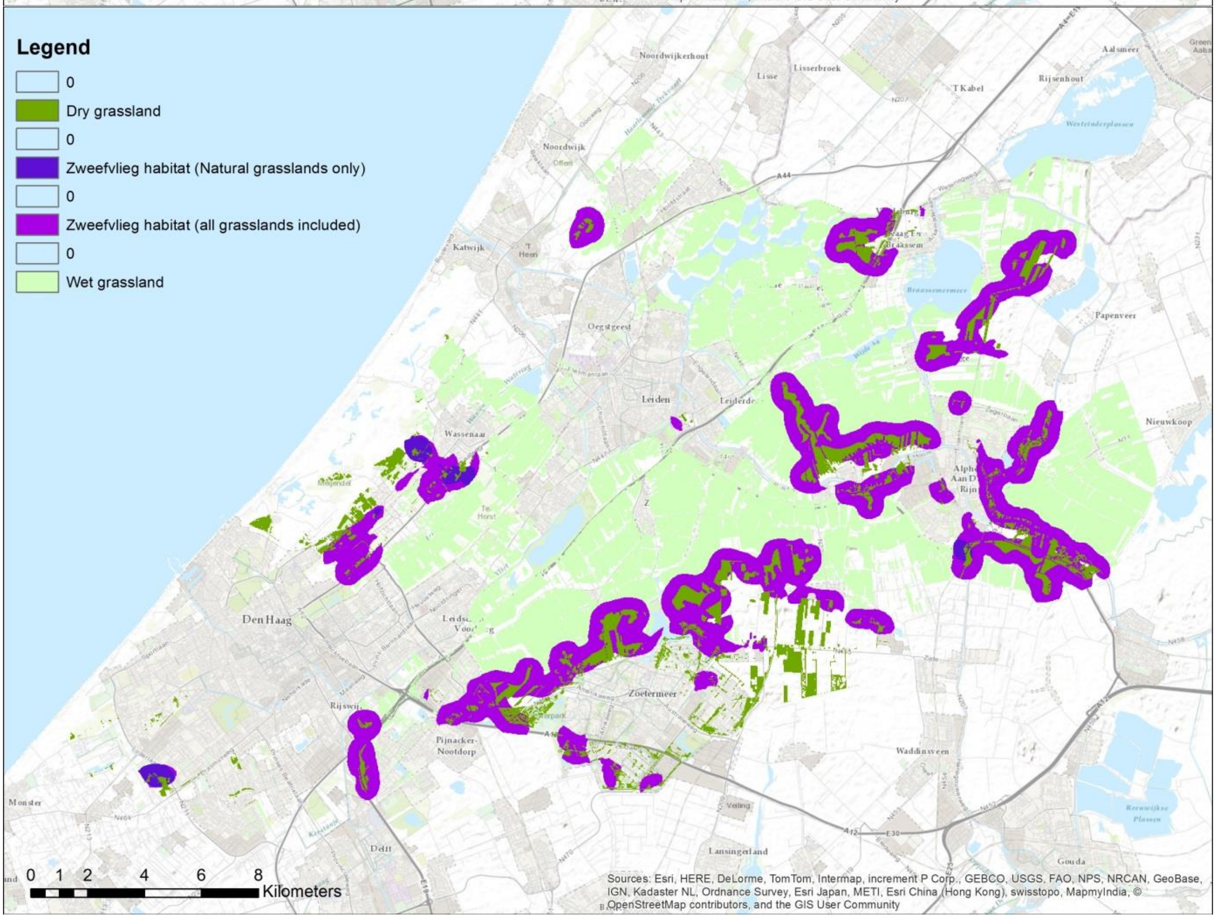


Figure 14: Suitable habitat for the Hommel (top) and Zweefvlieg (bottom) ecoprofiles.

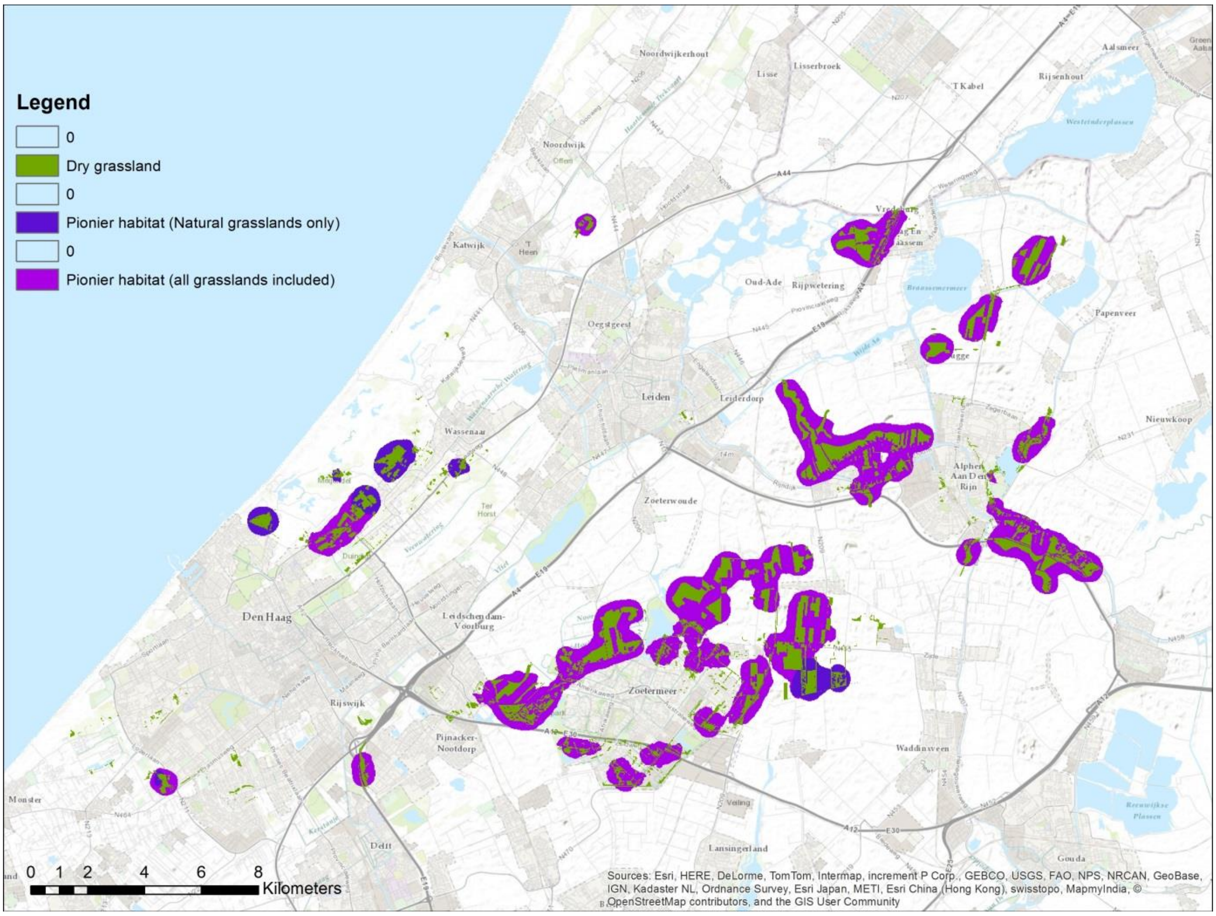


Figure 15: Suitable habitat for the Pionier ecoprofile.

Discussion

It is important to note that the low overall values of pollination demand mean that it is easier to achieve extraordinary peak values. A factor 10 variation in Outdoor recreation, for example, would require a peak value of 56, which would be well over half the total number of dreams in the session with the highest value in it (Voorschoten; 95), an increase of 24 from its current value. What this means is that for a service such as pollination, a few vocal individuals can set the tone. This may well have happened in Zoetermeer and The Hague. Sadly, I have no reliable way of verifying this.

However, the interest in pollination in Zoetermeer is supported by other research. A study by Alterra (2014) lists a number of initiatives in the area between The Hague, Leiden, Alphen aan den Rijn and Zoetermeer (Figure 18). This map indicates two large project areas in Zoetermeer. However, it also indicates several projects in Voorschoten, which in the dream sessions had the second lowest demand (1.05). It also indicates no projects within The Hague, though only a small part of it is included in the map. And farther north, Alterra’s map does support the dream session results again, with a modest interest in bees and their services in the Rural Area and Alphen aan den Rijn sessions.

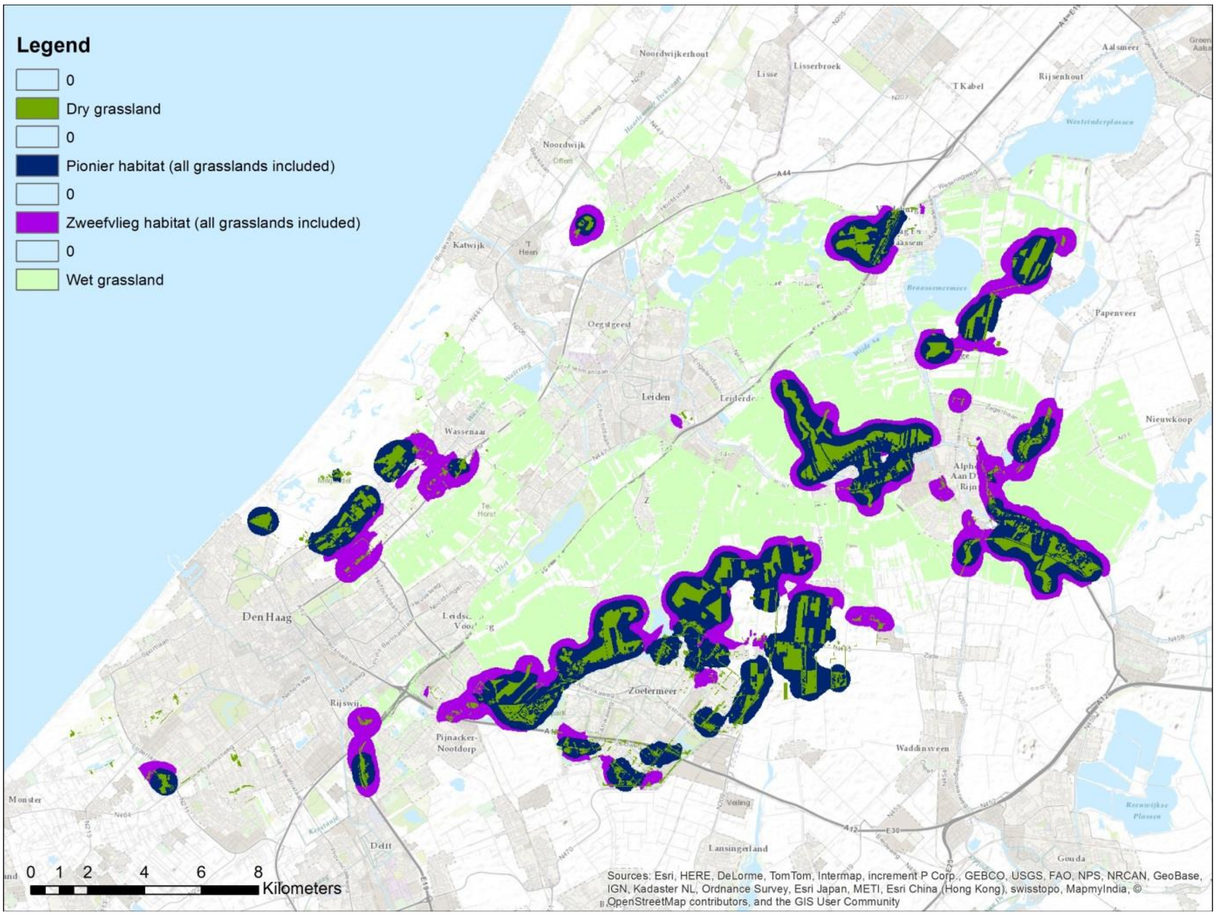


Figure 16: Overlapping habitat for the Zweefvlieg and Pionier ecoprofiles.

Conclusions

Mismatch

Taking all three ecoprofiles together, there seems to be a lot of space with potential for the supply of pollination, as long as we consider all grasslands to be potentially suitable habitat. Since grazed and mowed grasslands are of poor suitability for all three ecoprofiles (van Rooij et al. 2014), the currently suitable habitat is rather small (Figure 19). The Hommel ecoprofile retains some larger areas of suitability, but primarily within the areas of the dream sessions Coastal Area and Voorschoten, which have the lowest demand for pollination services. It's not unlikely that the reason for the lack of demand is that the supply of pollinators is already sufficient here. In the rest of the study area, it is clear that some changes will be required.

However, I would argue that the pastures, while not immediately suitable, can still be considered potential supply areas. Figure 18 indicates that there is a certain willingness to convert traditional pastures into more pollinator-friendly grasslands. Taking this willingness to adapt into account enables all of the dream session areas to independently provide a minimum viable population of at least one ecoprofile. This means that, depending on how much a community (or even specific land owners) are willing to adapt their fields, there might not be a mismatch at the dream session scale at all.

Another consideration is the specific demand for linear elements. This complicates matters for two reasons. The first is that linear elements alone are not sufficient to maintain a minimum viable population; meeting the demand of 10 ha (100,000 m^2) suitable habitat within a 500 m radius means that, assuming roadsides of 2 m on each side, 25 km of roads would be required within that 500 m radius. Major roads, on levees, would have larger roadsides, but also occur much less frequently. Ditches occur in much higher density than roads, but those exist primarily for drainage purposes in very wet areas and thus can only provide wet grasslands.

The result is that these linear elements must be connected to patches that can sustain a population. Since these patches are fairly small, such a network can technically still be constructed within a dream session area. Yet the increase in scale makes does make it much more likely that the network starts to cross boundaries. As all the dream session areas with an above average demand are all connected to at least one other, it is in fact possible to connect all of them in a single, region-spanning network.

The second challenge is a mismatch on the jurisdictional scale, rather than spatial. The major roads, on levees, tend to be provincial or national roads. This means that these valuable roadsides are owned and managed by provincial and national institutions. Therefore, dream session participants have little to no control over the management. Any form of community-based planning is therefore impossible for these roadsides; the most dream session participants can probably do is lobby for pollinator-friendly roadsides at higher jurisdictional scale levels.

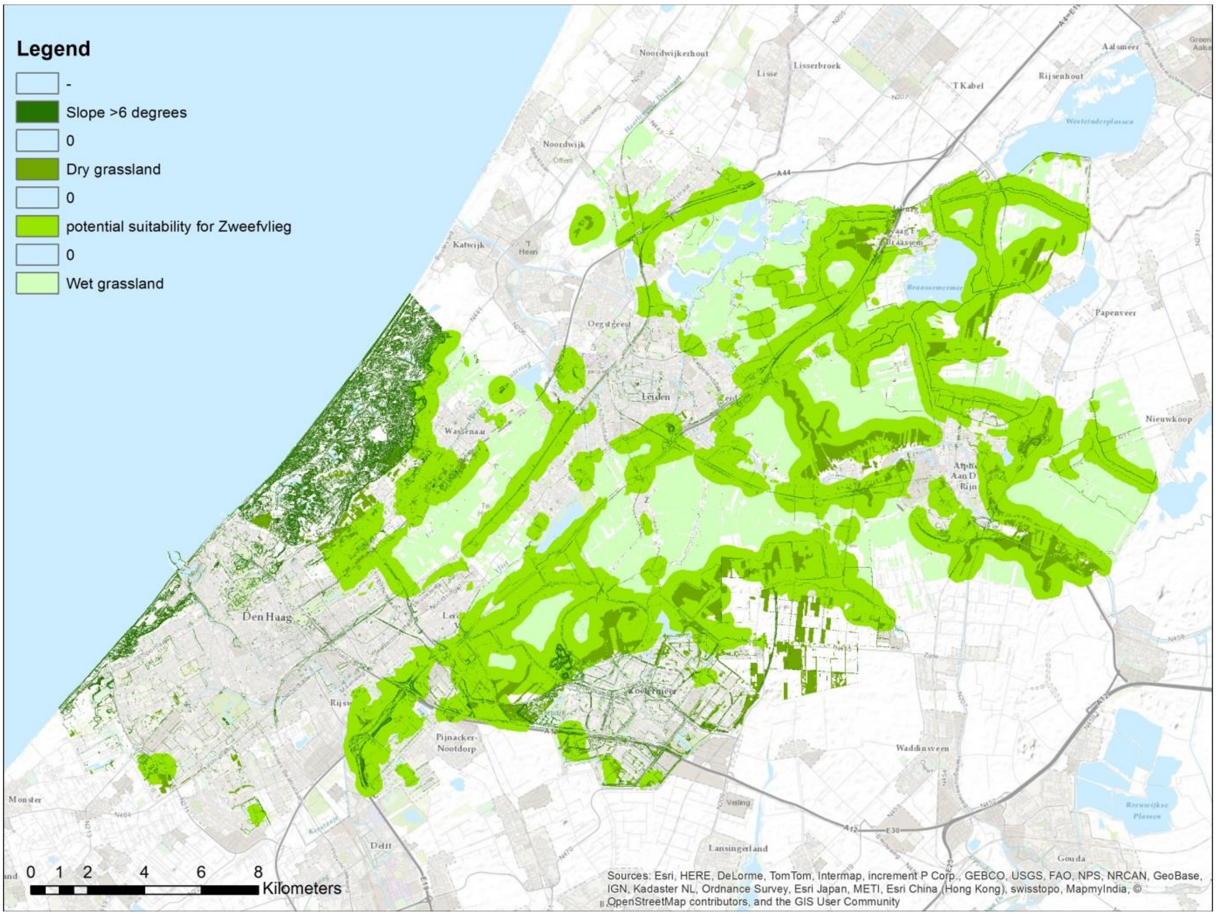


Figure 17: potential habitat for Zweefvlieg, including roadsides of major roads.

Plurality: Actor involvement

The key areas in the (potential) ecological network vary between the three ecoprofiles (Table 10). This means that between the ecoprofiles, there's a lot of difference in the roles that the dream session participants can take. For example, The Hague and Zoetermeer would be key players for a Hommel-network, but only beneficiaries in a Zweefvlieg-network (Figure 20). When looking to establish a regional, ecological network, a focus on the Hommel ecoprofile could put The Hague and Zoetermeer in a position of power, whereas they would be dependent on others in a Zweefvlieg-oriented network. The opposite is the case for Alphen aan de Rijn and Rural area. These differences may cause tension and conflicts of interest between participating actors in such a network.

It is therefore possible that the dream sessions participants in the south (The Hague and Zoetermeer) will try to create a Hommel network, independently from efforts to the north (Alphen aan den Rijn and Rural area) to develop a Zweefvlieg network. While this option may avoid social conflicts, it is not the strongest ecological network possible: a larger network, incorporating not just one ecoprofile, would be preferable. However, this might well go beyond the ambition level of dream session participants (Opdam et al. 2006; Vanbergen 2013). This raises a concern about the initiatives shown in Figure 4: Are the different participants contributing to the same network, or are the plans in the south aimed at a different ecoprofile than those up north?

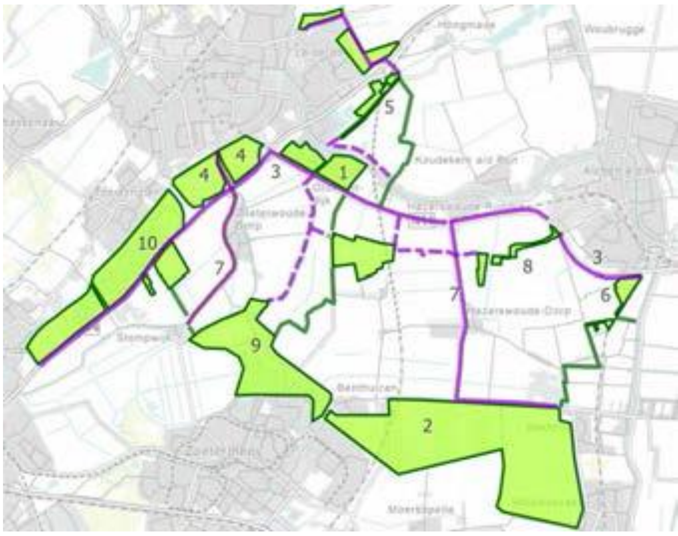


Figure 18: Proposed or ongoing plans for bee-friendly management (van Rooij et al. 2014).

Table 10: ranking involvement in outdoor recreation.

	Key players	Service providers	Beneficiaries	Others
Hommel	The Hague, Zoetermeer	Voorschoten, Coastal area	Alphen aan den Rijn, Rural area	North-side Leiden
Zweefvlieg	Alphen aan den Rijn, Rural area	Voorschoten, North-side Leiden	The Hague, Zoetermeer	Coastal area
Pionier	Zoetermeer	-	Alphen aan den Rijn, Rural area, The Hague	Coastal area, North-side Leiden, Voorschoten

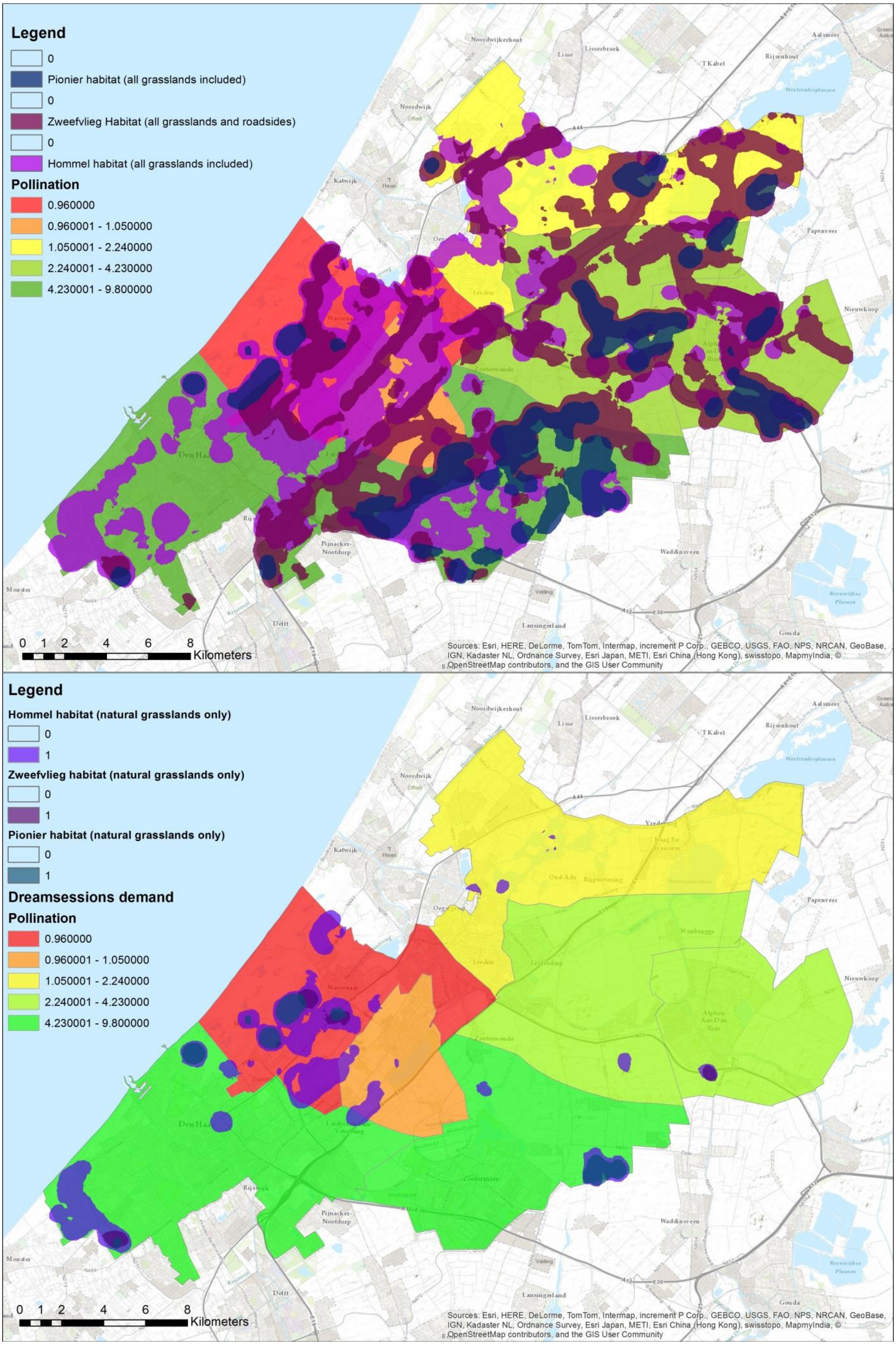


Figure 19: Potential (top) and current (bottom) habitat suitability for all three ecoprofiles.

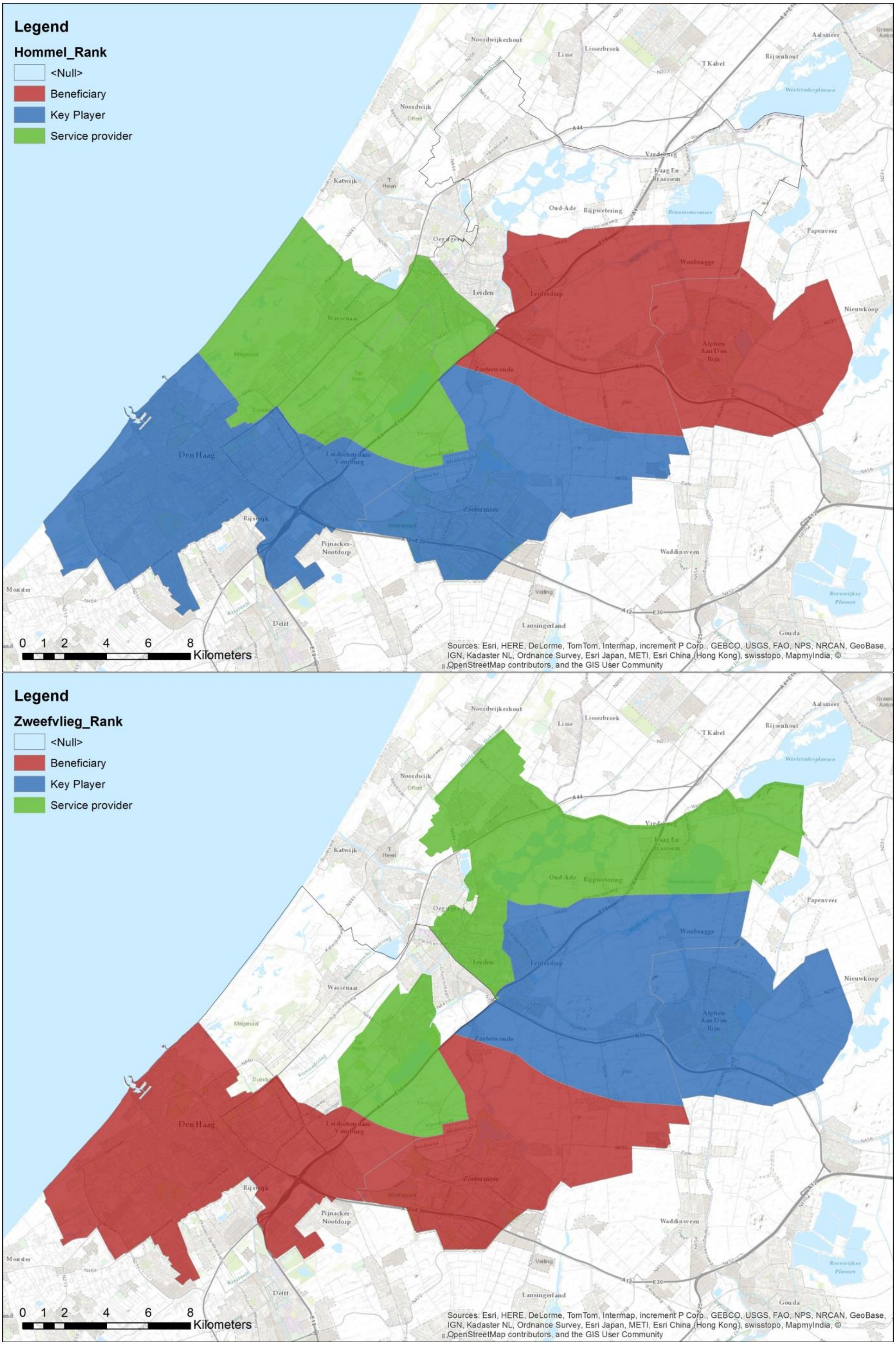


Figure 20: Actor ranking for Hommel and Zweefvlieg ecoprofiles.

Water purification

Results

Dream session demand

In the dream sessions, demand for water purification is rather limited (Figure 21). Only in two cases do we find a corrected value above 1: North-side Leiden (3.73) and Voorschoten (2.11). Alphen aan den Rijn and Rural area stand out on the other end of the spectrum, with no demand for water purification at all. As such, the map indicates clearly that in the east of the study area, water pollution is not considered a significant problem. Areas where such concern does exist appear to be more dispersed. Though one could draw a line from The Hague, though Voorschoten, to North-side Leiden, It is more likely that these are two separate cases: Both Voorschoten and North-side Leiden contain one or more lakes which are extensively used for water recreation, including swimming. This would make a poor water quality more directly experienced. However, Alphen aan den Rijn also contains such a water, without the heightened demand for water purification.

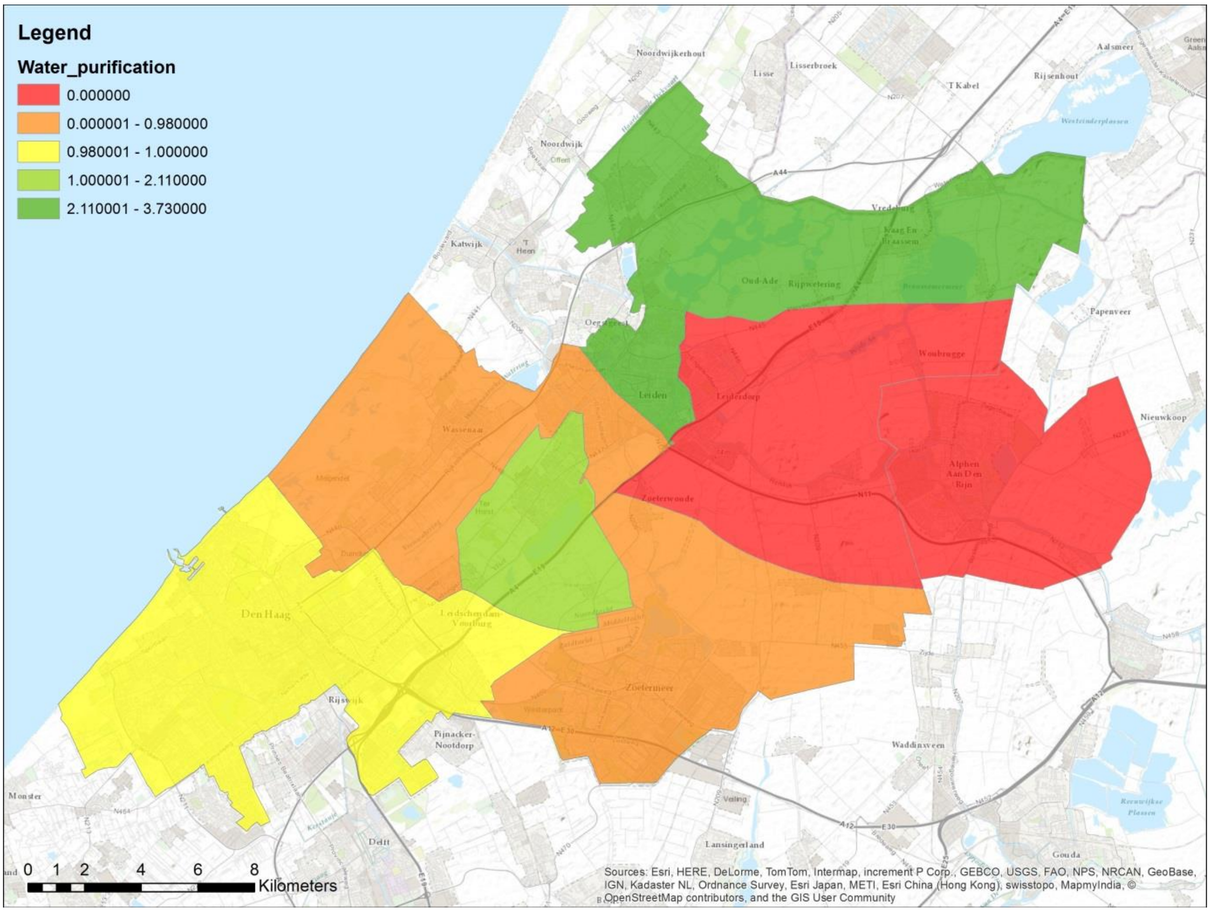


Figure 21: demand for water purification services.

Municipal demand

The need for water purification varies much more among municipalities than among dream sessions. Many municipalities do not even mention it, primarily in the east of the study area. As with the dream sessions, municipalities that do consider it an issue are dispersed. These municipalities do show a much higher corrected value (with the exception of Zoeterwoude), ranging from 4.21 to 28.13, leading to the unusual case where average values are somewhat rare.

Zoetermeer stands out, as can be expected from a structuurvise that is aimed particularly on health and quality of life. Teylingen's interest can also be explained through the environmental focus of its structuurvisie. Wassenaar is still an odd one: with a structuurvisie in-progress, based primarily on dream session input, it manages to score highly, even though the Coastal Area dream session scores poorly on water purification.

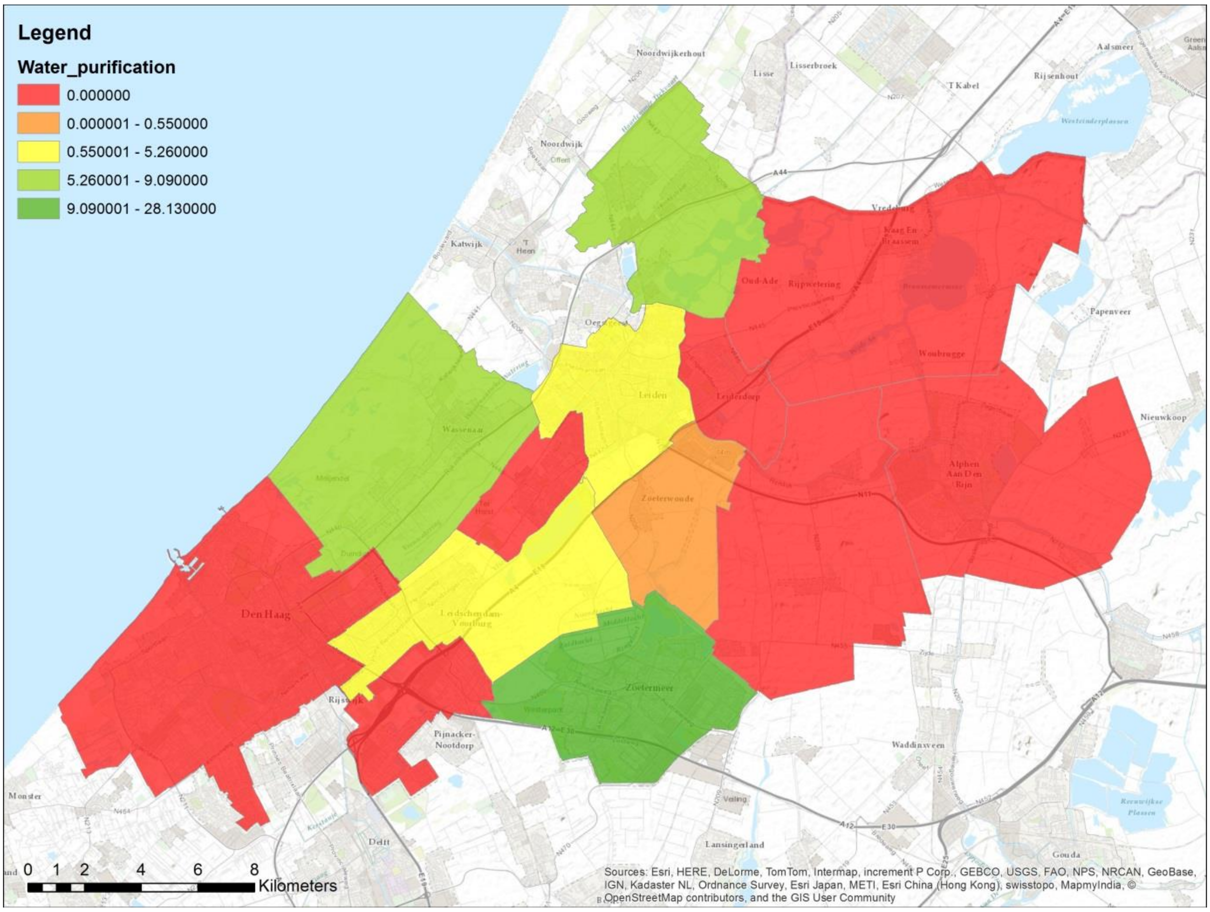


Figure 22: Municipal demand for outdoor recreation services.

Hoogheemraadschap Rijnland (Water board)

In terms of water management, almost the entire study area falls under the jurisdiction of Hoogheemraadschap Rijnland. The notable exception is The Hague. As a specialized water management institution, the Hoogheemraadschap has a much more data driven approach: the water quality in various lakes and channels is actively monitored, resulting in a dataset of not only where problems with water quality are found (in terms of legal norms for various concentrations), but also whether the water quality suffers due to algae, nutrients or other contaminations (Figure 23).

According to the Hoogheemraadschap's data, the primary problem in the area is that the water is too rich in nutrients, specifically phosphor. Out of the 21 areas distinguished, 16 were found to have too high concentrations in wither nutrients in general, or phosphor in specific. In two of these, algae are also considered problematic. Two areas were found to have no significant problems. For 4 areas, there was considered to be a lack of data for a complete assessment, one of which was still identified with high phosphor concentrations. Finally, one area was considered too nutrient rich, but as this actually matched the nature development targets for the area, it was considered unproblematic. That leaves 15 areas of too nutrient rich water, spread out fairly evenly across the study area, excluding The Hague.

Potential supply

Water purification through constructed wetlands can be applied virtually anywhere in the study area. Two key criteria do apply, but they present a challenge in only a small part of the study area: 1) a slow, evenly-paced inflow of the water to be purified, and 2) isolation from ground- and other surface waters (Wamelink, 2015). Size is not a significant criterion: constructed wetlands of smaller than 1 ha are not uncommon (Joly 2013, p.10).

Since the surface waters in most of the study area are controlled by pumping stations, the first criterion is already met by default. The second criterion is a challenge primarily in soils of loose sands, which are only found in the dunes. Throughout the rest of the study area, soils consist of peat and clay, and can easily be made impregnable. However, alternative methods of water purification can be applied to sandy soils, such as the sand filtration system used in the dunes.

This does not mean that all sites are equal. A significant difference in potential supply between sites may be found in the form of their efficiency: how much water can be treated per hectare of constructed wetland. However, this depends not only on the characteristics of a site, but also the design of the constructed wetland. The size, the concentrations of pollutants in the intake water and the intended concentrations after purification all matter (Joly 2013). The design specifics of a wetland that may or may not be constructed in the future are clearly unknown and cannot be taken into account.

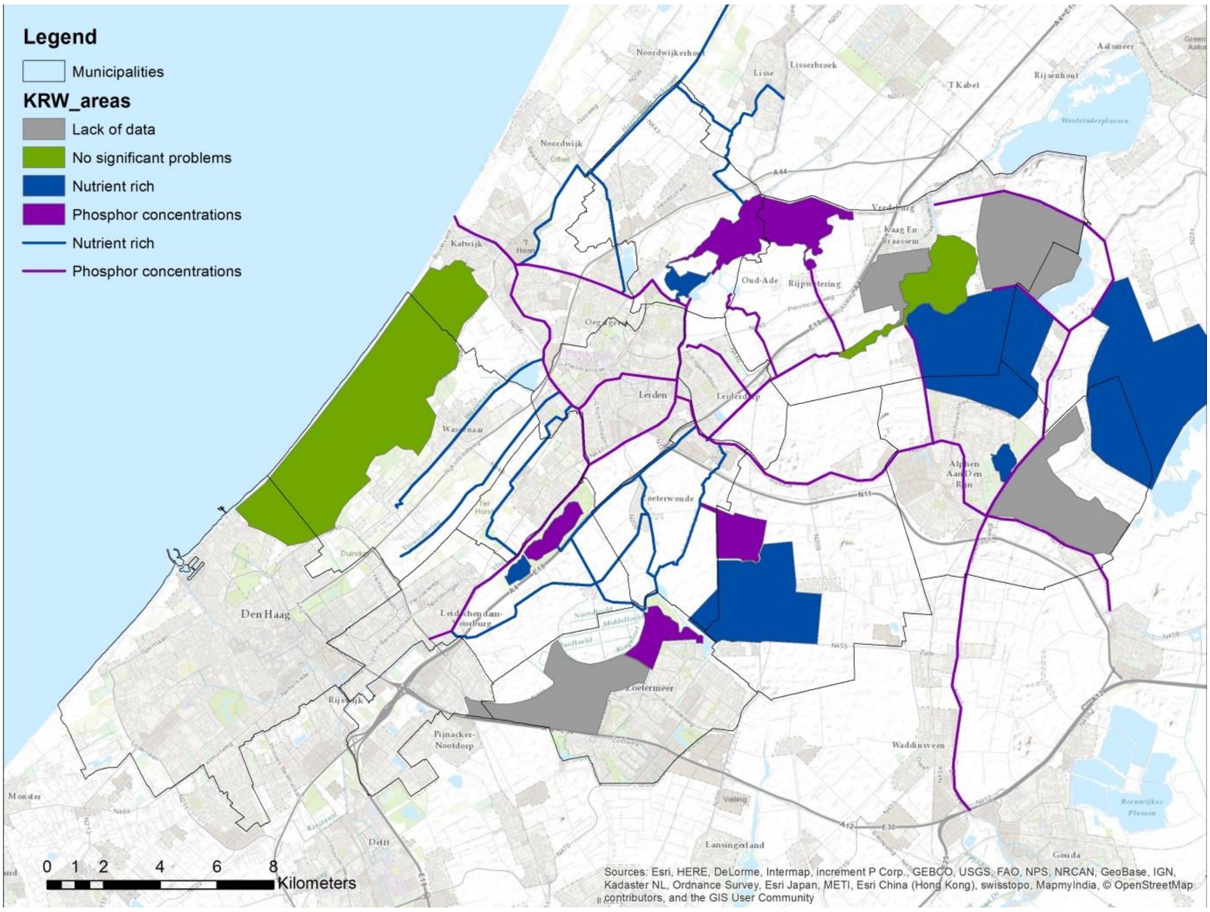


Figure 23: Water quality measurements (source: http://www.rijnland.net/plannen/voortgang-kaderrichtlijn-water/informatiebladen-en-gebiedsprocessen).

Discussion

As with pollination, and even more so in this case, demands for water purification are generally low when compared to other (non-regulating) services. This allows for large differences in values among dream sessions and municipal structuurvisies. In the case of the municipalities, a further contributing factor to the odd distribution could be that water quality is generally considered the jurisdiction of the water board. As such, it may well be ignored by many planners, excluding those that are particularly concerned with health and environmental issues (Zoetermeer, Teylingen), or a text based directly on dream session results (Wassenaar).

Conclusions

Mismatch

Since the potential supply of water purification is so widespread, it is safe to assume that there would be no significant mismatch of supply and demand: wherever there is a demand for water purification, one can also find a large potential supply there. However, the general suitability for wetlands throughout the area does not automatically negate problems of fit. Figure 23 shows that many of these waters cross municipal boundaries, whether they are channels, lakes or polders. It is no different for the dream session areas and there are several instances where these waters cross the boundaries of the study area as a whole.

The Old Rhine river system is a prime example of this: not only does it cross the entire study area from east to west, it is also connected to other waterways, both within and outside the study area. Figure 23 shows that phosphor concentrations are too high all along the river, as well as in many of the channels connecting to the river. As such, this problem is of too large a scope to be solved through a dream session or a municipality and highlights the importance of the water board, which does have the necessary spatial and jurisdictional scale.

The water board also has a clear demand for more water purification. Yet for 10 out of the 16 areas with high nutrient concentrations, no measures are currently planned. Some of these areas can be found in all the dream session areas where demand is high (North-side Leiden: 3, Voorschoten: 1) and most of the municipalities: (Teylingen: 3, Wassenaar: 1), the only exception being Zoetermeer. This lack of plans on the side of the water board here creates room for municipalities and dream session participants to step in. As water purification through constructed wetlands is a scale independent service, there is no need for a minimum viable population, or a carefully connected ecological network: every independently constructed wetland, whether large or small, can support the larger system.

Plurality

In the east of the study area, demand in the dream sessions and municipalities seems to align, specifically in its absence. The dream sessions of Alphen aan den Rijn and Rural area and the municipalities of Alphen aan den Rijn, Leiderdorp and Kaag en Braassem do not show awareness of a (potential) interest in water purification. However, according to the Hoogheemraadschap, six areas that are too rich in nutrients (either phosphor or otherwise) can be found here. Beyond this eastern corner, there are just two municipalities where demand matches that of the dream sessions: Teylingen and Zoeterwoude. In contrast to this dispersed demand, the water board's data identifies problems in water quality throughout the study area.

These differences could indicate a lack of coordination between these actors, but there is some evidence to the contrary: In five areas, the Hoogheemraadschap has discussed the issues with the corresponding municipality. These municipalities are Zoetermeer (two areas), Kaag en Braassem, Leidschendam-Voorburg and Alphen aan den Rijn. However, while the municipality of Zoetermeer shows a clear awareness of the issues in water quality, neither Kaag en Braassem nor Alphen aan den Rijn show any concern in their structuurvisie.

As mentioned, this could result from the notion that water quality is the jurisdiction of the water board, and therefore not a significant element in municipal policy. From this perspective, municipalities might be willing to cooperate on water issues, if the water board approaches them. Dream session participants are probably less concerned with such jurisdictional boundaries, and thus more likely to take initiative themselves.

Actor involvement

It is difficult to determine the roles that dream session participants and municipalities might play in a planning process. Since there are no significant differences in potential supply, this leaves only the differences in demand (Figures 21 and 22). As such, all involved would be ranked either as 'Key Player' or 'Service Provider' (Table 11). Neither of these roles encourages active cooperation.

Yet, as mentioned, even key players rely to some extent on neighbours for their water supply and thus, the quality of their water. This could be sufficient motivation to encourage key players to seek a better coordination of water purification measures. All the key players appear to be entirely surrounded by service providers, but the dream session area of Voorschoten actually connects to the municipalities of Wassenaar and Zoetermeer. The municipality of Teylingen also falls within the wider dream session area of North-side Leiden. Whether such cooperations are worthwhile still depends on the waters these players seek to purify, and how these particular waters are connected within the regional water network, though.

Table 11: ranking involvement in water purification.

	Key players	Service providers	Beneficiaries	Others
Dream sessions	North-side Leiden, Voorschoten, The Hague	Coastal Area, Rural area, Zoetermeer, Alphen aan den Rijn	-	-
Municipalities	Teylingen, Wassenaar, Zoetermeer	Alphen aan den Rijn, Leiden, Leiderdorp, Kaag en Braassem, Leidschendam-Voorburg, The Hague, Voorschoten, Zoeterwoude	-	-

Synthesis

Interaction between the identified scale challenges

The previous three chapters analysed each of the studied landscape services individually. Landscape planning, whether community-based or in a more top-down form, must address these services together, as these are all delivered through the same, multifunctional landscape (Opdam et al. 2006).

Table 12: Summary of mismatch and plurality challenges

	Mismatch	Plurality
Outdoor recreation	Despite large areas that are highly suitable for outdoor recreation, there is still a very high demand. Since meeting both hiking and cycling recreation requires for the supply to be within a certain proximity to the demand (5km), only a few areas are available for increasing the landscape's supply.	Demands for outdoor recreation from dream sessions and municipalities rarely coincide: where dream session demand is high, municipal demand is often low and where dream session demand is low, municipal demand may well be high.
Pollination	Currently suitable grasslands (natural grasslands) are scarce, but potentially suitable grasslands (pastures) are abundant enough that local communities with a particular interest in pollination could sustain a minimum viable population independently. However, doing so without establishing an ecological network will not result in the desired, flower-rich landscape.	There is zero municipal demand for pollination, leaving this level of scale possibly uninvolved in any form of planning for pollination. This could be a significant problem for the creation of a regional network, as municipalities and inter-municipal cooperations provide a suitable scale for connecting various small scale efforts of dream session participants.
Water purification	There is no lack of potentially suitable space for constructed wetlands. However, neither the dream sessions nor the municipalities are really the appropriate scale for addressing the problems with water quality. Dream session participants and municipalities are still able to make small scale contributions.	Dream session demand and municipal demand differ greatly and both are dispersed through the study area, while the water board identifies problems all over. The water board does communicate with municipalities in a few problem areas, though these are often not the municipalities with a demand for water purification. There is no indication of communication between the water board and the dream session scale.

Table 12 summarizes the findings on both the mismatch and plurality challenges for outdoor recreation, pollination and water purification. Pollination and water purification both have the typical problem of fit, where the dream session participants or a single municipality operate on a small scale, while a larger scope is necessary to really address the problem. This is not so much the case for outdoor recreation. As a maximum scale service, there is no clear need for region-wide changes. However, there is still a boundary-crossing challenge, where the area that could be used to improve the landscape's supply is outside the area with the primary demand for it.

To add further complexity, in all cases the municipalities and dream session participants seem to have very different interests. This suggests a lack of vertical coordination: dream session participants and municipalities perceive different problems to be addressed. The results are consistent with an assumption of horizontal coordination between the dream sessions, though not between the municipalities.

Another interesting situation is the potential for a diagonal coordination: between a municipality and dream session participants from neighbouring areas. This can be seen in outdoor recreation, with the municipality of Zoeterwoude and the dream sessions of the Coastal area and Voorschoten, as well as in water purification, with the municipality of Zoetermeer and the dream session of Voorschoten (Figure 24). There is no indication of actual cooperation or communication here, but it is an option to consider for planners.

The problems of fit, along with the (lack of) vertical and horizontal interplay (Young 2006) show that all three services could benefit from some form of organization at a regional level, such as an inter-municipal council or the provincial government. For outdoor recreation, an inter-municipal council seems suitable: there is a municipal demand throughout the study area and the mismatch is at the inter-municipal level rather than at the provincial level. For pollination, an inter-municipal council seems an unlikely option, given the complete lack of interest in the service from the municipalities. As such, regional coordination must come either from the provincial or community level. Close cooperation among community-level actors could result in the creation of a grassroots, regional organization (Adger et al. 2005, p.7). For water purification, the water board is already the designated regional organization. Looking at each service individually, then, a different regional arrangement would be preferable. From a landscape planning perspective though, these services should all be included in a more integrative planning process, combining and coordinating the local, regional and watershed levels of scale.

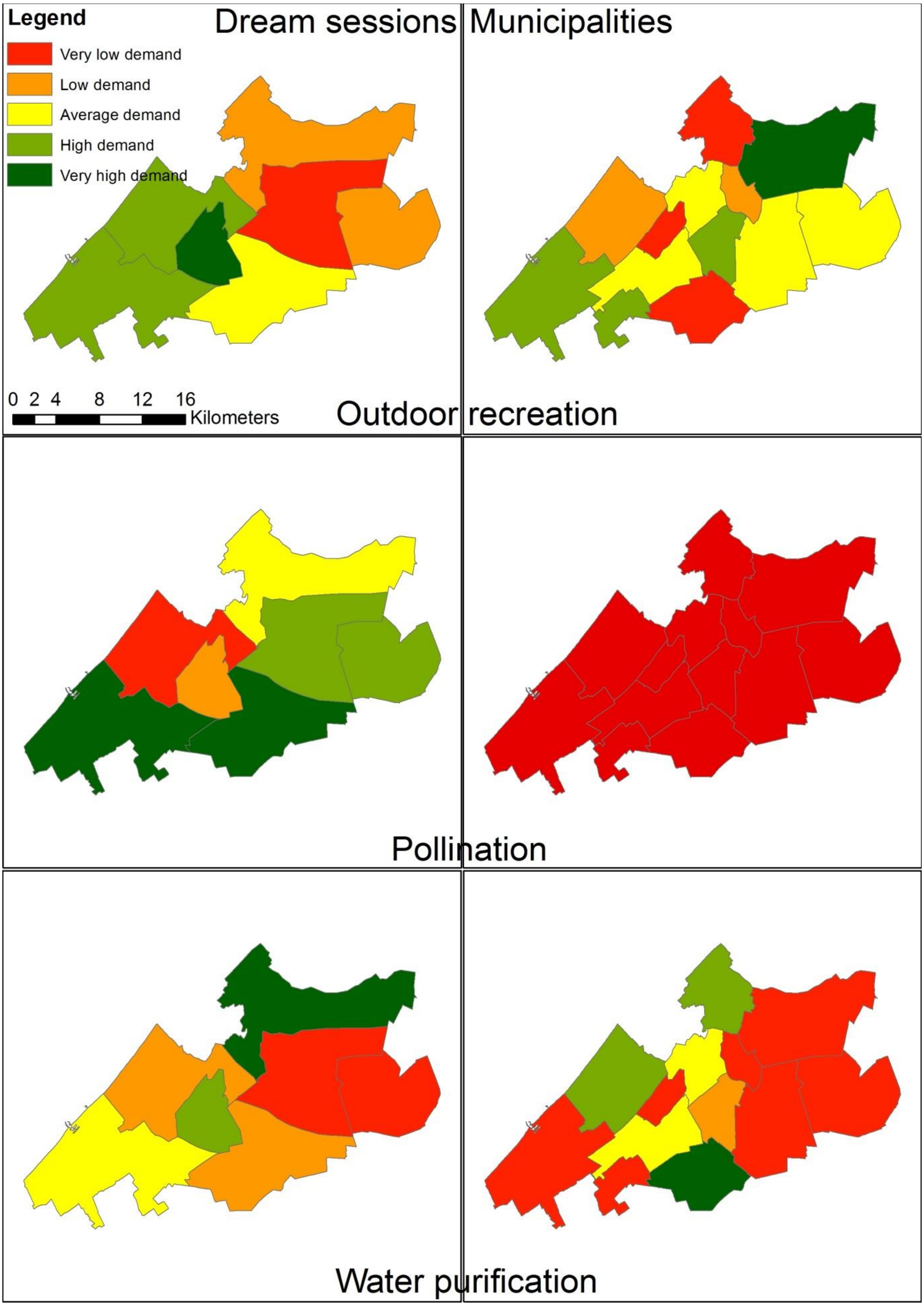


Figure 24: summary of the demand for outdoor recreation, pollination and water purification.

Actor ranking

The results of the actor ranking are summarized in tables 13 and 14. It shows that all dream session groups are a key player in at least one service. All but The Hague are a service provider in at least one. In 4 out of 7 dream sessions, there are beneficiaries in at least one service. All four of them are a beneficiary in terms of one of the pollinator ecoprofiles, while being a key player for one of the other ecoprofiles. There are no beneficiaries for outdoor recreation or water purification among the dream session groups.

Among the municipalities, only two are beneficiaries, both in outdoor recreation (Leiden and The Hague). All municipalities have the ability to act as service provider for at least one service, allowing for negotiations regarding other services. Out of the 11 municipalities, 6 are a key player in one service.

The municipality of Leiden illustrates how such negotiations and exchanges of services might look like. Leiden is a beneficiary in outdoor recreation, but a service provider for pollination (Hommel ecoprofile). The Rural area dream session is a service provider in outdoor recreation, but a beneficiary in regards to pollination (Hommel ecoprofile). It would therefore be beneficial to both Leiden and Rural area to set up some kind of exchange of services. For example, Leiden could support a Hommel population near the border with the Rural area, while the Rural area could open up new hiking routes that simultaneously act as flower-rich corridors for pollinators. This arrangement would enable more recreation in the vicinity of Leiden and draw pollination into the Rural area.

There is one problem with such an exchange: The Rural area already provides outdoor recreation potential to Leiden. The landscape service of outdoor recreation is not a commodity that the dream session participants can effectively barter, as it is established through publicly available goods and services. Therefore, the dream session participants of the Rural area cannot deny this service to Leiden, regardless of whether Leiden offers anything in return. Pollination is also no trade-able commodity, yet Leiden does not automatically provide pollination services for two reasons: 1) Leiden has space with potential suitability for Hommel pollination, rather than actual suitability, and 2) the Hommel habitat has to be extended into the Rural area for its inhabitants to benefit from it.

This sets the Rural area dream session participants at a disadvantage in negotiations. An exchange of services, or rather a shared landscape plan can still be mutually beneficial, because there is a strong synergy between outdoor recreation and pollination: creating a bee-friendly landscape also results in a more attractive landscape (van Rooij et al. 2014).

Such an exchange of services does not have to be purely bilateral, as potential for a regional network exists in this case. There is a number of neighbouring actors that have something to offer and something to gain in this regard as well: the dream session participants of Zoetermeer, Voorschoten and the Coastal area, and the municipalities of Leidschendam-Voorburg and Zoeterwoude. These in turn have neighbours with interests in one or both services.

There is potential for synergy between these two services and water purification as well (Kampf & van den Boomen 2013; Joly 2013), expanding the possible involvement of municipalities and dream session participants even further. As such, it appears that nearly all actors have something to offer that is relevant to the interests of others, and something they want from others. That means it would be in the interest of all to negotiate and establish some sort of regional decision making arrangement.

Table 13: Complete dream session actor ranking

Dream session	Outdoor recreation	Pollination: Hommel	Pollination: Zweefvlieg	Pollination: Pionier	Water purification
Alphen aan den Rijn	Other	Beneficiary	Key player	Beneficiary	Service provider
Coastal area	Key player	Service provider	Other	Other	Service provider
North-side Leiden	Other	Other	Service provider	Other	Key player
Rural area	Service provider	Beneficiary	Key player	Beneficiary	Service provider
The Hague	Key player	Key player	Beneficiary	Beneficiary	Key player
Voorschoten	Key player	Service provider	Service provider	Other	Key player
Zoetermeer	Service provider	Key player	Beneficiary	Key player	Service provider

Table 14: Complete municipalities actor ranking

Municipality	Outdoor recreation	Pollination: Hommel	Pollination: Zweefvlieg	Pollination: Pionier	Water purification
Alphen aan den Rijn	Other	Other	Service provider	Service provider	Service provider
Kaag en Braassem	Key player	Other	Service provider	Other	Service provider
Leiden	Beneficiary	Service provider	Other	Other	Service provider
Leiderdorp	Other	Service provider	Other	Other	Service provider
Leidschendam-Voorburg	Key player	Service provider	Service provider	Other	Service provider
Teylingen	Other	Service provider	Other	Other	Key player
The Hague	Beneficiary	Other	Other	Other	Service provider
Voorschoten	Service provider	Service provider	Other	Other	Service provider
Wassenaar	Service provider	Service provider	Other	Other	Key player
Zoetermeer	Other	Service provider	Other	Service provider	Key player
Zoeterwoude	Key player	Other	Other	Other	Service provider

Final discussion and conclusions

In this thesis, I merged two separate but related objectives. The primary aim was to identify scale challenges for (community-based) planning. However, I also developed a method for this identification and tested it in a case study. This leads to two distinct chapters of discussion. The first answers the research questions as outlined in the problem description, and discussed some forms of multi-scale governance to address the found challenges. The second chapter discusses the method itself, how it could be used and how it could be improved.

Identifying scale challenges

The mismatch challenge

This study identified two types of mismatches: at the regional level, there is a problem of fit between the scope of ecological networks and the scope of both municipalities and dream sessions. At the local level, there is a mismatch between supply and demand of services.

The landscape has a lot of potential supply for each of the three studied services, though the present supply of pollination and water purification appears very low. For both these services, significant changes in the landscape would be required to meet the demand indicated by the dream sessions and municipal structuurvisies. For outdoor recreation, less widespread changes would be required, partly due to it being a maximum scale service.

There does not appear to be a single, appropriate scale of planning for any of these services. All three of them can be seen as regional networks of either routes, corridors or waterways, and their connectivity is an important part of their functionality (Vanbergen 2013; Janssen et al. 2006). At the same time, all of them also benefit from small scale action: the creation of a new hiking path, the pasture that is converted into flower-rich grassland, and the constructed wetland are all measures taken at a small spatial scale, well within that of a municipality, village council or even an individual land owner. This supports the arguments made for multi-scale governance (Ostrom 2010; Cash et al. 2006).

The plurality challenge

The results also indicated a lack of shared interests between the dream session participants and their respective municipalities. For outdoor recreation and water purification, demand in the dream sessions and municipalities is often contrary to each other. For pollination, there is no municipal demand at all. Thus, municipal planners and dream session participants perceive very different challenges in the landscape.

Dialogue between dream session participants and municipalities, with the purpose of social learning, could help to avoid conflicts between these actors (Ebrahim & Ortolano 2001; Armitage et al. 2008). The dream sessions might have already provided this, but the results indicate that large differences continue to exist. It is unlikely that conflicts can be avoided entirely through social learning, and Lane and Corbett argue that *"…institutional authority needs to be retained in [Community-based Environmental Management] programmes so that competing claims and interests of different actors can be mediated."* (Lane & Corbett 2005, p.155).

Whether the lack of shared interests is the result of differences in (spatial) scale remains uncertain. Another option is that municipal planners rely more on technical knowledge and dream session participants on experiential knowledge. On the other hand, it could be argued that such differences are also a scale challenge (Cash et al. 2003; Cash et al. 2006).

The actor ranking suggests that many dream session participants and municipalities, being classified as key players, would be able to provide a supply to meet their demand within their own boundaries. The main reason for this result is the widespread potential supply found in this study for each of the three services. However, numerous problems of fit were also found, indicating that planning at only the local scale, whether by municipalities or dream session participants, will not be able to fully address the presented challenges.

The planning challenge

For each of the three studied services, a different institutional arrangement seems appropriate. This creates an additional challenge for planners: there are not only multiple levels on the spatial scale to take into account, but also multiple levels on the organizational scale (Cash et al. 2006). Landscape planning thus requires tools to manage this vertical interplay (Young 2006) and cross sectional boundaries (Cash et al. 2003). This is the domain of multi-scale governance.

The actor ranking would paint a different picture, as all dream session areas and all but two municipalities appear to be self-sufficient in regards of all three services; they either have little demand for a service, or a significant potential supply exists within the area. Yet the actor ranking was not made scale-sensitive, as it only compared differences in supply and demand. As such, the classification of 'key player' should not be read as self-sufficiency, but rather the presence of both beneficiaries and service providers within the same area. Whether this indicates heterogeneous communities, including both beneficiaries and service providers, or the presence of multiple communities, possibly overlapping, within the dream session area cannot be said at this point. Other studies on community-based planning make both cases plausible (Duane 1997; Lane & McDonald 2005).

Of the various approaches to multi-level governance, the majority offers little to no practical guidance to landscape planning, but rather analytical frameworks. Only the theories of Adaptive co-management and Boundary organizations provided practical guidelines. Many of these guidelines regarded governance systems, rather than address scale challenges directly, but still highlighted a number of issues that planners in the study area will have to address:

1. Provide training and resources to dream session participants for capacity building.
2. Maintain openness and inclusiveness.
3. Build commitment among the involved actors.
4. Establish responsibility and accountability across spatial and organizational boundaries.

Based on my conclusions here, I can add:

5. Foster continued social learning of municipalities and dream session participants.
6. Set up a system of conflict mediation.

Limitations of the used methods

This study did not address the plurality that can be found within local communities and municipalities. I have assumed both dream session participants and municipalities to be fairly homogeneous and unified, though many studies point out that this is an incorrect assumption for both local communities (Lane & Corbett 2005; Lane & McDonald 2005) and municipalities (Measham et al. 2011). This simplification was necessary to conduct the study. While differences of interest can be found within each dream session, these were not spatially explicit and could therefore not be analysed with the applied methods.

This study also made the sphere of influence of local communities appear larger than it probably is. This is a direct result of the number of dream sessions held within the study area. The study area included eleven municipalities and seven dream sessions. The interpolation of the dream sessions therefore resulted in larger areas than the municipalities. However, the boundaries drawn are more indicative of differences in demand for landscape services than the boundaries of communities of place (Duane 1997). As there is also no indication that these communities would be homogeneously spread over the area, the results presented here should not be read as the unified service demand of the people in any delineated area, but rather the ideas that are popular enough that a community of practice may be built around it (Quick & Feldman 2011). There are indications that such communities already exist or are being built in the study area: aside from the site-specific dream sessions, three thematic sessions were also organized around specific topics or practices: water, beekeeping, and sustainable agriculture (www.mijngroenonsgroen.nl/dromen).

Multi-scale governance

A number of governance options have been constructed, at least on the theoretical level, to deal with the scale challenges presented here. Berkes (2006) mentions six: co-management, epistemic communities, policy networks, boundary organizations, polycentric systems and institutional interplay.

Most of these appear to provide an analytical framework, rather than normative guidelines for governance (Adler & Haas 1992; Carlsson 2000; Ostrom 2010; Young 2006). The two exceptions are adaptive co-management and boundary organizations (Armitage et al. 2009; Cash et al. 2003). A set of criteria has been developed for both these approaches, which the presented case could be measured against, insofar as these topics have been addressed in the study.

The set of criteria established for adaptive co-management reads as follows (Armitage et al., 2009, p. 101):

1. **Well-defined resource system**: Within this study, the discussed landscape services have been defined to fit a specific set of measurable objectives. The dream sessions and their participants have not bothered with any form of delineation, which actually has been the main challenge in the translation of dream session results to landscape services. Thus, the prospect of a well-defined resource system exists, but so does the problem of a poorly defined resource system.
2. **Small-scale resource use contexts**: the services of outdoor recreation and pollination can meet this criterion. Since the watershed is much larger than the study area, water purification is problematic in this regard.
3. **Clear and identifiable set of social entities with shared interests**: This appears lacking. Dream sessions attracted a variety of people with mixed interests. However, many participants were members of one community or another such as a nature- or farmer's association, through which invitations for the dream sessions were sent.
4. **Reasonably clear property rights to resources of concern**: Taking Ostrom's (reference: 2003) definition of well-defined property rights, Dutch law seems to fit this definition (reference: Needham, 2005).
5. **Access to adaptable portfolio of management measures**: This depends very much on the form implementation an adaptive co-management system would take.
6. **Commitment to support a long-term institution-building process**: This is also an unanswered question. A certain amount of commitment can be expected from the provincial government, as they initiated the dream sessions and invested resources into it. How committed the municipalities and dream session participants are, was not studied.
7. **Provision of training, capacity building, and resources for local-, regional-, and national-level stakeholders**: This topic was not part of the study.
8. **Key leaders or individuals prepared to champion the process**: Key leaders could be found at the provincial government. Within the study area, key leaders might also be found in areas classified as ´key player´ in the actor ranking.
9. **Openness of participants to share and draw upon a plurality of knowledge systems and sources**: This topic was also not addressed in the study.
10. **National and regional policy environment explicitly supportive of collaborative management efforts**: regional policy is most likely supportive of the process, as it was conceptualized and initiated here. If regional policy is not supportive, the provincial government would be contradicting itself.

It is clear that no form of adaptive co-management is currently in place. Yet there does seem to be potential: Two of these criteria, property rights and a small-scale resource use context, are well met. For others, such as a well-defined resource system and social entities with shared interests, there seems room for improvement. There remains a lot of uncertainty, as for none of these criteria a clear 'pass' or 'fail' can be given at this point.

Boundary organizations have three key features (Cash et al. 2003, p.8089):

1. They involve specialized roles within the organization for managing the boundary.
2. They have clear lines of responsibility and accountability to distinct social arenas on opposite sides of the boundary
3. They provide a forum in which information can be coproduced by actors from different sides of the boundaries through the use of "boundary objects" (Guston 1999)

At first glance, the series of dream sessions provide a boundary-bridging function. They provide a forum where actors from different communities, municipalities and the province can discuss landscape services and co-produce plans. However, there is no responsibility or accountability across the boundaries and there is no indication that the produced plans act as boundary objects: provincial and municipal planners are free to ignore them. Therefore, the dream sessions did not establish a boundary organization, but they did provide a temporary boundary-bridging space. An evolution of the dream sessions that has a more permanent presence and has these key features is very well possible.

It is important to note that adaptive co-management and boundary organizations are not discrete, mutually exclusive forms of multi-scale governance. They employ similar concepts of inclusiveness, institution-building and responsibility. This also means that efforts to establish a boundary organizations cannot simply ignore the criteria set for adaptive co-management (Olsson et al. 2007).

A method for assessing scale challenges

In this thesis, I presented a method for studying both the mismatch and plurality scale challenges, without reliance on a specific topic in which these challenges could be framed. I have attempted to establish a concrete, measurable concept of both mismatch and plurality by combining the concepts of landscape services and supply and demand. With this method, each scale challenge is still framed by a specific service, but it can theoretically be applied to any landscape service. While I had some successes with the application of this method, I also encountered several problems.

Among the three services I studied, I encountered the least problems in outdoor recreation, as both supply and demand were measurable. This was not the case for pollination and water purification. For pollination, measuring potential supply resulted in a fairly precise identification of potential supply, largely thanks to the clear criteria provided by the ecoprofiles. Demand was more problematic, as the topic of pollination was not mentioned in any form by the municipal structuurvisies. In the dream sessions, demand was significantly less than outdoor recreation. This effectively resulted in a much smaller data set to map the demand with, and therefore a less reliable one. Remarkable spikes in demand, as found in Zoetermeer and The Hague, indicate that perhaps, the data set was too small. The same problem was found with water purification, a service with even lower demand. Unlike pollination, water purification was mentioned in the majority of the structuurvisies. Another problem with water purification was the inability to identify the potential supply. This was a direct result of characteristics of the study area: virtually the entire area could be suitable for the use of constructed wetlands, but the area of effect of any given wetland was variable and therefore unpredictable. A better grasp on the potential supply might be attained by studying the possible flow directions that the pumping stations could establish. A study on flow directions in the Netherlands has been done, but was considered unreliable for the study area (Jochem, 2015. personal communication). Therefore, it was not used in this thesis.

These problems highlight three weaknesses inherent in the method. The first is that a popular demand for a service is required. It appears that without, differences in demand cannot be mapped reliably and it becomes difficult to distinguish an absence of demand from an absence of data. The second problem is related; the results of both the dream sessions and structuurvisies indicate that regulating services (de Groot et al. 2010, p.268) are consistently in little demand, compared to provisioning or cultural services. Therefore, the method might be less suitable for the assessment in scale challenges for regulating services. The third problem is that characteristics of a study area can interfere with the method. The method proved to lack flexibility in this regard. Together, these three problems limit the applicability of the method to services which are in high demand and behave predictably.

Approaching the matter differently could circumvent some of these problems. The questions of supply, demand could be posed more directly in the dream sessions, or similar community-based context. Regarding municipalities, planners could also be asked directly, rather than interpreting their written works. In this way, attention could be brought to services that might otherwise be underrepresented. Doing so raises another question, though: how does one distinguish services which are underrepresented from those that are simply in little demand?

Improving the method

Aside from recognizing these limitations, three general improvements of the method are required: 1) further quantification; 2) clear delineation between actual and potential supply; 3) further specification of landscape services.

Further quantification

The comparisons between supply and demand here provided a pseudo-quantification; comparing relative differences in demand with relative differences in potential supply. As such, the results are at best indicative of a mismatch between supply and demand. The dream sessions and structuurvisies did not quantify a demand for services. As a result, I could not quantify a demand for services beyond the frequency of their appearance in the dream sessions and structuurvisies. This limitation continues into the actor ranking. As mentioned, being a key player does not make one self-sufficient. To truly assess the mismatch between supply and demand, such a quantification is necessary. With it, one could determine whether a municipality or community is self-sufficient in regards to a specific service, some form of import is required to meet the demand, or a surplus could be exported.

Supply and demand in a given area is not enough to define the problem of fit, though. Whether a landscape service can be imported or exported depends on whether it has stock-flow or fund-service characteristics (Daly & Farley 2011) and in case of the latter, the way in which a service's benefit may extend to beyond the area that produces the service (Fisher et al. 2009, p.650). This can result in a dependency on external forces, even when internally, supply and demand match perfectly. In this thesis, I applied a basic quantification of this extension for both outdoor recreation (a 5km radius (Willemen et al. 2010)) and pollination (500m radius, as defined by the used ecoprofiles). The nature of the study area made it infeasible to do so for water purification; flow directions are determined by pumping stations and are therefore reversible. This flexibility in flow direction means that I could not determine where the effects of water purification at any given site would be felt. In less controlled environments, where water flows are directed by natural features of slope and soil, the service benefit area might be more easily determined.

Clear delineation between actual and potential supply

Using the dream sessions and structuurvisies as input for service demand provides not the actual service demand, but rather those demands that are not currently met: if no shortage or problem is perceived for a service, it is unlikely to be mentioned in either the dream sessions or structuurvisies. This means that, in order to come to an accurate measurement, service supply must be measured likewise, with a clear difference between actual supply and potential supply. For pollination, I differentiated between natural grasslands (actual supply) and pastures which could be converted or adapted to provide habitat for pollinators (potential supply). For outdoor recreation, I lacked a clear distinction. One way to resolve this would be to consider landscape attractiveness as potential supply, with the density of hiking and cycling routes in attractive areas as actual supply. The potential supply could then be unlocked by providing more routes in attractive areas. Alternatively, one could also consider areas with a high density of routes, but little landscape attractiveness to have a potential supply. Improving the landscape attractiveness would likely be a larger investment than providing new hiking and cycling paths, though.

This touches on the concept of ambition levels in planning (Opdam et al. 2006): how much are people willing and able to invest in order to create the desired landscape service supply? I applied this concept implicitly here by deciding that pastures could be converted into natural grasslands, but not into forest. Such ambition levels might not be measurable, as the difference between supply and demand would only be one part of the equation. Capacity, available resources, competing interests and opposition to planned changes (Beunen & de Vries 2011; Agardy et al. 2011) all play a role as well, and may change over time. Instead, it would probably be more fruitful to assess the investment required to realize the potential supply in any given area. Knowing the potential supply and the required investment of different sites allows for a landscape plan that matches both the difference in supply and demand and the resources available as best as possible.

Further specification of landscape services

Services such as outdoor recreation, pollination and water purification are too vague and do not describe a specific purpose. Such a specific purpose is necessary for quantification. For example, 'single-day hiking and cycling recreation opportunities', 'a flower-rich landscape', and 'meeting European norms for water quality' would have provided more clarity. The dream session results are vague, but did offer some indications of specific demands within the categories of outdoor recreation and pollination. I therefore applied my own interpretation of the dream session results to come to more specific service demands, which could be measured. For future assessments of scale issues, I would advise to involve local stakeholders directly into this process of specifying service demands. In the case study, the thematic sessions, held for a couple of topics, were a step in this direction. These were not used in this thesis because they were not spatially explicit. Specified service demands, which are made spatially explicit, would allow for a much more clear indication of the scope of each demand. Such clarity is not only necessary for quantification; it also helps to define targets for landscape planning.

Application of the method in community-based or multi-scale planning

While these improvements add a scientific rigor to the analysis and provide a much greater accuracy and reliability of results, it would also take much more effort to complete the analysis. This raises the question of whether it is feasible in a community-based planning context. Of the three improvements suggested here, further quantification is perhaps the most difficult to accomplish. Quantification increases the need for data and when such data is not present, it can take significant effort to acquire it. Within the scope of this thesis, a thorough quantification of supply and demand of three services was infeasible. Planners with limited resources, whether community-based or not, could face the same obstacle.

On the other hand, the direct involvement of local and regional actors in the assessment can provide a basis for social learning processes, which are considered important for both community-based planning (Whelan & Oliver 2013) and adaptive co-management (Armitage et al. 2008). It can also help to establish some of the conditions for successful co-management, specifically "Commitment to support a long-term institution-building process" (Armitage et al. 2009, p.101).

To deal with the limitations of available resources, I would consider which elements are relevant in any given context. The mismatch challenge and plurality challenge are stand-alone elements that can be assessed separately from one another. Which of these two is the key scale challenge likely depends on the specifics of any study area. For example, in a small, homogenous social network, plurality might not be a significant challenge. In a case of high degrees of self-sufficiency, mismatch might not be an issue. To put it simply, in order to save time and resources, the first step should be to consider what scale challenges could be significant and therefore worth investigating. However, since there is overlap between the input data for both mismatch and plurality, analysing one of the two lowers the investment required for analysing the other as well.

Recommendations for further study

The South Holland case provided an interesting combination of Provincial organization towards community-based planning, which also included municipalities. In the dream session, the province took the role of organizer and facilitator, rather than active participant in the planning process. As such, the province was not included in this study. I also did not discuss the planning process itself. As a result, there remain a number of unanswered questions. The above six planning issues could provide a starting point for further studies.

The role of the province is another important part of the South Holland case. As the main driver behind the planning process, its interactions with municipalities, dream session participants and other local actors could tell a lot about the process as a whole.

Another open question is the effectiveness of the dream session approach in building and empowering local communities (Quick & Feldman 2011). I argued that it has potential to provide a boundary organization, but its true effects in terms of capacity building and social learning were not studied.

Finally, the notion that the dream session results offered low resolution data raises another issue: planning and organization at the sub-municipal level. How do small-scale communities (either of place or practice) and individuals organize and manage the landscape? This could include not only the processes of decentralization that result in community-based planning (Lane & McDonald 2005), but also the activism and informal processes of grassroots planning (Irazábal & Neville 2007). Internationally, there is a significant body of literature on the topic of grassroots planning (Hall 1994; Salsich 2000; Miraftab 2009). It appears more scarce in the Netherlands, perhaps due to the highly regulated Dutch landscape (Needham 2005). How grassroots initiatives play within, or circumvent the rules is an interesting question for state-supported community-based planning and by extent, multi-scale planning.

References

Literature

Adger, W., Brown, K. & Tompkins, E., 2005. The political economy of cross-scale networks in resource co-management. *Ecology and society*, 10(2). Available at: http://dlc.dlib.indiana.edu/dlc/handle/10535/3467 [Accessed January 6, 2015].

Adler, E. & Haas, P.M., 1992. Conclusion: epistemic communities, world order, and the creation of a reflective research program. *International Organization*, 46(01), pp.367–390. Available at: http://journals.cambridge.org/abstract_S0020818300001533 [Accessed January 7, 2015].

Agardy, T., di Sciara, G.N. & Christie, P., 2011. Mind the gap: Addressing the shortcomings of marine protected areas through large scale marine spatial planning. *Marine Policy*, 35(2), pp.226–232. Available at: http://linkinghub.elsevier.com/retrieve/pii/S0308597X10001740 [Accessed January 9, 2014].

Armitage, D., Marschke, M. & Plummer, R., 2008. Adaptive co-management and the paradox of learning. *Global Environmental Change*, 18(1), pp.86–98. Available at: http://www.sciencedirect.com/science/article/pii/S0959378007000490 [Accessed July 27, 2014].

Armitage, D.R. et al., 2009. Adaptive co-management for social–ecological complexity. *Frontiers in Ecology and the Environment*, 7(2), pp.95–102. Available at: http://www.esajournals.org/doi/abs/10.1890/070089 [Accessed July 9, 2014].

Berkes, F., 2006. From Community-Based Resource Management to Complex Systems: The Scale Issue and Marine Commons. *Ecology And Society*, 11(1). Available at: http://dlc.dlib.indiana.edu/dlc/handle/10535/3066 [Accessed December 17, 2014].

Beunen, R. & de Vries, J.R., 2011. The governance of Natura 2000 sites: the importance of initial choices in the organisation of planning processes. *Journal of Environmental Planning and Management*, 54(8), pp.1041–1059. Available at: http://www.tandfonline.com/doi/abs/10.1080/09640568.2010.549034 [Accessed January 9, 2014].

Blaikie, P., 2006. Is Small Really Beautiful? Community-based Natural Resource Management in Malawi and Botswana. *World Development*, 34(11), pp.1942–1957. Available at: http://www.sciencedirect.com/science/article/pii/S0305750X06001343 [Accessed July 10, 2014].

Bodin, Ö. & Tengö, M., 2012. Disentangling intangible social–ecological systems. *Global Environmental Change*, 22(2), pp.430–439. Available at: http://www.sciencedirect.com/science/article/pii/S0959378012000179 [Accessed July 9, 2014].

Born, B. & Purcell, M., 2006. Avoiding the Local Trap: Scale and Food Systems in Planning Research. *Journal of Planning Education and Research*, 26(2), pp.195–207. Available at: http://jpe.sagepub.com/content/26/2/195.short [Accessed July 11, 2014].

Carlsson, L., 2000. Policy Networks as Collective Action. *Policy Studies Journal*, 28(3), pp.502–520. Available at: http://doi.wiley.com/10.1111/j.1541-0072.2000.tb02045.x [Accessed January 7, 2015].

Cash, D.W. et al., 2003. Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences of the United States of America*, 100(14), pp.8086–91. Available at: http://www.pnas.org/content/100/14/8086.short [Accessed December 16, 2014].

Cash, D.W., Adger, W. & Berkes, F., 2006. Scale and cross-scale dynamics: governance and information in a multilevel world. *Ecology and …*, 11(2). Available at: http://www.ecologyandsociety.org/vol11/iss2/art8/ES-2006-1759.pdf [Accessed January 16, 2015].

Cash, D.W. & Moser, S.C., 2000. Linking global and local scales: designing dynamic assessment and management processes. *Global Environmental Change*, 10(2), pp.109–120. Available at: http://www.sciencedirect.com/science/article/pii/S0959378000000170 [Accessed January 7, 2015].

Colvin, R.A., 2002. Community-Based Environment Protection, Citizen Participation, and the Albany Pine Bush Preserve. *Society & Natural Resources*, 15(5), pp.447–454. Available at: http://www.tandfonline.com/doi/abs/10.1080/08941920252866792#.VMOdgE10xoI [Accessed January 24, 2015].

Cox, K.R., 1998. Spaces of dependence, spaces of engagement and the politics of scale, or: looking for local politics. *Political Geography*, 17(1), pp.1–23.

Daly, H. & Farley, J., 2011. *Ecological Economics* 2nd ed., Washington, DC: Island Press.

Duane, T., 1997. Community participation in ecosystem management. *Ecology Law Quarterly*, 24(4), pp.771–797.

Ebrahim, A. & Ortolano, L., 2001. Learning Processes in Development Planning a Theoretical Overview and Case Study. *Journal of Planning Education and Research*, 20(4), pp.448–463.

Ernstson, H. et al., 2010. Scale-crossing brokers and network governance of urban ecosystem services: The case of stockholm. *Ecology and Society*, 15(4).

Fisher, B., Turner, R.K. & Morling, P., 2009. Defining and classifying ecosystem services for decision making. *Ecological Economics*, 68(3), pp.643–653. Available at: http://linkinghub.elsevier.com/retrieve/pii/S0921800908004424 [Accessed January 9, 2014].

Girvetz, E.H. et al., 2008. Integration of landscape fragmentation analysis into regional planning: A statewide multi-scale case study from California, USA. *Landscape and Urban Planning*, 86(3-4), pp.205–218. Available at: http://linkinghub.elsevier.com/retrieve/pii/S0169204608000352.

Gray, G.J., Enzer, M.J. & Kusel, J., 2001. Understanding Community-Based Forest Ecosystem Management. *Journal of Sustainable Forestry*, 12(3-4), pp.1–23. Available at: http://www.tandfonline.com/doi/abs/10.1300/J091v12n03_01#.VMOdoU10xoI [Accessed January 24, 2015].

De Groot, R.S. et al., 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecological Complexity*, 7(3), pp.260–272. Available at: http://linkinghub.elsevier.com/retrieve/pii/S1476945X09000968 [Accessed January 9, 2014].

Guston, D.H., 1999. Stabilizing the Boundary between US Politics and Science: The Rôle of the Office of Technology Transfer as a Boundary Organization. *Social studies of Science*, 29(1), pp.87–111.

Hall, A., 1994. Grassroots action for resettlement planning: Brazil and beyond. *World Development*, 22(12), pp.1793–1809.

Irazábal, C. & Neville, J., 2007. Neighbourhoods in the Lead: Grassroots planning for social transformation in post-Katrina New Orleans? *Planning Practice and Research*, 22(2), pp.131–153.

Janssen, M., Bodin, Ö. & Anderies, J., 2006. Toward a network perspective of the study of resilience in social-ecological systems. *Ecology and …*, 11(1). Available at: http://www.researchgate.net/publication/42763973_Toward_a_Network_Perspective_of_the_Study_of_Resilience_in_Social-Ecological_Systems/file/9c96052a7b5076c538.pdf [Accessed January 17, 2015].

Joly, V., 2013. *Water purification: a valuable wetland service.*

Kampf, R. & van den Boomen, R., 2013. *Waterharmonica's in the Netherlands*, Amersfoort. Available at: http://www.stowa.nl/.

Klein, C. et al., 2009. Incorporating ecological and evolutionary processes into continental scale conservation planning. *Ecological Applications*, xxx(1), p.xxxx.

Lane, M.B. & Corbett, T., 2005. The Tyranny of localism: Indigenous participation in community-based environmental management. *Journal of Environmental Policy & Planning*, 7(2), pp.141–159. Available at: http://www.tandfonline.com/doi/abs/10.1080/15239080500338671#.VKqg6U10ymQ [Accessed January 5, 2015].

Lane, M.B. & McDonald, G., 2005. Community-based Environmental Planning: Operational Dilemmas, Planning Principles and Possible Remedies. *Journal of Environmental Planning and Management*, 48(5), pp.709–731. Available at: http://www.tandfonline.com/doi/abs/10.1080/09640560500182985 [Accessed January 9, 2014].

Measham, T.G. et al., 2011. Adapting to climate change through local municipal planning: barriers and challenges. *Mitigation and Adaptation Strategies for Global Change*, 16(8), pp.889–909. Available at: http://link.springer.com/10.1007/s11027-011-9301-2 [Accessed October 24, 2014].

Miraftab, F., 2009. Insurgent Planning: Situating Radical Planning in the Global South. *Planning Theory*, 8(1), pp.32–50.

Needham, D.B., 2005. Een andere marktwerking in de ruimtelijke ordening. *Geografie. Vaktijdschrift voor geografen*, 14(4), pp.20–23. Available at: http://hdl.handle.net/2066/46800.

Olsson, P., Folke, C. & Galaz, V., 2007. Enhancing the fit through adaptive co-management: creating and maintaining bridging functions for matching scales in the Kristianstads Vattenrike Biosphere. *Ecology And Society*, 12(1). Available at: http://www.ecologyandsociety.org/vol12/iss1/art28/ES-2006-1976.pdf [Accessed January 13, 2015].

Opdam, P. et al., 2008. Setting biodiversity targets in participatory regional planning: Introducing ecoprofiles. *Ecology and Society*, 13(1).

Opdam, P., Steingröver, E. & Rooij, S., 2006. Ecological networks: a spatial concept for multi-actor planning of sustainable landscapes. *Landscape and urban planning*, 75(3-4), pp.322–332. Available at: http://linkinghub.elsevier.com/retrieve/pii/S016920460500054X [Accessed February 26, 2014].

Ostrom, E., 2010. Polycentric systems for coping with collective action and global environmental change. *Global Environmental Change*, 20(4), pp.550–557. Available at: http://www.sciencedirect.com/science/article/pii/S0959378010000634 [Accessed July 10, 2014].

Phua, M.-H. & Minowa, M., 2005. A GIS-based multi-criteria decision making approach to forest conservation planning at a landscape scale: a case study in the Kinabalu Area, Sabah, Malaysia. *Landscape and Urban Planning*, 71(2-4), pp.207–222. Available at: http://linkinghub.elsevier.com/retrieve/pii/S0169204604000763.

Pressey, R.L. & Bottrill, M.C., 2009. Approaches to landscape- and seascape-scale conservation planning: convergence, contrasts and challenges. *Oryx*, 43(04), p.464. Available at: http://www.journals.cambridge.org/abstract_S0030605309990500.

Quick, K.S. & Feldman, M.S., 2011. Distinguishing Participation and Inclusion. *Journal of Planning Education and Research*, 31(3), pp.272–290. Available at: http://jpe.sagepub.com/cgi/doi/10.1177/0739456X11410979 [Accessed January 9, 2014].

Van Rooij, S. et al., 2014. *Een Bij-zonder kleurrijk landschap in Land van Wijk en Wouden Handreiking voor inrichting en beheer*, Wageningen. Available at: www.wageningenUR.nl/alterra.

Salsich, P.W., 2000. Grassroots Consensus Building and Collaborative Planning. *Washington University Journal of Law & Policy*, 3(1), p.27.

Selman, P., 2004. Community participation in the planning and management of cultural landscapes. *Journal of Environmental Planning and Management*, 47(3), pp.365–392. Available at: http://www.tandfonline.com/doi/full/10.1080/0964056042000216519#tabModule [Accessed December 15, 2014].

Steingröver, E., Geertsema, W. & van Wingerden, W., 2010. Designing agricultural landscapes for natural pest control: a transdisciplinary approach in the Hoeksche Waard (The Netherlands). *Landscape ecology*, 25(6), pp.825–838. Available at: http://link.springer.com/10.1007/s10980-010-9489-7 [Accessed February 26, 2014].

Termorshuizen, J.W. & Opdam, P., 2009. Landscape services as a bridge between landscape ecology and sustainable development. *Landscape Ecology*, 24(8), pp.1037–1052. Available at: http://link.springer.com/10.1007/s10980-008-9314-8 [Accessed January 24, 2014].

Throgmorton, J. a., 2003. Planning as Persuasive Storytelling in a Global-Scale Web of Relationships. *Planning Theory*, 2(2), pp.125–151.

Trepel, M. & Palmeri, L., 2002. Quantifying nitrogen retention in surface flow wetlands for environmental planning at the landscape-scale. *Ecological Engineering*, 19(2), pp.127–140.

Vanbergen, A.J., 2013. Threats to an ecosystem service: Pressures on pollinators. *Frontiers in Ecology and the Environment*, 11, pp.251–259.

Vos, C., Grashof-Bokdam, C. & Opdam, P., 2014. *Biodiversity and Ecosystem Services: does species diversity enhance effectiveness and reliability?*, Wageningen.

De Vries, S., Klein-Lankhorst, J.R. & Buijs, A.E., 2007. Mapping the attractiveness of the Dutch countryside : a GIS-based landscape appreciation model. *Forest Snow and Landscape Research*, 58(81), pp.43–58.

Whelan, J. & Oliver, P., 2013. Regional Community-Based Planning: The Challenge of Participatory Environmental Governance. Available at: http://www.tandfonline.com/doi/abs/10.1080/14486563.2005.10648643#.VKqfUU10ymQ [Accessed January 5, 2015].

Willemen, L. et al., 2010. Space for people, plants, and livestock? Quantifying interactions among multiple landscape functions in a Dutch rural region. *Ecological Indicators*, 10(1), pp.62–73. Available at: http://www.sciencedirect.com/science/article/pii/S1470160X09001472 [Accessed January 22, 2015].

Young, O., 2006. Vertical interplay among scale-dependent environmental and resource regimes. *Ecology and Society*, 11(1). Available at: http://www.ecologyandsociety.org/vol11/iss1/art27/ES-2005-1519.pdf?origin=publication_detail [Accessed January 12, 2015].

GIS Datasets

Actueel Hoogtebestand Nederland (AHN2). 2007-2012. Waterschapshuis, Amersfoort.

Basiskaart Natuur. 2013. Alterra, Wageningen.

BelevingsGIS. 2010. Alterra, Wageningen.

Bevolkingskernen. 2011. Alterra, Wageningen.

Bodem. 2006. Alterra, Wageningen.

Fietsknooppuntennetwerk. 2013. Provincie Zuid-Holland, The Hague.

Wandelroutenetwerk. 2015. Provincie Zuid-Holland, The Hague.

Appendix 1: Dream session results

	Leiden Noord	Duin, Horst en Weide	Alphen aand den Rijn	Leiderdorp	Wassenaar	Geerpolder	Zoetermeer	Kustgebied		Sum	Percentage
Provisioning											
Biofuels production	3.73	0.00	0.00	1.41	0.00	0.00	0.00	0.00		5.14	0.50%
Regional food production	8.96	6.32	7.02	25.35	1.00	13.70	12.75	0.96		76.05	7.44%
Organic agriculture	2.24	1.05	0.00	5.63	2.00	4.11	1.96	0.00		17.00	1.66%
Local growing and gathering	11.19	1.05	26.32	12.68	11.00	6.85	1.96	2.88		73.93	7.23%
Raw materials and products	0.75	2.11	0.00	1.41	0.00	1.37	0.98	0.96		7.57	0.74%
Regulating											
Evaporative cooling	0.00	1.05	1.75	0.00	5.00	0.00	0.00	0.96		8.77	0.86%
Water flow control	1.49	0.00	0.00	5.63	0.00	1.37	2.94	1.92		13.36	1.31%
Noise absorption	1.49	0.00	3.51	2.82	3.00	0.00	0.98	0.00		11.80	1.15%
Natural pest control	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.96		1.94	0.19%
Pollutant removal from soil/water	3.73	2.11	0.00	0.00	1.00	0.00	0.98	0.96		8.78	0.86%
Soil formation	0.00	0.00	0.00	4.23	0.00	1.37	0.00	0.00		5.60	0.55%
trapping air pollutants	0.00	0.00	0.00	2.82	0.00	0.00	0.98	0.96		4.76	0.47%
Water infiltration	0.00	1.05	1.75	0.00	6.00	0.00	0.00	2.88		11.69	1.14%
Nutrient cycling	2.24	0.00	0.00	1.41	0.00	1.37	0.98	0.00		6.00	0.59%
Pollination	2.24	1.05	3.51	4.23	9.00	1.37	9.80	0.96		32.16	3.15%
Cultural											
Aesthetics	6.72	20.00	28.07	9.86	26.00	19.18	28.43	26.92		165.18	16.16%
Learning	13.43	8.42	8.77	9.86	10.00	9.59	15.69	14.42		90.18	8.82%
Outdoor recreation	10.45	32.63	10.53	5.63	23.00	15.07	15.69	21.15		134.15	13.13%
Water recreation	9.70	11.58	3.51	4.23	5.00	4.11	6.86	4.81		49.79	4.87%
Agrotourism	5.22	3.16	1.75	1.41	6.00	9.59	0.00	0.00		27.13	2.65%
Playing in a green environment	5.97	12.63	10.53	5.63	5.00	2.74	4.90	0.96		48.37	4.73%
Heritage	4.48	6.32	0.00	4.23	7.00	8.22	9.80	4.81		44.85	4.39%
Supporting											
Habitat for wildlife	11.94	18.95	17.54	38.03	30.00	17.81	16.67	26.92		177.86	17.40%

Appendix 2: Municipal structuurvisie results

	Alphen	Den Haag	Kaag en Braa	Leiden	Leiderdorp	Leidschendan	Teylingen	Voorschoten	Wassenaar	Zoetermeer	Zoeterwoude		Sum	Percentage
Provisioning														
Biofuels production	3.10	0.00	1.29	0.00	0.00	0.00	2.04	0.00	0.00	0.00	0.00		6.43	0.66%
Regional food production	10.08	1.92	12.26	0.00	0.00	3.51	2.04	0.00	0.00	0.00	16.48		46.29	4.73%
Organic agriculture	0.00	0.00	0.00	0.00	0.00	0.00	2.04	0.00	0.00	0.00	0.00		2.04	0.21%
Local growing and gathering	0.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10		1.87	0.19%
Raw materials and products	0.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.78	0.08%
Regulating														
Carbon storage	1.55	1.92	0.00	3.16	0.00	3.51	2.04	0.00	0.00	3.13	0.55		15.86	1.62%
Evaporative cooling	0.78	0.00	0.65	1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00		2.47	0.25%
Water flow control	0.00	1.92	1.29	1.05	0.00	3.51	0.00	0.00	0.00	0.00	1.10		8.87	0.91%
Noise absorption	0.00	0.00	0.65	1.05	0.00	3.51	0.00	0.00	0.00	9.38	2.75		17.33	1.77%
Natural pest control	0.00	0.00	0.00	0.00	0.00	0.00	2.04	0.00	0.00	0.00	0.00		2.04	0.21%
Pollutant removal from soil/water	0.00	0.00	0.00	4.21	0.00	5.26	8.16	0.00	9.09	28.13	0.55		55.40	5.66%
Soil formation	0.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.85		4.62	0.47%
Trapping air pollutants	0.78	1.92	0.65	6.32	0.00	7.02	8.16	0.00	9.09	40.63	0.00		74.56	7.61%
Water infiltration	0.78	0.00	0.65	2.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00		3.53	0.36%
Nutrient cycling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00%
Pollination	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00%
Cultural														
Aesthetics	19.38	26.92	21.29	31.58	18.60	26.32	16.33	13.79	9.09	25.00	52.20		260.50	26.59%
Learning	10.85	21.15	7.10	6.32	6.98	5.26	10.20	0.00	0.00	3.13	0.00		70.99	7.25%
Outdoor recreation	12.40	17.31	22.58	12.63	9.30	12.28	2.04	0.00	9.09	0.00	19.78		117.42	11.99%
Water recreation	2.33	1.92	7.74	5.26	0.00	3.51	2.04	0.00	0.00	0.00	0.00		22.80	2.33%
Agrotourism	0.00	0.00	5.16	0.00	0.00	0.00	2.04	1.72	0.00	0.00	1.65		10.57	1.08%
Playing in a green environment	3.88	5.77	2.58	6.32	0.00	1.75	2.04	0.00	0.00	0.00	0.55		22.89	2.34%
Heritage	0.78	1.92	4.52	4.21	2.33	8.77	0.00	98.28	0.00	6.25	8.24		135.29	13.81%
Supporting														
Habitat for wildlife	2.33	5.77	11.61	7.37	2.33	12.28	8.16	0.00	27.27	6.25	13.74		97.10	9.91%

Appendix 3: Dream session and Structuurvisie coding

GIFT-T! functions	South Holland mapping												
Provisioning	Provisioning	Provisioning											
Biofuels production	Biofuels production	Biofuels production	mensenm	biomassa	Biovergis	biogas	Bio-based economy						
Food production	Regional food production	Regional food production	Boeren (a	Jacht (inc	Voedsel	producte	Regionale	bijenkorv	regionale	visteelt	voedselz	boomgaard	
		Organic agriculture	biologisc	diervrien	geen bes	keurmerk							
		Local growing and gathering	Moestuin	smulbos	Kruiden	eetbaar	plukken (	dieren ho	stadsland	Permacul	akkertjes		
Timber production		Raw materials and products	Wol	nat. bouw	medicina	Schaapsherders							
Regulating	Regulating	Regulating											
Accessible water storage													
Carbon storage		Carbon storage											
Coastal storm protection													
Evaporative cooling		Evaporative cooling	groene d	beplante	groene flats								
Flow reduction through surface roughness		Water flow control	doorspoe	Verzilting	Waterber	hoge wat	drooglegg	waterpeil	verdroging				
Inaccessible water storage													
Noise absorption		Noise absorption	Stilte	verstoren	geluid								
Pest and disease control	Natural pest control	Natural pest control	tekendet	geen bestrijdingsmiddelen									
Pollutant removal from soil/water	Pollutant removal from soil/wa	Pollutant removal from soil/wa	Waterzui	doorspoe	Drinkwat	waterkwa	zuiverenc	milieukwaliteit					
Shading from the sun													
Soil stabilisation		Soil formation	bodem le	veengron	bodemvr	mest	compost						
Trapping air pollutants		Trapping air pollutants	Zuivering	fijnstof	milieukw	schone lucht							
Water conveyance													
Water infiltration		Water infiltration	tegels	asfalt	groene d	beplanten bovenop gebouw							
Water interception													
Wind shelter													
	Nutrient cycling	Nutrient cycling	hergebru	kringlope	fosfaat	herwinbaar							
		Pollination	bloemen	Vlinders	Bijen	bloeien	honing	bonte be	drachtplanten				
Cultural	Cultural	Cultural											
Aesthetic		Aesthetic	begroeiin	Zicht en c	Landscha	bebouwi	Dieren (v	donkere	beleving	verandering (verstuiving, wind, schaker			
Cultural Asset		Cultural asset											
Encouraging green travel													
Learning	Learning	Learning	fantasie	educatie	Demonst	Informati	inzicht (b	Kennis (onderzoek, waarnemingen)					
Providing jobs													
Recreation – private; public; public with restrictions	Walking, Cycling, being outside	Walking, Cycling, being outside	Routes er	tochten (t	Kampere	Excursies	park	recreatie	Eilandhoppen				
	Water recreation	Water recreation	waterrec	Varen (ka	Watersp	Eilandhop	duikplank						
	agrotourism	agrotourism	Ijsboerde	Boer bez	kinderbo	zorgboer	producen	boerderij (boerenerf, koeientuin)					
	Playing in a green environment	Playing in a green environment	sport	voor kind	Spelen	Feesten e	avontuur	Skaters e	geocaching				
Heritage	Heritage	Heritage	geschied	Herkomst	behoud, I	Molen							
Supporting	Supporting	Supporting											
Corridor for wildlife													
Habitat for wildlife	Habitat for wildlife	Habitat for wildlife	Dieren (z	biodivers	Natuur	ecologisc	verbindin	beschern	Groen (be	duinen (kerven in zeereep, slufter)			

Specific to Structuurvisies:

Word/phrase	**Interpreted service(s)**
Bio-based Economy	Biofuels
innovatie	Learning
aantrekkelijke omgeving	Aesthetic
Klimaat	Climate
CO2	Climate
Windturbines	Aesthetic
Agrariers	Regional food production
Gezond leefmilieu	Pollutant removal from soil/water, Trapping air pollutants

Appendix 4: ArcGIS processes

Outdoor recreation

Source files

WUR:

1. W:\ESG\Shares\Arc\LayerFiles-2013\NatureEnvironment_NatuurMilieu\Landschap\Belevinsgis06_beleving.lyr
2. W:\ESG\Shares\Arc\LayerFiles-2013\AdministrativeDivisions_Administratief\WijkenBuurten\BevolkingsKernen-2011.lyr

Province South Holland:

1. Fietsknooppuntennetwerk.shp
2. Wandelroutenetwerk_PZH_def.shp

Demand map

Input files: BevolkingsKernen-2011.lyr, Dreamsessions

Step 1: Raster to Polygon (Input: Dreamsessions). Output: Dreamsessions_Polygon.

Step 2: Clip (Input: BevolkingsKernen-2011; Clip feature: Dreamsessions_Polygon; x7). Output: Bevolkingskernen_Alphen, Bevolkingskernen_DenHaag, Bevolkingskernen_DHW, Bevolkingskernen_Kustgebied, Bevolkingskernen_Landelijk, Bevolkingskernen_Noordrand, Bevolkingskernen_Zoetermeer.

Step 3: Buffer (Input: step 2; 5km; x7). Output: BevolkingsKernen_*_5kmBuffer (x7).

Step 4: Attribute table BevolkingsKernen_*_5kmBuffer; Add field (Outdoor recreation; x7).

Step 5: Polygon to Raster (Input: Step 3; x7). Output: BevolkingsKernen_*_5kmBuffer_Raster (x7).

Step 6: Mosaic to new Raster (Input: Step 5; Sum) Output: BevolkingsKernen_5kmBuffer_SumMosaic.

Supply map

Input files: Fietsknooppuntennetwerk.shp, Wandelroutenetwerk_PZH_def.shp

Step 1: Create Fishnet (250x250 cells, extent is study area +3 km on all sides). Output: Fishnet.

Step 2: Merge (Input: Fietsknooppuntennetwerk.shp, Wandelroutenetwerk_PZH_def.shp). Output: Hiking_Cycling_Network.

Step 3: Intersect (Input: Hiking_Cycling_Network, Fishnet). Output: Hiking_Cycling_Intersect.

Step 4: Attribute table Hiking_Cycling_Intersect; Summarize (FID_Fishnet; Sum Shape_Length). Output: Hiking_Cycling_Intersect_Summarize.

Step 5: Join Fishnet (Input: Hiking_Cycling_Intersect_Summarize FID_Fishnet).

Step 6: Export Data Fishnet (All features). Output: Hiking_Cycling_Fishnet.

Step 7: Attribute table Hiking_Cycling_Fishnet: Select by attributes (Sum_Shape_length >= 0). Reverse selection. Field Calculator (Sum_Shape_Length = 0). Add Field (Total_Length; Long Integer). Field Calculator (Total_Length = Sum_Shape_Length).

Step 8: Polygon to Raster: (Input: Hiking_Cycling_Fishnet, Total_Length; Cell size: 250). Output: Hiking_Cycling_Fishnet_Raster.

Step 9: Focal Statistics (Input: Hiking_Cycling_Fishnet_Raster; Circle 1000m; Mean). Output: Hiking_Cycling_Fishnet_Raster_1kmFocalMean.

Outdoor Recreation Ranking

Step 1: Reclassify (Input: Beleving_Mask; table 1). Output: Beleving_Mask_Reclass.

Step 2: Reclassify (Input: Hiking_Cycling_Fishnet_Raster_1kmFocalMean; table 1). Output: Hiking_Cycling_Fishnet_Raster_1kmFocalMean_Reclass.

Step 3: Times (Input: Beleving_Mask_Reclass, Hiking_Cycling_Fishnet_Raster_1kmFocalMean_Reclass). Output: HikingCycling_beleving_Times.

Social network

Step 1: Union (Input: Municipalities, Dreamsessions_polygon). Output: Dreamsessions_Municipalities_Union.

Step 2: Attribute table Dreamsessions_Municipalities_Union; Add field: OutdoorRecreation_Difference; Field Calculator: OutdoorRecreation_Difference = Outdoor_Recreation – Outdoor_recreation_1.

Pollination

Source files

W:\ESG\Shares\Arc\LayerFiles-2013\NatureEnvironment_NatuurMilieu\Natuur\BasiskaartNatuur\Basiskaart_Natuur_2013_v1.lyr

W:\ESG\Shares\Arc\LayerFiles-2013\Soil_Bodem\Bod-Gwt-50_2006\bodem50_gwt_tekst_2006.lyr

W:\ESG\Shares\Arc\LayerFiles-2013\Elevation_Hoogte\AHN2 (2013)\AHN2 5m (NoDataFilled).lyr

Groundwater maps

Step 1: Clip (Input: bodem50_gwt_tekst_2006; Clip: Municipalities). Output: Groundwater.

Step 2: Polygon to Raster (Input: Groundwater; Cell size: 25). Output: Groundwater_Raster.

Step 3: Reclassify (Input: Groundwater_Raster; I-III = 1, IV-VII = 0). Output: Groundwater_Raster_ReclassWet.

Step 3: Reclassify (Input: Groundwater_Raster; I-III = 0, IV-VII = 1). Output: Groundwater_Raster_ReclassDry.

Suitability maps

Step 1: Clip (Input: Basiskaart_Natuur_2013_v1; Clip: Municipalities). Output: BasiskaartNatuur2013_Clip.

Step 2: Reclassify (Input: BasiskaartNatuur_Clip; forest = 1, others = 0). Output: BasiskaartNatuur_Clip_ReclassForest.

Step 3: Reclassify (Input: BasiskaartNatuur_Clip; grassland = 1, others = 0) > Output: BasiskaartNatuur_Clip_ReclassGrass.

Step 4: Reclassify (Input: BasiskaartNatuur_Clip; grassland = 1, forest = 1, others = 0) > Output: BasiskaartNatuur_Clip_ReclassGrassForest.

Step 5: Reclassify (Input: BasiskaartNatuur_Clip; grassland = 1, others = 0) > Output: BasiskaartNatuur_Clip_ReclassNaturalGrass.

Step 6: Mosaic to new Raster (Input: BasiskaartNatuur_Clip_ReclassGrass, Groundwater_Raster_ReclassWet; Minimum). Output: BasiskaartNatuur_Clip_ReclassGrassWet.

Step 6: Mosaic to new Raster (Input: BasiskaartNatuur_Clip_ReclassGrass, Groundwater_Raster_ReclassDry; Minimum). Output: BasiskaartNatuur_Clip_ReclassGrassDry.

BasiskaartNatuur cell size = 25x25m = 1/16 ha.

Ecoprofile ‘Hommel’

Within 500m radius:
Forest >= 1.5 ha (24 cells)
Grassland >= 5 ha (80 cells)
Grassland + forest >= 10 ha (160 cells)

Step 1: Focal Statistics (Input: BasiskaartNatuur_Clip_ReclassForest; Sum; 20 cell radius). Ouput: Forest_FocalSum.

Step 2: Reclassify (Input: Forest_FocalSum; <24 = 0, >=24 = 1). Output: Forest_FocalSum_ReclassHommel.

Step 3: Focal Statistics (Input: BasiskaartNatuur_Clip_ReclassGrass; Sum; 20 cell radius). Output: Grass_FocalSum.

Step 4: Reclassify (Input: Grass_FocalSum; <80 = 0, >=80 = 1). Output: Grass_FocalSum_ReclassHommel.

Step 5: Focal Statistics (Input: BasiskaartNatuur_Clip_ReclassGrassForest; Sum, 20 cell radius). Output: GrassForest_FocalSum.

Step 6: Reclassify (Input: GrassForest_FocalSum; <160 = 0, >=160 = 1). Output: GrassForest_FocalSum_ReclassHommel.

Step 7: Mosaic to new Raster (Input: Forest_FocalSum_Reclass, Grass_FocalSum_Reclass, GrassForest_FocalSum_Reclass; Minimum). Output: Hommel_Mosaic

Ecoprofile ‘Zweefvlieg’

Within 500m radius:
Wet grassland >= 2 ha (32 cells)
Dry grassland >= 2 ha (32 cells)
Wet grassland + Dry Grassland >= 10 ha (160 cells)

Step 1: Focal Statistics (Input: BasiskaartNatuur_Clip_ReclassGrassWet; Sum; 20 cell radius). Output: GrassWet_FocalSum.

Step 2: Reclassify (Input: GrassWet_FocalSum; <32 = 0, >=32 = 1). Output: GrassWet_FocalSum_ReclassZweefvlieg.

Step 3: Focal Statistics (Input: BasiskaartNatuur_Clip_ReclassGrassDry; Sum; 20 cell radius). Output: GrassDry_FocalSum.

Step 4: Reclassify (Input: GrassDry_FocalSum; <32 = 0, >=32 = 1). Output: GrassDry_FocalSum_ReclassZweefvlieg.

Step 5: Reclassify (Input: Grass_FocalSum; <160 = 0, >=160 = 1). Output: Grass_FocalSum_ReclassZweefvlieg.

Step 6: Mosaic to new Raster (Input: GrassWet_FocalSum_ReclassZweefvlieg, GrassDry_FocalSum_ReclassZweefvlieg, Grass_FocalSum_ReclassZweefvlieg; Minimum). Output: Zweefvlieg_Mosaic.

Ecoprofile ‘Pionier’

Within 500m radius:
Dry grassland >= 10 ha (160 cells)

Step 4: Reclassify (Input: GrassDry_FocalSum; <160 = 0, >=160 = 1). Output: GrassDry_FocalSum_ReclassPionier.