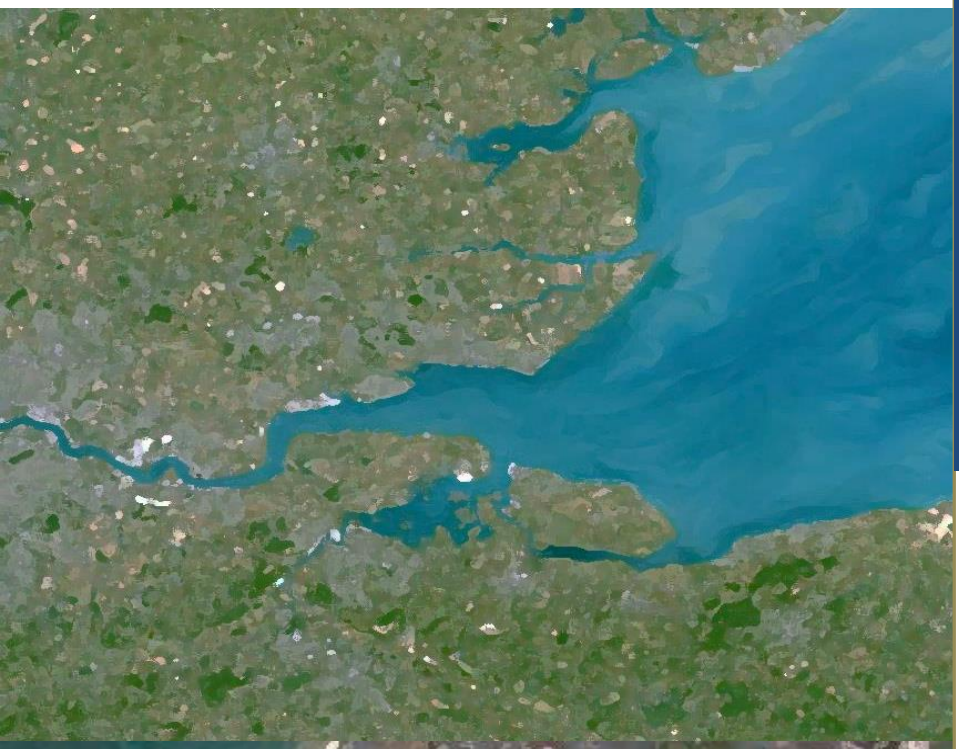

The Coastal Zone:

Different Worlds are Colliding

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The Coastal Zone: Different Worlds are Colliding!

How to establish a framework of tools for implementing ecosystem services in coastal planning?

A comparative case-study research between London & Rotterdam

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Abstract

The Ecosystem Services Approach recently has received increased attention due to increasing awareness of the depletion of natural resources and the urge to maintain our natural resources. The Millennium ecosystem Assessment and other programs have contributed to the understanding of ecosystem services. Through this improved understanding the concept of the ecosystem services approach was mainstreamed in the decision-making. From the literature it stems that the link between ecosystem services in policy and the implementation of ecosystem services in practice is insufficient. There exists a so called 'implementation gap'. The aim of this research is to analyze how the ecosystem services are being addressed in policy and to what extent they are implemented in the practice of spatial planning. In order to analyze the ecosystem services and tools in policy, a comparative case study is executed between the cities of London (United Kingdom) & Rotterdam (Netherlands). In this case study research a specific focus on ecosystem services in relation to water in the coastal zone is chosen. In the coastal zone the urgency to use the potential of ecosystem services is acknowledged because of the existing pressures and ongoing urban and ecological developments in this area. The comparative case study analyzes how the ecosystem services are addressed in current policy documents, and the tools that are currently available in spatial planning are analyzed. What can be found from this research is that ecosystem services are widely addressed in the policy documents, but mostly indirect and much overlap exists between different services. In addition to this the linkage between existing policy and the implementation in practice is lagging behind. Due to the complexity of ecosystem services in valuing and translating them into practical services for human well-being, the operationalization of ecosystem services asks for integrative and explicit management. The analysis of tools in spatial planning shows that there are measures available with the potential to incorporate ecosystem services for implementation. The most important aspect in closing the implementation gap for ecosystem services is to combine different tools in addressing multiple ecosystem services. Ecosystem services don't stand alone, its potential can only be realized through the integration of different measures on different scales and levels. This research provides a framework of which tools can be utilized for the different ecosystem services as a result of the comparison of ecosystem services and tools in London & Rotterdam.

Key words: Ecosystem Services Approach, Spatial planning, Tools, Implementation Gap, Coastal zone

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Chapter 1: Introduction

1.1 Introduction to the research topic

The coastal zone is the interface between land and water. So to speak it brings two different worlds with different features together at one place. The reason why these coastal zones are so important is because a majority of the world's population inhabits the coastal zones. Coastal zones are highly popular, because they often offer a good location for harbors and other trading and shipping facilities. They can be seen as areas which concentrate a variety of human activities, so they are often used intensively by mankind (Cocossis, 2004). Because of the intensive use of coastal zones they are also continually changing. Also because of the weather conditions and erosion, the coastal zones differ from day to day. Thus an understanding of the interaction of the oceans and the land is essential in understanding the possibilities and the hazards associated with coastal zones (Nelson, 2011). Due to ecological and socio-economic factors, the coastal zones are continually changing. These ecological and socio-economical functions are in many respects intertwined and interdependent. These linkages become more important with the expansion of human activities over the coastal area (Cocossis, 2004).

In both developed and developing countries the coastal zone is likely to undergo the most profound change in the near future. Already more than 60 percent of the world's population lives within 60 kilometers of the coast. By the turn of the century two-thirds of the population (3.7 billion) in developing countries is expected to occupy the coast. These profound changes will result in higher pressures on the coastal zones and the urban areas situated in these areas. Also climate change is expected to have a paramount influence on the ecological situation of the zones and can pose great challenges to secure the safety for people living in the proximity of the coast. Consequently, unless careful environmental management and planning are instituted, severe conflicts over coastal space and resource utilization are likely, and the degradation of natural resources will close development options according to Post & Lundin (1996).

It is clear now that coastal zones are very important in our society and they bring together ecological, economic and social functions. But there has been a strong emphasis on the ecological aspect in recent planning, as Cocossis (2004) puts it: 'Coastal zone management is essentially physical planning and resource management with a strong emphasis on land-use regulation and physical interventions (project planning).' But this approach seems to be insufficient because many conflicts arise between socio-economic aspects and ecological aspects. These very diverse aspects need to be brought together, by means of integration expertise can be shared and a broader base can be established for decision-making and operationalization. That is why it is of paramount importance to establish a comprehensive approach. This approach contains multiple objectives and the need to account for a wider scale of interest in both space and time according to Cocossis (2004). An integrative approach can be the appropriate solution to account for these multiple objectives.

1.1.1 History of ecosystem services

The growing awareness about our natural capital developed over the years into the concept of sustainable development. This growing awareness was especially focused at the degrading of our natural resources. This made us aware of the need to manage our natural resources in a way that they would still be available in the future. The notion of "ecological sustainability" became more popular over the years.

This ecological sustainability has turned into an "overall" sustainability. Sustainability became a notion that reflects a perfect balance between the ecological, the economic and the social. A bridging concept was needed between the natural and the social sciences, this became the notion of "ecosystem services". From this notion it became clear that integrated research between the different scientific fields was necessary to analyze the potential of ecosystem services for the socio-economic effects. (Braat & de Groot, 2012)

The origins of the ecosystem services are from the late 1970's. It was first a rather pragmatic concept of how those ecosystem functions could benefit society. The main aim of this was to increase public interest for the conservation of the natural capital through economic services. In the 1980's this emerged into the sustainable development debate (WCED, 1987), into the 1990's when ecosystem services became mainstream in the professional literature. In this concept of ecosystem services there was increased focus on methods to estimate their economic value. (Braat & de Groot, 2012)

The ecosystem services approach can be regarded as the necessary integrative approach. According to Mooney et al. (2004) it is clear that the coastal zone has a significant function for our human wellbeing. There are many ecosystems functioning at the interface of land and water. The ecosystems of the earth are being massively impacted by human activities. Our demands for ecosystem services are increasing, although simultaneously we are reducing the capacity of many ecosystems to actually meet these demands. These demands are for instance the need for food and clean water. This problem of an uneven relation of the increased demands and the decreased capacities is widely acknowledged. The sustainability of our ecology and our human well-being is at stake. Especially with regard to the ongoing change the coastal zone faces, a different approach is needed. Because of the new problems that will arise in the near future we need to answer the increased demands without diminishing the ecological and socio-economic qualities. To establish a sound policy and management that addresses these issues a collaborative and integrated approach is necessary. In recent policies often the human well-being was provided, but the ecosystem capacities were undermined. (Mooney et al. 2004)

Ecosystem services try to deal with this problem of meeting the demands without degrading our ecology in an integrated manner. The ecosystem services approach recognizes that in knowing how to deal with this problem, we need significant understanding of both the ecological and the social systems involved. "Ecosystem services are more than just the notion of useful work and benefits from ecosystems. It is about bridging the gaps between ecology and economics, and between the domains of nature conservation and economic development, and the landing in the political arenas which took a few decades"(Braat & de Groot, 2012).

Much is recently known about the ecosystem services, but on the quantitative relationships there are still a lot of questions that remain open. Especially the quantitative relationships between aspects of the biodiversity, ecosystem components and processes, functions and services are poorly understood. The specific nature of these linkages is an important, but unsolved question in the ecosystem services. Specific measurable indicators are needed to describe the linkage between the ecological processes and components of an ecosystem and their services in a comprehensive and quantitative way. This is significant in doing an attempt to align policy and management with the ecosystem services (De Groot et al., 2002).

Many of the current measures and indicators of biodiversity were not developed for economic assessment. Often these indicators are therefore not able to show the clear relationship between components of biodiversity and the economic assessment. These measures are only appropriate for just a

small number of ecosystem services and their economic value. The quantification and the modeling of ecosystem services is therefore a huge challenge. It is not just a one to one relationship between an ecosystem service and the resulting economic value. Also mapping, quantification and modeling are complicated aspects in analyzing ecosystem services (Braat & de Groot, 2012). There is a lot of interaction between multiple ecosystem services. Therefore it is hard to distinguish the different trade-offs that emerge from the ecosystem services. This interaction between ecology and socio-economy is a key problem in spatial planning. Because a lot of spatial planning projects make use of the ecosystem services provided, they are mutually related so to speak. But the interaction between the provided ecosystem services and the policies in planning is often problematic and unclear.

1.1.2 The Millennium Ecosystem Assessment (MA) program

The MA program is one of the programs which made a great contribution to the understanding of ecosystem services. The MA is a large study of the state and relevance of ecological systems for society. The program was conducted by the UN in the year 2001. The main reason for this at the time was that there was growing awareness about the degradation of the natural capital of the earth. More insight about ecosystem services was necessary in order to be able to do something about it. Until that time information about ecosystems was scattered, there was no clear picture about the different ecosystem functions and how they served our human well-being.

The main aim of the MA program was to create a sound scientific basis on which policy-making and decision-making could be based. A comprehensive and standardized framework was necessary for the assessment of ecosystem functions, goods and services (de Groot et al., 2002).
The aim of MA is to establish the scientific basis for actions needed to enhance the contribution of ecosystems to human wellbeing without undermining their long-term productivity'.
Or in other words, 'how can we sustain the capacity of ecosystems to provide for human needs under increasing human demands put upon them?' (de Groot et al., 2002)

The bottom line of the findings of MA is that human actions are diminishing the ecosystem services of the natural capital. In this way the planet's ecosystem services can't be guaranteed for future generations. At the same time the MA shows that with the right actions it is possible to do something about this. The degradation of many ecosystem services can be reversed. But therefore substantial changes are necessary in policy and practice and these changes are not currently underway. (ICSU-UNESCO-UNU, 2008)

The main problem is the lack of understanding in how to use ecosystem services in spatial planning. Much research is done lately on what ecosystem services are and how they can be classified in order to get a clear picture of their functioning. But the linkage between knowledge and policy remains problematic. The mutual dependency of ecosystem services and spatial planning is acknowledged, what remains is an implementation in policies and practice. This can be seen as the missing link in the development of ecosystem services. That is what will be addressed in this thesis, the lack of understanding in translating the knowledge about ecosystem services into policies for implementation in practice. Especially in the coastal zone this understanding can play an important role in decision-making in coastal planning. Because in the coastal zone there is a great interrelationship between ecological and socio-economic. Especially in times of high pressure decision-making can be very influential in creating a sustainable coastal zone.

1.2 Research Design

1.2.1 Research objective

The objective of this research is to gain more understanding in the implementation of ecosystem services in establishing sustainable coastal zones. It will be necessary to set up an integrated approach in order to achieve sound policy to integrate ecosystem services in coastal planning. Different types of knowledge should be brought together and can lay a foundation in understanding the ecosystem services. A further step beyond this understanding is the implementation of this knowledge into decision-making and practice. This is the biggest challenge that is ahead of us now in the use of ecosystem services in planning.

The current assessment of the MA program has specifically outlined the gaps in scientific knowledge. These identified gaps relate to how humans influence the ecosystems and their services. This link between the human influences on the ecosystems should be complemented by more research on the impact of biodiversity on ecosystem services. How changes in these ecosystems affect the human wellbeing is an area of research where a lot is to be done. This includes better methods to give value to ecosystem services, for instance tools to measure economic valuation. Also essential for further research is to gain more understanding in how the different ecosystem services are linked and affect each other. The biggest challenge in integrating the ecosystem services approach, lies in the operationalization of the concept of the ecosystem services into policies, and to implement this in practice. The linkage between knowledge-policy-practice is what needs further envisioning. That is the challenge that is ahead of us, to make this linkage work. The first part is done by the MA, to create better understanding in the interaction of ecosystem services, now this must be translated into policy with tools for the implementation in practice.

1.2.2 Research question

In order to achieve this research objective I have proposed a main question and additional sub-questions. At the same time these sub-questions function as a sort of tentative table of contents. The sub-questions give direction to this research and step by step the main question will be answered at last.

How to establish a framework of tools for implementing ecosystem services in coastal planning?

- What are ecosystem services?
- What are possible tools that can be used in spatial planning?
- How can we determine tools for the implementation of ecosystem services in land use planning?

Chapter 1
- Introduction
- Research design
- Methodology
- Overview of chapters

Chapter 2
Theoretical framework:
What are ecosystem Services?
- What is the current understanding of Ecosystem Services?

- How do the MA and other programs contribute to the understanding of ES?
- How is the ecosystem services approach used in current spatial planning?
- What is the aim of the ecosystem services approach?
- What are the benefits and the drawbacks of ecosystem services?

What are possible tools that can be used in spatial planning?
- What are general tools available in spatial planning?
- What are possible tools for implementing Ecosystem services?

Chapter 3
Empirical Methodology
- Comparative case-study research
- Policy content analysis
- Qualitative research with Atlas.ti

Chapter 4
Case-studies:
- *How can we determine tools for the implementation of ecosystem services in land use planning?*
- Analysis and comparison of the two case studies: London and Rotterdam
    - How are ecosystem services addressed in current policy documents?
    - What are the benefits and the drawbacks of the implementation of ecosystem services in both cases?
    - What tools are mentioned in the policy documents?
    - What differences and similarities can be found in comparing the ecosystem services and tools in London & Rotterdam?
    - How can an attempt be made to implement ecosystem services with the available tools?
    - What are the best practices from London & Rotterdam?

Chapter 5
Discussion and Reflection

Chapter 6
Conclusions and recommendations:
- What can we conclude from the implementation of ecosystem services?
- What recommendations can be made in order to improve this implementation?
- What set of tools can be recommended in order to improve the implementation of ecosystem services in spatial planning?

1.2.3 Goals and aims of the study

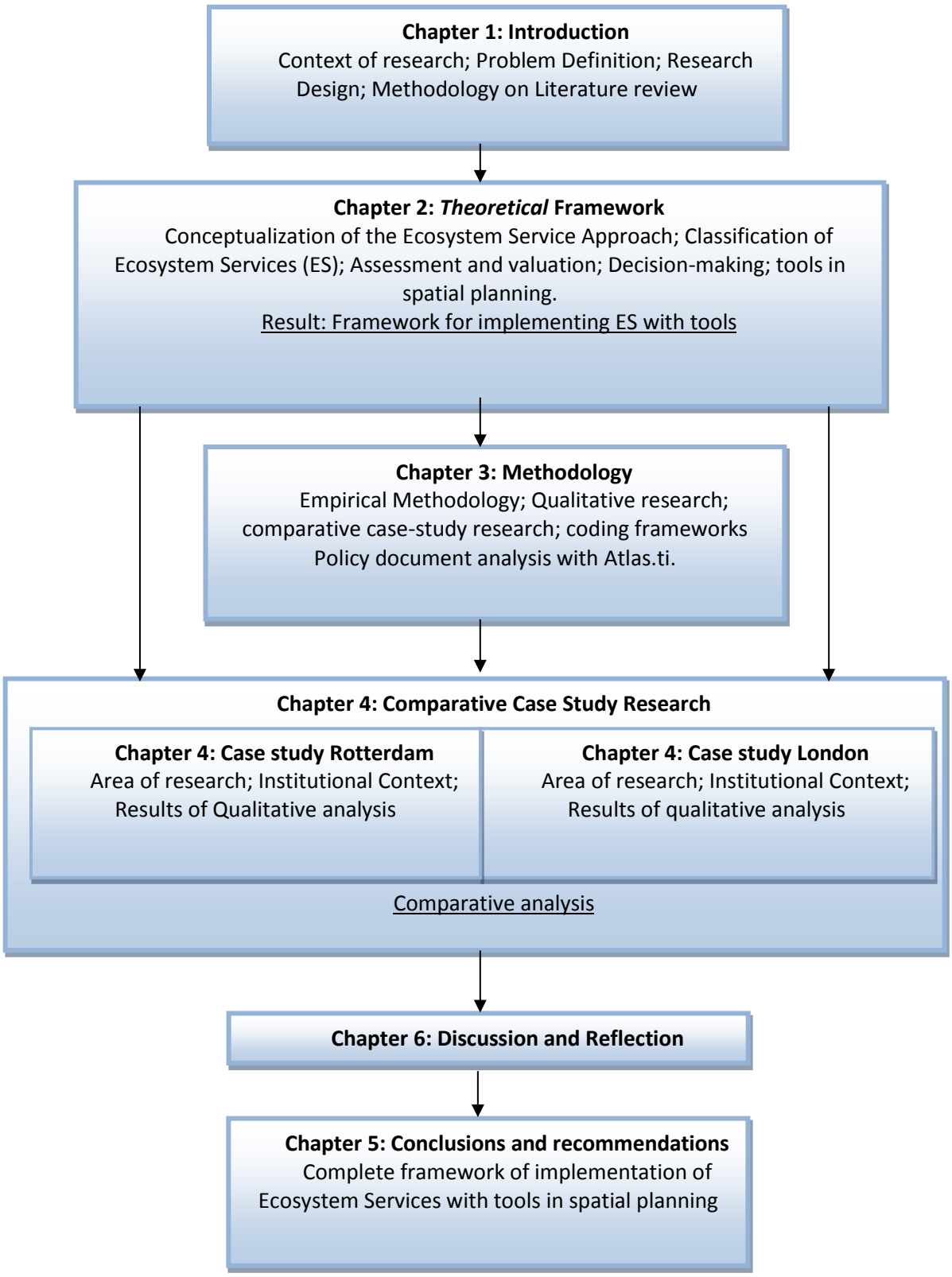
- To provide a better understanding in the current use of ecosystem services.
- To gain more understanding in the development of ecosystem services on the basis of results from programs contributing to the understanding of ecosystem services.
- Analyze and classify the ecosystem services and create a sound basis from where ecosystem services can be assessed and valuated.
- Analyze the challenges and opportunities of the ecosystem services approach that can be of great importance in future spatial planning.

- Investigate how knowledge about ecosystem services can be linked to policy-making and decision-making.
- Gain more understanding in the use of tools in current spatial planning.
- Investigate on the possible tools in spatial planning that can be appropriate for the implementation of ecosystem services in spatial planning.
- Gain more understanding in the current implementation of ES in planning policies through executing a comparative case-study research between London & Rotterdam.
- Analyze how ecosystem services can be implemented in the spatial planning practice.
- Make an attempt to create a framework to address with which tools ecosystem services can be implemented in spatial planning.
- Reflect upon the benefits and drawbacks of the ecosystem services approach

1.2.4 Methodological Framework

Research Question	Objectives	Data required	Methodology
Theoretical Perspective			
1. What is the Ecosystem Services approach? - What is the aim of the ES approach? - How do the MA and other programs contribute to the understanding of ES? - How is the ES approach used in current coastal planning? - What are the benefits and drawbacks of ES in coastal planning?	- Gain more understanding in ES approach - Classification and valuation of ES - Analyze how ES can be linked to policy- and decision-making in coastal planning. - Establish a framework for the different kinds of ES	- Scientific literature	- Literature review
2. What are suitable tools that can be used in Coastal planning? - What general tools are available in Coastal planning? - What are possible tools for implementing ES?	- Gain more understanding in the available tools in coastal planning. - Establish a framework for the different possible tools.	- Scientific literature - Policy documents on coastal planning	- Literature review - Content analysis
Empirical Perspective			
3. How can we attempt to determine tools for the implementation of ES in coastal planning? <u>-> Analysis and comparison of Case studies: London & Rotterdam:</u> - How are ES mentioned in policy documents? - What tools are mentioned for the implementation of ES? - What are the benefits and drawbacks? - What alternative tools can be used?	- Understanding the context for spatial planning. - Analyze what tools are available for the implementation of ES in London & Rotterdam. - Analyze the drawbacks and benefits of implementing ES. - Create a framework to address ecosystem services with tools.	- Scientific literature - Official policy documents - Official assessment reports	- Literature review - Qualitative research method - Comparative case study research - Policy content analysis
4. What can we conclude from the comparison of ES in policies in London & Rotterdam? - What set of tools can be recommended in order to improve the implementation of ES in coastal planning?	- Summarize and compare London & Rotterdam within a framework of ES and tools. > including a recommendation on a set of tools.	- Framework from chapter 2 - Scientific literature	- Literature review

1.2.5 Conceptual Framework



1.3 Methodology

1.3.1 Literature review

The first two chapters, the research proposal and the theoretical framework, will be executed through a literature review of primary data. This literature research has the aim to gain more understanding in the current use of the ecosystem services approach. Literature research will be done by analyzing articles from experts in the field of science. Articles of this kind stem mainly from independent researchers and also from different programs that wish to contribute to a better understanding of ecosystem services.
The ecosystem services are the central issue of research. Thereby different programs around the development of the ecosystem services will also be discussed. This second chapter has the aim to end with a conceptual framework. This framework is the result of an elaborate literature review on the Ecosystem Service approach.

This literature review will serve as a fundament for the case-study research. The literature review is not there to determine the answers about what is known about the topic. It is there to get a better insight in the topic and can in this sense be seen as a means to develop sharper and more insightful questions about the topic. So the literature review itself doesn't provide answers to the research question, but it develops a conceptual framework which can be used to operationalize the empirical research in an appropriate manner (Yin, 2009). Chapter two develops basic insights in the field of science and helps to understand what is done and what needs to be done. It also addresses the implementation gap within the ecosystem services approach. With the literature review a basis is laid for the case-study research and the comparative analysis in chapter four.

In chapter four a comparative case study will be executed that will be supported by a literature research of primary and secondary data. The primary data will stem mainly from the second chapter which will serve as a sound basis for further research on how this knowledge is currently translated into policy and practice. Besides this literature research a qualitative research will also be done on the basis of policy documents. This will be done by a content analysis of relevant policy documents as a basis of assessment and comparison. With this product from the content analysis it can be analyzed if and how ecosystem services are mentioned in policy documents and what is currently the implementation in practice. The results of the analysis of both the documents of London & Rotterdam can be compared. In the end the framework which is presented in chapter two can be completed.

In the last chapter conclusions and recommendations will be given following from the preceding chapters as an answer to the research question. The key function of this chapter will be to come up with a set of tools which can serve to translate the policies on ecosystem services into practice. This will be done on the basis of a framework which can serve as a product for the assessment. The assessment of the two case studies and the literature research together will be the fundament for the end product, a framework of tools to implement the ecosystem services approach in practice.

1.3.2 Case studies London & Rotterdam

For an analysis of the practice of the Ecosystem Services Approach in coastal planning the harbor cities of London and Rotterdam will be examined. This is done in order to get an understanding of how current planning incorporates the notions of Ecosystem Services and how this is implemented in decision making.

The metropolitan area of London has a population of 8.17 million and this number makes it the most populous European city. It is the capital of Great Britain and is situated in England. London also is a very important player in economic aspect, its economy is in the top 5 of largest urban economies in the world. (http://www.londoncouncils.gov.uk/londonfacts/default.htm?category=7)
The city of Rotterdam has a population of 617.424 and is situated within the bigger urban area called the 'Randstad'. De Randstad consists of 7.1 million inhabitants, this area is the very important for the Netherlands for its pivotal economic activities. This area is after London and Paris the third biggest metropolitan area of Europe (Bouman-Eijs et al. (2012).

Both cities can be regarded as important cities in larger metropolitan areas with an important role in national and global economies. Besides this London & Rotterdam share some other characteristics which make them suitable for a comparative case study research. Both cities are connected to the North sea by an important river or river delta. For the London area this is the Thames river and for the Rotterdam area this is the Rhine-Meuse delta. These rivers give both cities access to the sea which results in great opportunities for harbor activities. The harbors of both cities are internationally renowned and are huge drivers of economic activities at a national and global scale. Especially the harbor of Rotterdam is well known worldwide, between 1962 and 2004 it was the biggest harbor in the world, currently it is in the top 5 of biggest harbors in the world. The harbor is regarded to be of pivotal importance for the Dutch economy. (http://www.portofrotterdam.com/nl/Over-de-haven/haven-rotterdam/Pages/default.aspx)

From this we can conclude that London & Rotterdam are both harbor cities that have dealt with the benefits and drawbacks of being a major economic driver in the coastal zone. Another reason why London & Rotterdam are interesting case studies to do a research on implementing ecosystem services is because of their extensive history in spatial planning. The planning systems in both countries have developed significantly in the last century. Especially in the last decades a lot of developments have occurred in planning practice. Although both planning traditions have been subjected to similar changing conditions and developments, both traditions have faced these problems in different manners. The institutional contexts of both harbor cities differ and the spatial planning has developed differently. It is interesting to find differences and similarities in both approaches in what tools are available in the spatial planning traditions. And moreover to find how ecosystem services are addressed in current spatial planning. With this combination of investigating on tools and ecosystem services an attempt can be made to integrate the findings from both cities into a more general framework to show how ecosystem services can be implemented. A comparative case study of London & Rotterdam can offer great insight in how decision-making on ecosystem services can take place. From this point of view an attempt can be made to close the implementation gap and contribute to improve the implementation of the ecosystem services approach in spatial planning.

1.4 Overview of chapters

In the first chapter an overview will be given of the development of ecosystem services and how they became part of the current debate in spatial planning. The awareness of the importance of sustaining the natural capital of the earth has grown over the years. From this awareness new researches were done and programs were initiated to develop policies which aim at a sustainable future. The ecosystem services play a pivotal role in this development in being the key to translate the functioning of the ecosystem into goods and services for our human wellbeing. The relevance and the emerging of this development will be outlined in this first chapter. In this development it is important to notice the linkage and the interaction between the different ecosystem services and the current policies of spatial planning. In these policies often a clear framework of how to incorporate ecosystem services in spatial planning is lacking. Here lies a great challenge in bridging the gap between the knowledge available about ecosystem services and the policies on how to implement these services in practice.

In chapter two this 'implementation gap' will be discussed. The features of ecosystem services will be addressed and how they function in current spatial planning. The ecosystem services will be analyzed and the potential of these goods and services for human wellbeing will be discussed on the basis of a classification of the ecosystem services. Besides gaining understanding of the ecosystem services in general, this chapter will also focus on the urban ecosystem services and the mainstreaming of the ecosystem services approach in the decision making context.

Once it is clear what the potential and challenges are of implementing ecosystem services in spatial planning, possible tools will be analyzed to integrate the ecosystem services in the policies of spatial planning. First general tools in spatial planning will be categorized and discussed, and on this basis it will be analyzed what kind of tools and instruments can potentially address to the implementation of ecosystem services. The framework which will be presented at the end of this chapter will serve as a guideline for the comparative case-study research in linking ecosystem services with applicable tools.

Chapter three will explain more about the methodology for the empirical part of the study. It gives an explanation on how this empirical chapter is set up, with what aims and by what methods. To begin with the reason for choosing the comparative case-study research and subsequently it gives insights in how the policy document analysis is executed with the help of Atlas.ti.

Chapter four will be an 'empirical' chapter. Case studies will be executed on the harbors of London and Rotterdam. With the help of content analysis the current use of ecosystem services in policies of both harbor cities will be analyzed. Besides this, research will be done on how tools are addressed in the policy documents. After this separate analysis of policy documents a comparison will be executed to evaluate both the addressing of tools and ecosystem services in spatial planning. This comparison is aimed to distinguish some similarities and differences between both cases with regard to the use of tools and the implementation of ecosystem services. The benefits and drawbacks from the policies of both cities will be discussed and a selection of best practices will be highlighted. From this analysis lessons can be learned and an attempt can be made to clarify and improve the implementation of ecosystem services in spatial planning.

Chapter five will present the conclusions and the recommendations. An answer of the research question will be presented in a framework with a set of tools which has the potential to make the implementation of ecosystem services in spatial planning possible. Last but not least a discussion and reflection of the research will be given in chapter six. This chapter is meant to discuss the difficulties that were met in the research and to reflect upon the results of the comparative case-study. This discussion and reflection has the aim to give a clear picture on the reliability of the research and the value of the results.

Chapter 2 Theoretical framework:

The focus of this research is on the ecosystem services and how these can be implemented in spatial planning. Therefore this chapter mainly aims to gain more understanding on the ecosystem services and how this approach has developed into the decision-making context. The tools will also be analyzed, primarily with a focus on how they can contribute in providing measures for this implementation.

In this chapter the 'implementation gap' will be discussed between the understanding of ecosystem services and their implementation. A bridge is needed to give hands and feet to the ecosystem services approach. To do this at first the ecosystem services will be analyzed more profoundly and the features of ecosystem services will be addressed in how they function in current spatial planning. The ecosystem services will be analyzed and the potential of these goods and services for human wellbeing will be discussed on the basis of a classification of the ecosystem services. With regard to the comparative case study in chapter four, the urban ecosystem services and the decision-context in which the mainstreaming of the approach takes place will be discussed.

Once it is clear what the potential and challenges are of implementing ecosystem services in spatial planning, possible tools will be analyzed to integrate the ecosystem services in the policies of spatial planning. First general tools in spatial planning will be categorized and discussed, and on this basis it will be examined what kind of tools and instruments can potentially address to the implementation of ecosystem services. In the end of this chapter a framework will be presented that will serve as a fundament for the comparative case-study research. This framework will be a guideline in identifying the different categories of ecosystem services and the applicable tools.

2.1 Conceptualization of the Ecosystem Services Approach

The development of the Ecosystem Services Approach started with a growing awareness for the ecological functions and the importance of the biodiversity on earth. This growing awareness stemmed from different programs and reports that underpinned the pivotal role of our natural resources and the importance for sustainability. This growing awareness also resulted in the ES approach. This development of ES started with the linkage between ecology and economics. Slowly ecological aspects were translated to economic commodities in order to give them meaning in our socio-economic world.

"Ecological sustainability can be defined as the natural limits set by the carrying capacity of the natural environment (physically, chemically and biologically), so that human use does not irreversibly impair the integrity and proper functioning of its natural processes and components." (De Groot et al., 2000) It was regarded as being of great importance to take care of the ecological sustainability. The sustainable development is at stake, this is the core of the global societal challenge. Decision-makers therefore need to understand what this sustainable development involves. Ecological sustainability was being mainstreamed in policies and decision-making. Due to several programs that executed a thorough research to the ecosystem services this resulted in an approach to make the link between the ecological resources and our human well-being. An elaborate investigation has taken place in order to gain understanding the Ecosystem services. The services can be divided in functions that arise from the ecological structures and processes, the functions gain value for humans by the services and benefits they provide.
See De Groot et al. (2010a), in this article it is stated that it is important to distinguish functions from the fundamental ecological structures and processes. Because functions are not merely combinations of

structures and processes, but can also be considered as the potential that an ecosystem has to deliver a service. "For example; nutrient cycling (= process) is needed for water purification (=function) to provide clean water (=provisioning service). The benefits of the resulting services are manifold. Clean water can be used as drinking water, but also for swimming or other recreational use. So the role of woodlands in slowing the passage of water through a catchment is a function which has the potential of delivering a service."

The definition of 'ecosystem function' can differ in multiple interpretations. Sometimes it is explained as an internal functioning of the ecosystem and sometimes it relates to the benefits of it derived by humans. Internal functioning is about the maintenance of energy fluxes, nutrient (re)cycling, food-web interactions etc. The ecosystem functions as benefits for humans are derived from the properties and process of ecosystems such as food production and waste treatment (de Groot et al. 2002a).
De Groot has used the following definition of ecosystem functions: 'the capacity of natural processes and components to provide goods and services that satisfy human needs, directly or indirectly.' (De Groot, 1992) "In this definition, ecosystem functions are best conceived as a subset of ecological processes and ecosystem structures. Each function is the result of the natural processes of the total ecological sub-system of which it is a part. Natural processes, in turn, are the result of complex interactions between biotic (living organisms) and abiotic (chemical and physical) components of ecosystems through the universal driving forces of matter and energy." (de Groot et al. 1992)

Now it is one step more to go from functions to services. "Services are actually conceptualizations ('labels') of the ''useful things'' ecosystems ''do'' for people, directly and indirectly. It should be realized though, that these properties of ecological systems that people regard as 'useful' may change over time even if the ecological system itself remains in a relatively constant state." (Braat & de Groot, 2012)

These services are the things that matter to our human wellbeing. In the recent past the definitions of the concept of ecosystem services have changed. This has happened due to the emergence of different ecosystem services and their different focus. In these definitions there is varying attention for the ecological basis and for the economic use. Here are a number of definitions as an example of how the definition of ecosystem services has changed over time.

- "Ecosystem services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life (Daily, 1997)
- Ecosystem services are the benefits human populations derive, directly or indirectly, from ecosystem functions – (Constanza et al., 1997)
- Ecosystem services are the benefits people obtain from ecosystems (WRI, 2005)
- Ecosystem services are components of nature, directly enjoyed, consumed or used to yield human well-being. (Boyd and Banzhaf, 2007)
- Ecosystem services are the aspects of ecosystems utilized (actively or passively) to produce human well-being. (Fisher et al., 2009)
- Ecosystem services are the direct and indirect contributions of ecosystems to human well-being. (TEEB Foundations, 2010)"

(de Groot, 2012)

These definitions accept that the term ecosystem services contain both the 'work done' component as well as the 'product' component. This product component is often referred to as 'goods', it is suggested that in the next stage of development of the concept this distinction between goods and services should be re-considered (de Groot, 2012).

The ecosystem services are provided differently for different sectors. The tertiary sector considers the component to be a service in economic terms; this does not necessarily have to result in a physical transformation of the ecological structure that is at the basis of this service. “The primary sector deals with the extraction of raw materials from nature that generally must be physically transformed in order to provide benefit for human use.” This could lead to an adjustment of the definition of ecosystem services from the TEEB into: “Ecosystem services are the direct and indirect ‘flux’ of contributions to ecosystems to human wellbeing.” (Farley pers. Comm. in De Groot, 2012) What is made clear in this different perception of ecosystem services is that the different sectors of use determine the value of the service. Also in spatial planning there are many different perceptions on the services that can be provided by the ecosystem services. Urban areas can demand a wide variety of goods and benefits from the ecosystem services.

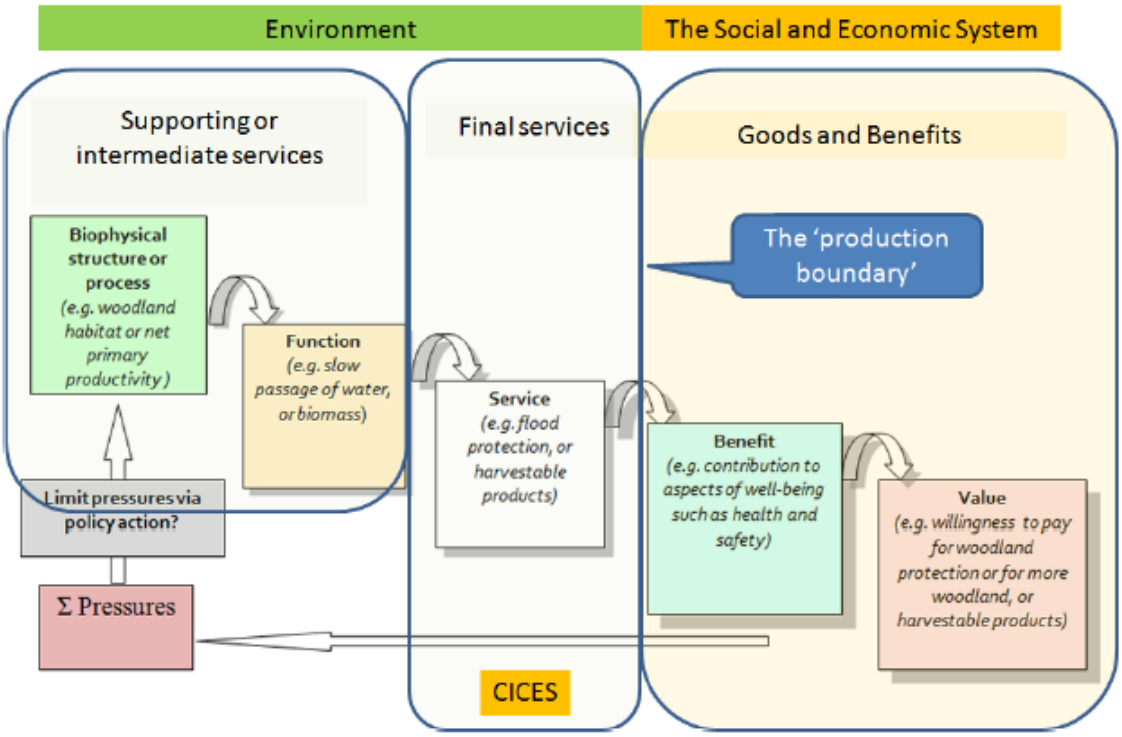


Figure 2.1: The ecosystem services paradigm (CICES Version 4, after Potschin and Haines-Young, 2011)

Figure 2.1 shows the link from structures and processes to the function of and ecological system to the final service, and to the goods and benefits that these services can contribute to. It also shows the inter-linkage between the environment and the socio-economic system. The aim of the ecosystem services approach is to link the services that can be derived from the environment to the goods and benefits for society.

2.2 Contribution of research programs to the understanding of Ecosystem Services

A few programs have made an important contribution to the understanding and further development of the ecosystem services approach. Three programs will be discussed, first the Millennium Ecosystem Assessment (MA) because they made a major contribution in the understanding of ecosystem services through a substantive collaboration between a lot of different stakeholders. Secondly the Ecosystem Services Database (ESD) will be analyzed because they tried to integrate and compare different ecosystem services in a wider geographical scale. By doing this they created possibilities to create

integrated modeling by which ecosystem services can be compared. Finally the TEEB Project, The Economics of Ecosystems and Biodiversity (TEEB), will be discussed. This project can be seen as the next step in the development of ecologically based, social and economic decision making.

Millennium Ecosystem Assessment

"The Millennium Ecosystem Assessment (MA) was called for by the United Nations Secretary-General Kofi Annan in 2000. The MA was initiated in 2001. The objective was to assess the consequences of ecosystem change for human wellbeing and the scientific basis for action needed to enhance the conservation and sustainable use of those systems and their contribution to human wellbeing. The findings of the experts involved in the MA are elaborate; they provide a state-of-the-art scientific appraisal of the condition and trends in the world's ecosystems and the services they provide. And thereby the options to restore conserve or enhance the sustainable use of ecosystems." (ICSU-UNESCO-UNU, 2008 & Millennium Ecosystem Assessment, 2003)

The MA program was done by many scientists from different fields of knowledge, from different countries and from different sectors; these groups were led by experts in their field. Important in this program was that the natural and the social scientists had to collaborate on the same matter. The working method of the program was very refreshing and managed to create a better understanding in ecosystem services in an inter-sectored approach and on multi-scale levels. The challenge remains that the knowledge gained from the MA program must be translated into policy-making and decision-making.
Political entities often have specialized and separated departments, more interaction is necessary. Poor policy decisions can result from the lack of a clear understanding about how an action in one sector can affect actions in other sectors (Mooney et al. 2004).

MA builds on recent reports from the United Nations Environmental Program (UNEP), the Global Environment Outlook (GEO) and the Intergovernmental Panel on Climate Change (ICPP). The MA differs fundamentally from these previous efforts in that the MA is built on a conceptual framework. This conceptual framework considers how ecosystems provide their services to the society and in turn it relates these services to our human wellbeing. This linkage which MA makes is key in enabling to show explicit results in this effort in order to create understanding and to be appealing to a wide range of audiences. The effort of MA in this perspective can be seen as the missing link between already existing data of the problematique and the necessity for all the people to actually make a change. The ecological degradation was recognized, including the need for a sustainable approach to integrate the different sectors to include ecosystem services in decision-making (de Groot et al. 2002).
The main findings of the MA program are that the changes that have been made have contributed to an improvement of human wellbeing and economy. These are so called socio-economic gains. But these gains have been achieved at the expense of other ecosystem services. Now the challenge is born to reverse the degradation of ecosystems and at the same time meeting the increasing demands for services. This can only be done if significant changes are made in policies, institutions and practices. By examining the ecosystem services it becomes much easier to identify how changes in ecosystems influence human wellbeing and to provide information in a form that decision-making can weigh alongside other social and economic information (Layke, 2012 & ICSU-UNESCO-UNU, 2008).

The overall aim of the MA program was to contribute to the integration of different fields of expertise and to allow a more comprehensive decision-making process concerning ecosystem management, and moreover to build a capacity for scientific assessment to do this. The impact of the MA program is dependent on the extent that it will be used in the decision-making process. The scientific findings

therefore have to be translated into policies, and these policies again have to be translated into tools to implement the ecosystem services in practice. This is the big challenge that is lying ahead of us now. The MA has brought us a lot in the understanding of ecosystem services and has stretched out very clear the significance of treating our natural ecosystems very carefully. The next step is to think of tools how this can be done in practice, how we can use our ecosystems in an appropriate manner without degrading their services (Millennium Ecosystem Assessment, 2003).

Before MA the delivery of ecosystems was also evaluated, but not in a quantitative manner. It is highly significant to assess ecosystem services in a quantitative manner, so that their losses and gains can be evaluated under different management practices. Because all services will be evaluated, the consequences of the enhancement of the delivery of one service can be seen on the delivery of all others. No service stands on its own. This is a significant change in evaluation that is fundamental to the assessment of ecosystem services. This focus on the ecosystem service and the trade-offs in their delivery is therefore an important innovation in environmental assessment.

The MA also made a classification of the ecosystem services, in this classification they made a division between 4 different services: Provisioning, regulating, providing and supporting. The supporting service forms the fundamental services in this classification. The supporting service has no direct output for human wellbeing but serves the other three ecosystem services that do have a direct impact on human wellbeing. In figure 2.2 the different ecosystem services are linked with the constituents of well-being. In this figure it is important to see how the 'ecological factors' are linked to the 'social factors'.

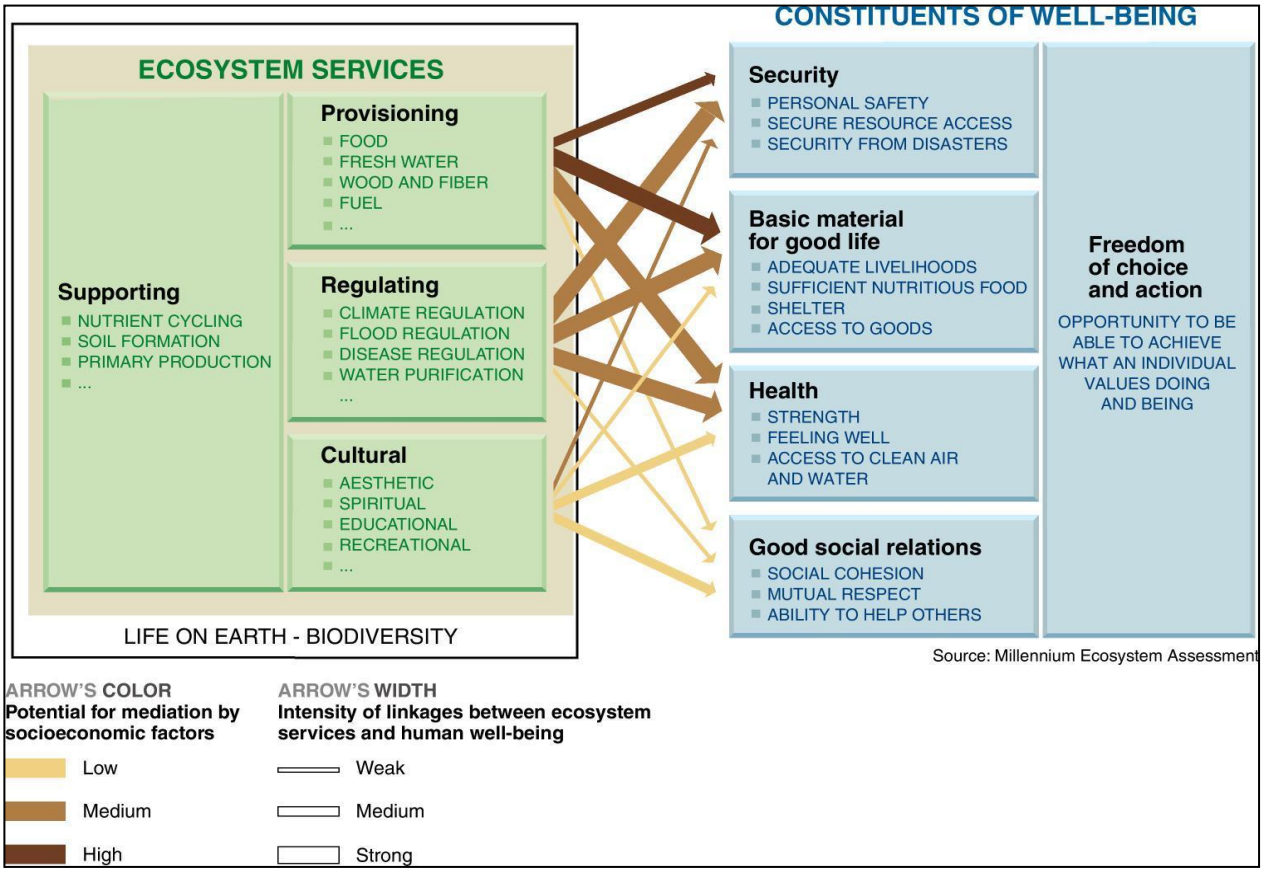


Figure 2.2: Linkages between Ecosystem Service and Human Well-being (CICES Version 4, after Potschin and Haines-Young, 2011)

Ecosystem Services Database

In order to be able to compare ecosystem services across geographic regions we must verify all the components that contribute in these processes. There should be a form of open-source research where scientists collaborate freely and share data with each other. This is a form of collaboration which the AM also stands for. The ESD model can have integrated dynamic modeling capabilities. This can contribute to the analysis of socio-economic and ecological values of natural capital. The ESD design can in this sense be seen as a tool for analyzing data in order to give value to ecosystem functions in an integrated manner (De Groot et al, 2002b).

Ecosystem service is the central entity in the ESD design of connecting information. To be able to understand and to compare ecosystem services across different scales in space and time we must be able to verify the components of these services. We must know what went into their formulation and how these services came to being. With open-source research scientists can collaborate freely and share information and analyses on the World Wide Web. The ESD interface will be able to analyze socio-economic and ecological values of the ecosystem services by the dynamic modeling that is integrated in the design. It is very important to consider the information provided on ecosystem structure and function. Values are often given in a context of sustainability; therefore these values must be determined upon their contribution to the objective of sustainability (Villa et al., 2002).

Many processes in ecosystems can be directly linked to ecological values that can be estimated and stored in physical units. With information of the underlying ecosystem structure it is possible to gain understanding in the substitutability of ecosystem services. This understanding can help in determining appropriate economic valuation methods. The economic value is a key factor to the data model of the ESD. The economic values are estimated using a wide range of possible methods. Often it is complicated to value an ecosystem service in entities that determine their economic value (De Groot, 2002 & Villa et al., 2002).

The ESD design gives certain benefits to scientists and can have a significant role in the understanding and analysis of ecosystem services. There are a number of tools in which the design can be helpful. First of all it can function as a communication tool because it integrates different analyses and results from experts in different fields of expertise. With the design a form of synthesis and higher analysis is possible which can develop the theoretical and practical understanding of ecosystem services. Secondly it can serve as an analytical tool, the design can help to analyses ecological-economic data and can contribute to standardize this data in valuation. Thirdly the ESD can contribute to education and the distribution of knowledge. Fourth the design can stimulate collaboration and it can improve networks of people working together on the same issue in different levels and different scales. And at last the ESD can serve as an example for linking data and models. This linkage makes it possible for researches and the public to easily transfer their local database to other contexts of research. And the system can be adapted easily by all different users, because it is available on the web for everyone (Villa et al., 2002).

TEEB project

The roots of the ecosystem services are the ecosystems, the structures and process in ecology that can result into benefits for human wellbeing. The ecosystem services can link the natural and the human world. But how this takes place and how we can make the most out of these ecosystem services is still very complex. There are still quite a number of challenges left in this area of research to integrate the scientific research, the policy development and the discussion in society. This is where the TEEB project

comes in. The TEEB project consists of different steps to structure the agenda for the ecosystem services and emphasizes the science-policy-practice linkage.
We have seen the development of the increasing influence of ecological aspects in economics and decision making since the 1970's. This growing awareness and influence slowly evolved into the acknowledgment of ecosystem functions, and later into ecosystem services. With the Environmental Impact Assessment (EIA; EEC, 1985) and the Strategic Environmental Assessment (SEA; EC, 2001) the foundations to incorporate ecology in economics were laid. These tools support decision making and can be combined with cost-benefit analysis into so called social cost-benefit analysis or sustainability assessment. The TEEB (The Economics of Ecosystem Biodiversity) procedure can be seen as a next step in the process towards an ecologically based, socio-economic decision making (Braat & de Groot, 2012).

"The TEEB has executed a lot of research on the monetary value of ecosystem services. This has in turn led to the development that policy makers now turned to market based instruments to create economic incentives for conservation." (Braat & de Groot, 2012) This has been a major contribution to the development of ecosystem services in decision making. For decision making a sound economic basis is necessary, that's why the TEEB project was of great importance for the incorporation of the Ecosystem Services Approach in decision making.

2.3 Classification of the Ecosystem Services Approach

Classifying ecosystem services demands at first a clear definition of what ecosystem services are. The key characteristics of the very diverse services with their different behavior must be explained in order to understand the development of these ecosystem services. This understanding is the fundament for the management of the services. It is important to notice that there is not one single or fundamental classification for ecosystem services. We should approach the classifications with caution because the ecosystem services are very complex and dynamic. Here fore we should consider different types of classification schemes according to Fisher et al. (2009).

The context in which the ecosystem services are understood also plays a significant role. The concept of ecosystem services and its approach is highly determined by its institutional context. In order to capture how the classifying or packaging of ecosystem services for decision-making takes place, Fisher et al., (2009) made a figure(2.3) in which they explain how this process works.

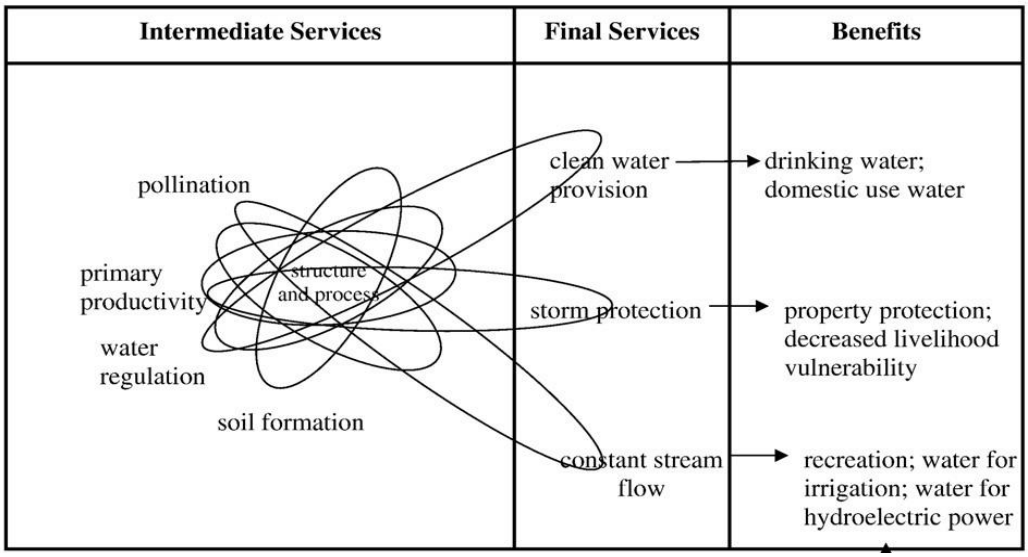


Figure 2.3: Conceptual relationship between intermediate and final services and the benefits they provide. (Fisher et al., 2009).

Figure 2.3 shows how different services are related to each other. Many services can be described as indirect or intermediate services. In this figure by Fisher et al., (2009) it is clarified by a few examples how intermediate services can develop into final services from which humans can derive benefits for their wellbeing. The intermediate services can emerge from their interrelationship with other ecosystem structures. The complexity of functions, processes and interactions that underlie the intermediate services are difficult to recognize. Different functions can work together into one individual intermediate service, subsequently a number of intermediate services can become a final service from which people can derive benefit. The way in which final services are constructed is very different for each kind of service. Nutrient cycling for example is a service than can be used by humans, but not directly. The provision of clean water on the other hand is a service that can be directly used by humans. Clean drinking water can be regarded as a direct benefit for humans (Fisher et al, 2009).

There are many different classifications made through the years of development of the ecosystem service approach. What follows are a few examples of widely recognized and used classifications. Also a further understanding is provided on the different categories which are distinguished in the classifications. At the end of this paragraph I will present my own classification which will be used for the operationalization of the research. At first figure 2.4 shows a classification by Gómez-Baggethun et al., (2012) based on information from the MA and the TEEB programs. This classification clearly indicates the four categories in which the ecosystem services can be divided. The provisioning, regulating and cultural services can generate final services for human benefit. The supporting services are placed under the other three categories to show that this service is only supporting the provisioning, regulating and cultural services. In this manner the supporting service does not function as a final service where humans can derive benefits from. For each category some examples are given to clarify what services can be recognized in this category.

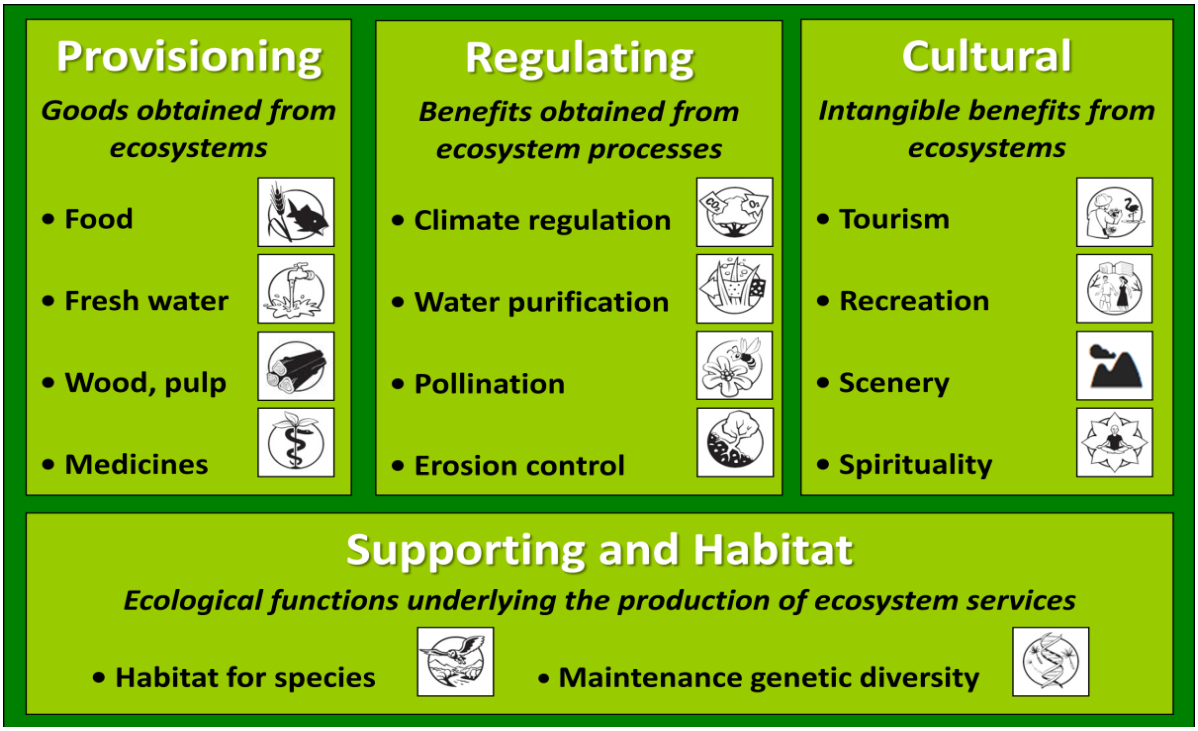


Figure 2.4: Classification of ecosystem services by the TEEB initiative. (Gómez-Baggethun et al., 2012. Sources: Millennium Ecosystem Assessment 2005; TEEB for Local and Regional Policy 2010; Icons by Jan Sasse, TEEB)

In figure 2.5 the Common International Classification of Ecosystem Services (CICES) is shown with the different divisions and according TEEB categories, which will be discussed in the next paragraph. This classification is slightly different then the classification by de Groot. The supporting service is not recognized as a distinct category, but is housed mainly in the regulating and maintenance section especially with regard to biodiversity and ecological control. These services can also be regarded as supporting. Gómez-Baggethun et al., (2012) give some examples of supporting services, like soil formation and retention, nutrient cycling and provisioning of habitat. In the figure some examples are given for each section and for each division. This gives an overview of what ecosystem services are available.

CICES Section	CICES Division	TEEB Categories			
Provisioning	Nutrition	Food			
	Water supply	Water			
	Materials	Raw materials	Genetic resources	Medicinal resources	Ornamental resources
	Energy				
Regulating and Maintenance	Regulation of bio-physical environment	Air purification	Waste treatment (esp. water purification)		
	Flow regulation	Disturbance prevention or moderation	Regulation of water flows	Erosion prevention	
	Regulation of physico-chemical environment	Climate regulation (incl. C-sequestration)	Maintaining soil fertility		
	Regulation of biotic environment	Gene pool protection	Lifecycle maintenance	Pollination	Biological control
Cultural	Symbolic	Information for cognitive development			
	Intellectual and experiential	Aesthetic information	Inspiration for culture, art and design	Spiritual experience	Recreation and tourism

Figure 2.5 CICES classification and explanation on ecosystem services (Haines-Young, 2012)

Last but not least figure 2.6 shows a classification of the Ecosystem Services Approach by de Groot. This classification will mainly serve as the basis for the classification that will be used for the case study research. This classification has the same categories as the MA classification but provides a more clear definition with specific examples of how these ecosystem services operate in practice. The supporting services are the underlying structure of the other services. They are necessary for the production of all other services, but have no direct outcome for human wellbeing. The other services, i.e. provisioning, regulating and cultural services, do have a direct outcome for our human wellbeing.

This classification by de Groot shows the definitions for each category and gives a few examples of how these ecosystem services operate in practice. The provisioning services can obtain products from ecosystems; this is a very direct service that can be linked to benefits for our human wellbeing. Within food production ecosystem services can, for example, focus on local food production on a small scale to maintain the value of the ecosystem and to produce good quality food. Provisioning services include all the products obtained from ecosystems, for example genetic resources, food and fiber, and fresh water. (Gómez-Baggethun et al., 2012) The regulating services are less directly contributing to our human wellbeing; they mainly provide the flow and quality of the services that are available. Regulating services can be linked to the provisioning services as they shape the context in which sustainable energy production for instance can take place. The regulating services are very important because they provide a secure ecosystem and quality of living space in socio-economic as well as in ecological respect. Examples of regulating services are climate regulation, the regulation of water and human diseases.
The cultural services are very important in receiving support and understanding in the implementation of ecosystem services that are not valuable in economic regard. These ecosystem services contribute to our human wellbeing by providing non-material benefits. These benefits can for example be obtained through

spiritual enrichment, cognitive development, reflection, aesthetic experience and social relations. (Gómez-Baggethun et al., 2012) This non-material benefit is difficult to measure, but it can be recognized in recreation, education and aesthetics (de Groot, 2009).

Category	Definition	Example
Provisioning services	Products obtained from ecosystems	Food production, Green energy production(alga), Freshwater retention
Regulating services	Benefits obtained from regulation of ecosystem processes	Water regulation (buffering and mitigation), Water purification and waste treatment, Climate regulation (source of and sink of greenhouse gases)
Cultural services	Non-material benefits people obtain from ecosystems	Recreation, Education, Aesthetic
Supporting services	Necessary for the production of all other ecosystem services, but not directly yield to human benefits	Nutrient cycling(storage, recycling, processing, acquisition), Soil formation(sediment retention, accumulation of organic matter) Biodiversity

Figure 2.6: Classification of ecosystem services (de Groot, 2009)

2.4 Urban ecosystem services

Ecosystem services come in different shapes and sizes, for the coastal zones and urban areas there is a wide variety of ecosystem services that contribute to human wellbeing. The coastal zone which is subject to this research is the meeting place between land and water. In this research especially the coastal harbor city is being analyzed with regard to the ecosystem services. This city that is situated in a coastal zone has specific characteristics; it is interconnected globally through political, technical and economic systems and it is also connected to the biophysical life-support systems of the earth. (Gómez-Baggethun et al., 2012) Ecosystem services can be described as the benefits human populations derive, directly or indirectly from ecosystems. (TEEB, 2010) The ecosystem services are experienced as useful in analyzing the connection between the work nature and human welfare. (MA, 2005) However, with regard to urban ecosystem services there is a significant lack of knowledge (MA, 2005 and World Bank, 2009).

Gómez-Baggethun et al. (2012) explain that cities consume to a great extent the products of the functioning ecosystems for their consumption and waste treatment. Most of the ecosystem services that cities consume are generated by ecosystems that are located in a different area outside the city. Here fore we need to focus not only on the 'ecology in cities', but also on the 'ecology of cities'. This focus on the ecology of cities can be characterized by interdisciplinary and multi scale studies with a social-ecological systems approach. The city is dependent on the area that surrounds it and the links between the urban and the rural, the city should be viewed as an ecosystem according to Grimm et al. (2009) in (Gómez-Baggethun et al., 2012).

Urban ecosystems are defined in a broader sense, because many flows and interactions extend beyond the borders of the urban area. The urban ecosystems also include the hinterland that is affected by the energy and material flows from the urban area according to Gómez-Baggethun et al. (2012). Urban ecosystems can be seen as an ecological infrastructure, a so called 'green infrastructure'. The urban ecosystem provides a variety of services for human wellbeing. This term includes the importance of water and vegetation in or near the built environment in delivering these ecosystem services in different spatial scales (Gómez-Baggethun et al., 2012).

The MA (2005) emphasizes that different habitats provide different types of ecosystem services, therefore it is important to adapt a general classification to a specific ecosystem. Urban ecosystems mainly contribute in providing services with a direct impact on health and safety. Examples of these services are air purification, urban cooling and mitigation of runoff. It is very complex to analyses which ecosystem service is most relevant in a given place and time. This depends upon the environmental and the socio-economic characteristics of the area (Gómez-Baggethun et al., 2012).

Examples of different urban ecosystem services

To clarify on the ecosystem services that address the urban area a few examples are given for each of the categories following the classification de Groot (2012). These examples can give an impression on how ecosystem services can contribute to human benefits in urban areas.

Provisioning services

Food supply: Food production in urban areas often takes place on rooftops, backyards, peri-urban fields and in vegetable gardens. Mostly cities only produce a small share of the food they consume. So cities depend largely on other areas for their food production (Gómez-Baggethun et al., 2012).

Water supply: Ecosystems provide the city with fresh water for human use by storing the water en by releasing it in flows. Vegetation and forests in the catchment have great influence on the quantity and quality of the water. Many cities are dependent on a large natural water resource for drinking water for the citizens (Gómez-Baggethun et al., 2012).

Regulating Services

Flood management: Ecosystems can act as a natural buffer in case of extreme weather conditions, like storm surges, waves, floods, hurricanes and hazards. Vegetation makes the ground more stable and can be a firm fundament to reduce the likelihood of landslides and damage caused by storms for instance ((Gómez-Baggethun et al., 2012 & Costanza 1997).

Runoff mitigation: Due to an increase of impermeable surfaces in cities the capacity of water to percolate in soils has reduced. That is why the volumes of surface water runoff have increased which results in a higher risk to flooding. Green infrastructure, trees and green roofs for instance can intercept rainfall and can percolate water, these means can reduce the amount of runoff water and the amount of pollution in water (Gómez-Baggethun et al., 2012).

Cultural services

Education and knowledge: Green spaces in urban areas give the opportunity for education and environmental development. This is of high importance for the development of local ecological knowledge (Gómez-Baggethun et al., 2012).

Cultural value and aesthetic: Several studies showed that living in the proximity of green areas results in a greater appreciation of the living area. With initiatives like eco-design; urban citizens can develop affinity with the ecological sites and the social cohesion in the community can be enhanced (Gómez-Baggethun et al., 2012).

Supporting services

Habitat for biodiversity: Urban areas can be a habitat for many different species. Green roofs, golf courses, the right climate conditions can for instance can contribute to fauna and flora support (Gómez-Baggethun et al., 2012).

In order to give a clear overview of the ecosystem services that are to be analyzed for this research an attempt is done to select the ecosystem services that are relevant in the light of the ecosystem services addressing the harbor cities of London & Rotterdam. The table 2.1 shows a short description of the different services based on the classification by de Groot (2012), the CICES classification and the literature on urban ecosystem services mainly by Gómez-Baggethun et al., (2012).

Category	Service	Definition	Example
Provisioning: *These are the products that are obtained from ecosystems*	Soil	Soil formation, sediment retention and accumulation of organic matter	Vegetation and soil fertility
	Energy production	Produce sustainable energy with forces from nature	Green energy, biomass, renewable energy
	Food and resources Production	The production of resources for human use.	Local food production, vegetable gardens
	Water supply	People obtain fresh water from ecosystems	Fresh water retention, desalination
	Coastal space for industry, development and infrastructure	Space in the coastal zone which is designed to carry new development	Land reclamation, multiple land use
Regulating*: These are the benefits obtained from the regulation of ecosystem processes*	Waste treatment	Processing waste and effluent,	Energy production from waste treatment, recycling, effluent filtering and nutrient fixation by urban wetlands
	Climate regulation	At different scales changes in land cover or sequestering can affect temperature and precipitation	Improve micro-climate in cities, carbon sequestration, shading by trees, green infrastructure
	Flood, storm prevention and coastal protection	Coastal ecosystems such as dunes, can reduce the damage caused by floods and storms.	Flood risk management, natural water banks, land supplementation, vegetation barriers
	Erosion and siltation control	Vegetative cover plays a key role in erosion and siltation control and prevention of landslides	Green vegetation on dunes, natural development of supplementation, root system
	Water purification	Purify the water for residential and industrial use with natural measures	Reed bed, filter bed, ecological remediation
	Water regulation	The timing and magnitude of runoff, flooding and aquifer recharge can be influenced through the design. Soil and vegetation can percolate water during heavy precipitation events.	Buffer zones, basins, sustainable drainage systems, hydrological flows,
Cultural*: These are the nonmaterial benefits*	Education/science	Learn from nature and managing ecosystems, provide a basis for formal and informal education, human shaping of socio-ecological systems	Learning-by-doing, knowledge building, allotment gardening as preservation of socio-ecological knowledge

people obtain from ecosystems	Aesthetic/spiritual	Beauty of nature that can give joy and pleasure to people	Sense of place, explicit value of the landscape, urban parks close to housing
	Recreation/tourism	Leisure activities for people, ecosystems with recreational values	Recreational nature area, walking and cycling routes in green infrastructure,
	Cultural heritage and identity	Traditional characteristics that give identity to a region	Historical sites and culturally significant species
***Supporting**: these services are those that are necessary for the production of all other services*	Maintenance of biodiversity	Maintain the living areas of flora and fauna to create and maintain their habitat and improve diversity	Habitat protection, ecological stepping stones to improve living space for flora and fauna, urban green spaces provide habitat for different species
	Nutrient cycling	Cycling of organic matter in natural ecosystems. Nutrients that is essential for life cycle through ecosystems.	Food chain, resources cycling
	Storage/ Retention	Temporarily store water for direct protection and/or later use	Water squares and retention areas with multiple functions

Table 2.1: Classification of ecosystem services for case study research.

2.5 Assessment and valuation of the Ecosystem Services approach

A first step towards a comprehensive assessment of ecosystem goods and services is the translation of the complexity of the ecology into a number of ecosystem functions. These services will provide the goods and services that are valued by humans (De Groot et al., 2002).
The concept of ecosystem functions aims to provide an empirical basis for the classification of useful aspects of the natural ecosystems to human values. So the key function is that the ecosystem functions can be reconceptualised into ecosystem goods and services when human values are implied. The key understanding in this process is that ecosystem functions have no value if they are not interpreted primarily as goods and services for humans. We as human beings are the translators of the basic ecological functions and processes into value-laden entities (De Groot et al., 2002).

Peterson et al. (2010) notice a move from the original emphasis on ecosystem services merely as an educational concept to create awareness and public interest among the people. In view of the conservation our natural capital and of the ecological biodiversity. Whereas now this has changed into an emphasis on how to convert ecosystem services into monetary values and commodities on potential markets.

Valuation and trade-offs

Ecosystem services are the consequences of ecosystem processes and components which humans considered to be valuable for their needs and desires. Only what is valued by humans can be regarded as an ecosystem service. Hein et al. (2006) argue that it is very important to consider the different perceptions of the stakeholders and the varying scales of the services in the valuation of ecosystem services. More attention is currently given in assessing the economic value of an ecosystem service.
Although it is beneficial to give ecosystem services an economic value because this value is highly determinant in decision making, the economic valuation also has limitations. First because many ecosystem services have no market price. The value of non-market ecosystem services is based on the perception of different stakeholders, who often have very diverging values. A fundamental point regarding this issue is brought forward by Sagoff (2011 p. 501,) in Hauck et al. (2013) “A science of ecosystem services that captures or measures economic production or value in ‘final biophysical units’ lies beyond our human potential. The ‘ecosystem services’ project is bound to fail in its attempt to

substitute an in *natura* calculus of value for the artifice of market price." The challenge of valuing ecosystem services increases even more when we realize that they are available at a range of ecological scales and that they are supplied to and by stakeholders at a range of institutional levels. (Hauck et al. 2013) However there is a great potential for ecosystem services to be integrated in policies and decision making processes, there is no simple or established way to do this. There are two major challenges which arise in the context of integrating ecosystem services in policy formulation and implementation. Namely the valuing of ecosystem services across scales and the trade-offs that occur when one ecosystem service is preferred over another (Cowling et al., 2008; Daily et al., 2009; Menzel and Teng, 2010) The Ecosystem Services Database (ESD) is an example of a design of an integrated knowledge base to support ecosystem services valuation. The ESD design will provide some important benefits for the analysis and the valuation of ecosystem services. The integrated and interactive approach has the capability to address the link between ecological and socio-economic data according to De Groot et al. (2002).

Another challenge in assessing the economic value of ecosystem services arises when we acknowledge that is generally not possible to value the different ecosystem services independently from each other. Ecosystems usually provide multiple (potential) services which are interlinked. In many cases an increase of one service can lead to a decrease of another service. Trade-offs can be deliberate, but they can also occur unintentional. These trade-offs might result from a lack of knowledge or understanding of the interactions between ecosystem services. Following Ring et al. (2010) Hauck et al. (2013) argues that trade-offs can also be interpersonal, where some lose and others gain.

The use of one ecosystem function may influence the availability of other functions and their goods and services. This is important to consider in determining and valuing the ecosystem functions. These functions should be determined under complex systems conditions (Limburg et al., 2002). "The ecosystem services do not always show a one-to-one correspondence, they are often interwoven in a complex network. A single ecosystem service can for instance be the product of two or more processes, or a single process contributes to more than one service. In analyzing the ecosystem services it is also important to understand that it takes place on different scales. There is the physical scale of the ecosystem and the scale at which humans value the provided goods and values. It is not a necessary condition that the two correspond." (De Groot et al., 2002) When we want to give value to ecosystem functions, then we should make clear what influence these inter-linkages and scale issues have.

Urban ecosystems present complex challenges in valuation that go beyond the general trade-offs between scale, resolution and accuracy. With urbanization, local ecological thresholds are crossed and ecosystem services in the city are lost. They are substituted by new, imported services from peri-urban areas and more distant markets. New possibilities in substitution have arisen due to new developments in technology, transportation and markets that can pose a solution for the crises in local ecosystems. These characteristics of urban development make it very complex to valuate local ecosystem services in long term planning for the urban area. The intensity of the demand, the substitution possibilities, the high heterogeneity and dynamism and the ecosystem disservices make the valuation and trade-offs of urban ecosystem services a very complicated task (Gómez-Baggethun et al., 2012).
It is clear that valuation and trade-offs in ecosystem services is very complex, this makes it difficult for policy makers. Although there are some findings that take in a different point of view. De Groot et al., (2010) explain in their article that nature conservation and conservation management strategies in other domains of public policy don't necessarily have to develop at the expense of one another. This does not have to lead to a trade-off between the 'environment' and 'development'. Managing conservation and the development of sustainable ecosystems can be regarded as a 'win-win situation' which can increase

ecological, social and economic benefits. This is the desired situation to which ecosystem services can contribute.

2.6 Mainstreaming the ecosystem services approach

Earlier in this chapter the implementation gap and the challenges following from this have been discussed. Although the ecosystem services are widely acknowledged in their contribution to a sustainable world which can give benefit to our human wellbeing, the operationalization of this concept appears to be easier said than done. There are several attempts that aimed to incorporate the ecosystem services approach into policy. Nowadays policy makers start to include the concept of ES in their guidelines and strategies. One example of this is the EU's new post-2010 biodiversity strategy which is announced in May 2011. In this strategy the ecosystem services are not only mentioned, but are also linked to specific targets (European Commission, 2011). The concept is increasingly being integrated in other policy fields as well. Such as sustainable land and water use, climate change mitigation, and ecosystem restoration (TEEB, 2010) The Water Framework Directive (WFD) can be seen as an example of a holistic approach to the conservation of the environment. The WFD sets out requirements and legislation and demands for a comprehensive management of river basin planning of water resources management in the EU.

The concept of ecosystem services has proven helpful in communicating the benefits of ecosystem conservation to diverse stakeholders. This is presumed to be because it provides a new, anthropocentric justification for conserving species and ecosystems, based on our dependence on the goods and services they provide (Lamarque et al., 2011). In addition scholars and practitioners hope that the concept of ecosystem services can render conservation economically attractive and commonplace. Lamarque et al. (2011) explains that there is a huge potential for the ecosystem service approach extending its scope beyond biodiversity conservation of the protected areas and to integrate the concept into the management of a wider landscape including privately owned land. This could for instance be done by payments for ecosystem services.

The potential to mainstream the ecosystem services approach has been recognized, but there are some difficulties that can cause a mismatch between legislative frameworks and the implementation of the approach in coastal zones. Holt et al., (2011) states that there is a disconnection between current policy and legislation that aims to conserve certain coastal ecosystems and the ambitions of the ecosystem services approach. The challenge according to Holt is to maximize the different benefits from ecosystem services and at the same time minimize conflicts between different subgroups of the people who benefit from them. Holt et al., (2011) emphasizes how important it is to analyze the disconnection between the current environmental policy and the aims of the ecosystem services approach. We need to identify the pivotal gaps and the mismatches, in this way we need to consider ways to address these issues. We must not forget that the ecosystem services approach is focused on the benefits humans derive from it. Therefore the different perceptions should be included in the analysis in order to prevent future conflicts which could become a restraint for policy initiatives in the future.

Current legislation is suitable for conserving certain values of coastal ecosystem services, but can in general not respond to the demands and perceptions of the people in relation to the human benefits from ecosystem services. Although Holt et al., (2011) are critical towards current legislation, they also emphasize legislation can be of great importance in protecting ecosystems, but it needs to focus on what people want from the system. This is difficult because of the many different perceptions, possible methods to incorporate the different perceptions of stakeholders into the decision-making process is for

instance through a participatory workshop. Networks of partnerships can increase the insight in the different perceptions and can increase the support base for decision-making.

2.6.1 Decision context

The decision context has many interacting characteristics. For example the public good, spatial scale, complexity and benefit dependence, if you combine all these features you will get a distinctive decision context. The nature of the interaction differs highly among in a decision context, this is of great importance for the measures that can be taken for ecosystem service management. The response that can be given is informed by some of the key characteristics of the given decision context or institutional context (Fisher et al., 2009). Hein et al., (2006) mention a characteristic of the decision context, namely that it is highly dependent on the different scales in ecological and institutional regard. Both scales have different borders and they hardly ever coincide. But in the end all the people, businesses and governments depend upon the benefits derived from ecosystem services.

Fisher et al., (2009) argues that the ecosystem services are very much linked to our social understanding and perceptions. For this reason it is very important to analyze the decision context in order to mobilize the concept of ecosystem services. In this sense the decision context can be explained as "the broad spectrum of processes which lead to social choices" (Fisher et al., 2009). These different spectra of processes will lead to different choices. Before making a choice on which strategy to follow with what tools and instruments, first decision makers should identify the characteristics of the decision context. This analysis can help to decide on which methods are most appropriate to use.

An example for such a decision context can be to use the ecosystem services as a means for education and to promote the awareness of the importance of ecosystem services for a greater public. This was especially a significant focus of the MA program, but also for governments who want to implement the ecosystem services in spatial planning understanding of the concept can be of paramount importance. For economic and landscape management purposes this decision context seems to be of less importance. In those cases are respectively valuation and the different scales and spatial characteristics of greater importance for decision-making (Fisher et al., 2009).

Fisher et al., (2009) concludes that decisions made on the basis of ecosystem services are very often social decisions. Science can tell us a lot about the characteristics of these services and on how to measure and value them. But the social processes tell us what perspectives are actually seen as important for our human wellbeing and what information is really used by the decision makers. Often society hasn't got enough information and understanding for long-term decision making. But there can also be circumstances that the scientific information might not be of importance for social decisions. This process of information and communication between the social decision makers and the scientists is very dynamic. Still there remain holes in the understanding that restrict decision makers to make well informed choices for the future. It is necessary for scientists to communicate their findings to the public and to the decision-makers.

2.6.2 Ecosystem services and urban planning:

In urban areas the stakes for decisions are higher in terms of spatial resolution and the scales of analysis. This leads to a higher importance of reliability of valuation because the support context for decision-making is more demanding. To incorporate ecosystem services into urban design a better understanding of the services and their interrelations in space and time is necessary to make the ecosystem services into an instrument for planning and design. This is a step further than only using it for assessment. There are multiple ways in which places of ecosystem services can relate to the places where people live and can derive benefit from it. Shading from a tree for instance can only be enjoyed at the specific place of the tree, but the impact and scale of other services like air purification spread out into a large area. The connection between the source of an ecosystem service and the actual use is intervened by social structures. There are numerous ways to provide people in different places with the same ecosystem services (Goméz-Baggethun et al., 2012).

Gómez-Baggethun et al. (2012) argues that urban ecosystem services can have a great contribution in improving the quality of life in urban areas. There is a large consensus that for example biodiversity has positive influence for the ecosystem services of the city. But there is still a large gap of knowledge in how different flora and fauna can improve ecosystem services in an urban area. The nature of our social-ecological systems are very complex, this complexity needs to be recognized in terms synergies and trade-offs between the different services. Urban ecosystem services also have a close linkage between social, cultural, ecological and economic values. One value can influence the other, so a loss of ecological qualities can affect the cultural value. The integration of these values is of high importance for the development of sustainable cities. By improving the social-cultural capital in a city, the sense of place and identity of the city can improve which can also lead to an increase of the ecological value. It works both ways, this is why it is so important to incorporate all values in valuing operationalizing the ecosystem services. For this operationalization we need tools and instruments to implement the ecosystem services into spatial planning.

Primmer and Furman (2012) emphasize in their article on operationalizing ecosystem service approaches that there is a mismatch between the demands of governments and the current paradigm of ecosystem services. This mismatch has emerged because a transition is initiated to go from sector governance to an integrated form of governance for the management of ecosystem services. This transition needs a fundamental shift towards a different form of governance in the opinion of Primmer and Furman. And further they state urban planning has shown that it is capable to identify the different ecosystem services, but challenges remain in the cross-comparison and the trade-off analysis. It is not possible to measure all the services and it is difficult to address the services that fall between multiple sectors. So the measurement and valuation of ecosystem services does not necessarily lead to an increased use of this knowledge. The mismatch between the decision context of the government and the ecosystem service paradigm can only be solved by developing a right set of tools. These tools should build on the provided knowledge and the agreements by governance, but communication across ecosystem and sectorial boundaries should be the main focus. Especially in urban planning when the boundaries of ecosystem services are difficult to recognize, communication is of paramount importance to close the implementation gap.

2.7 What tools are available in spatial planning?

In order to be able to establish a set of tools for implementing ecosystem services in planning practice, first the available instruments and tools will be analyzed. In this way an overview can be given of the possible tools that are available for implementing ecosystem services in spatial planning. As a result a table is given with a summarized overview of the tools that are currently available in spatial planning.

The collaborative approach plays a pivotal role in spatial planning especially in the Ecosystem Services Approach. It is important to engage the actors that are involved in the planning process in an early development stage. In this way the actors are actively involved in creating a constitutive change. This will likely create bigger support from the actors to voluntarily contribute to a better implementation of ecosystem services for the good of the sustainable spatial planning. People should be made aware of the consequences of the choices that they make in order to improve their human wellbeing. This can't be done at the expense of the ecosystem services, because at the long term this will lead to a decrease of the goods and services for human wellbeing.

Important to notice is that ecosystem services are often not the most profitable solution for many stakeholders. But those ecosystem services that are not so profitable can be of great importance for a sustainable environment. That is why policy makers should keep in mind that sometimes stakeholders are not willing to implement an ecosystem service. For these types of ecosystem services involuntary measures must be taken. In this way parties are more or less stimulated or forced to implement the desirable services. Voluntary measures aim to create a willingness to implement a less profitable ecosystem service. These measures must convince the stakeholders to collaborate for the higher goal of sustainability instead of achieving the highest profit. This is a change of perspective which will be hard to achieve, a good PR-program is necessary to convince all the stakeholders to aim for the same objective (Bressers, 2009 & Bressers & O'toole 2005).

Three types of tools can be distinguished following the literature; financial, communicative and regulatory tools. In the next three paragraphs these tools will be shortly explained and some examples of a possible use of the tool is provided.

Financial tools can be very helpful to achieve sustainability in long term planning and management. Different aspects of financing methods are of importance for the implementation of ecosystem services. The payment and financing methods must be feasible, this differs for each level of governance. It is also important to consider what costs should be included in the financial tool and who should pay for these costs. (de Groot et al., 2010) These are aspects that need to be analyzed before a financial tool is implemented. Financial tools can support certain stakeholders to collaborate in a project and address ecosystem services. Many ecosystem services cannot directly be valued in economic regard, financial compensation can make it attractive for stakeholders to contribute although the service itself does not render profit (Bressers & O'Toole, 1998)

Communicative tools are important for bringing together multiple perspectives in order to create consensus and support. A first condition for this type of integration is to share knowledge about the ecosystem services. Communication is the basis to share knowledge and results which should be accessible to all the people who have an interest in the issue. An example of such an initiative is the Ecosystem Service Database (ESD). Through this increased understanding of the issue it is important to create a consensus and support of the different stakeholders for the implementation of ecosystem services (De Groot et al., 2010).

Regulatory tools and legislation can serve as a strong fundament to regulate the management of ecosystem services. The European Commission for example has set up multiple legislative frameworks like the Water Framework Directive (WFD) in order to maintain and improve a 'good' quality of water. In this sense legislation can be a strong controlling measure to conform to the quality standards that are set out. Also impact assessments, multi-criteria analyses and cost-benefit analysis can give means to a government to have a penalty in case of crossing the requirements (Bressers & O'toole, 1998)

Table 2.2 provides a summarized overview of the different tools that are currently available in spatial planning. This table also contains who is involved in the decision-making and the operationalization of the tools. Also the aim of the tools are shortly pointed out and can give insight in how ecosystem services can be translated into tools for implementation.

	Who is involved?	Tools	Aim
Financial	- Governments - Businesses - Private stakeholders - European Union	- Subsidies - Funds - Tax - Penalties	- Stimulation to use less profitable ecosystem services that are more sustainable - Compensation for an ecosystem service - Discourage the use of contaminating products
Regulatory	- Governments - European Union	- Legislation - Permits - Impact assessments - Multi-criteria analyses - Cost-benefit analyses - Framework directives	- Regulation of the implementation of desirable services. - Controlled planning - Compliance to desired quality
Communicative	- Governments - NGO's - Private stakeholders	- Government campaigns - PR-programs - Educational program	- Create awareness and willingness to contribute - Create understanding - Improve knowledge and education

Table 2.2: An overview of the available tools and instruments that are available in spatial planning.

2.8 The Framework

The framework which is presented below in table 2.3 is constituted by dividing the ecosystem services into the four categories and by dividing these categories again into financial, regulatory and communicative tools. The framework will serve as a fundament for the comparative case-study research in the sense that it gives a frame for how ecosystem services can be implemented. With the aim to make an attempt in closing the implementation gap which has been analyzed in this chapter. The comparative case-study will be executed with the aim to analyze how the ecosystem services are currently addressed and to learn lessons from both cities in how to address these services. In the end of the comparison a wider understanding of how implementation of ecosystem services can be made possible in spatial planning will be established. With this framework an attempt will be made to identify the different categories of ecosystem services and the applicable tools. To combine the ecosystem services with the tools it is important to analyze who is involved in the implementation and to understand the objective of the tools. Also benefits and drawbacks will be shortly pointed out to reflect on the tool and its applicability.

Ecosystem Services	Who is involved?	Tools & Instruments	Aim	Benefits	Drawbacks
Provisioning					
Financial					
Regulatory					
Communicative					
Regulating					
Financial					
Regulatory					
Communicative					
Cultural					
Financial					
Regulatory					
Communicative					
Supporting					
Financial					

	Regulatory
	Communicative

Table 2.3: Framework of ecosystem services and tools in spatial planning

2.9 Conclusion

Current research on ecosystem services shows that there is a great basis of understanding from different programs on how the services can benefit for our human wellbeing. There are still some difficulties like the valuation and trade-offs between ecosystem services that make it more difficult to implement ecosystem services in spatial planning especially in urban areas this is an important challenge. This chapter has discussed the ecosystem services and has found that there is an implementation gap between the concept of the ecosystem services approach and the practical use of the services in the spatial planning practice. Ecosystem services can yield great benefits in spatial planning, but the mainstreaming in policy documents and the implementation of ecosystem services seem to be more challenging than expected. The first messages on ecosystem services were hopeful; the new idea has been adopted by many scientists, planners and policy makers in order to achieve a sustainable world. But the linkage between ecosystem services and different policy fields need more integration and collaboration than is currently taking place. A comprehensive approach is needed to solve the high pressures and changing circumstances in the coastal zones. The ecosystem services approach can be the solution to maintain the socio-economic and ecological values of this area.

What needs to be done is an incorporation of ecosystem services in spatial planning. Big steps have already been taken in mainstreaming the ecosystem services approach, but there are still challenges ahead of use in addressing the implementation of ecosystem services. At this moment the challenge is to bring the ecosystem services into action. The idea is clear, the framework in table 2.3 gives space to fill up how ecosystem services can be implemented by means of what tools. This framework can give a handle for implementing ecosystem services in spatial planning practice. The question remains for the empirical research; what tools can be appropriate to implement ecosystem services in spatial planning?

Chapter 3 Methodology

3.1 Case-study research

The reason to execute a case-study research is to answer questions that seek to explain a present circumstance. A case-study research is relevant the more extensive and in-depth the research on the phenomenon is. In this type of research there is a focus on contemporary events. To understand a real life phenomenon in-depth, this should be encompassed with important contextual conditions. Because the contextual conditions are highly pertinent to the phenomenon of study (Yin, 2009).

1. A case study is an empirical enquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.
2. The case study inquiry
   - Copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result
   - Relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result
   - Benefits from the prior development of theoretical propositions to guide data collection and analysis (Yin, 2009).

The literature review from chapter 2 is not there to determine the answers about what is known on a topic. But experienced researchers regard the review as a means to develop sharper and more insightful questions about the topic. In my chapter this has resulted in the insight that there is an implementation gap for ecosystem services in spatial planning. The importance of the implementation of ecosystem services has been widely acknowledged, but the practical implementation is still lacking behind. Therefore the theoretical chapter has resulted in a framework about what needs to be done to improve this. This framework has to be completed by insights from the comparative case-study.

“The essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result.” (Schramm, 1971, emphasis added, in Yin, 2009) In my case-study research between London and Rotterdam this is highly important to illuminate the set of decisions that are taken so far with regard to ecosystem services. The question is to what extent the ecosystem services are being implemented and what tools are available in planning to do this. With the information from chapter 2 it became clear that there is a lot of room to improve in the implementation of ecosystem services, that is why a comparative research can be valuable in giving new insights from different planning traditions (Yin, 2009).

3.2 Comparative case-study

A multiple case-study, in this research between London and Rotterdam, enables the researcher to explore differences and similarities within and between cases. The aim of this comparative research is to understand why these differences and similarities occur. It is essential in this research that based on the cases; the researcher can predict similar results across cases or predict contrasting results (Yin 2003, in Baxter & Jack, 2008).

By doing a comparative case-study research it is even more important to understand the context in which the implementation of ecosystem services takes place. Because in order to compare how ecosystem services are addressed in two different policies is highly influenced by the context of planning. The tools that are available in the spatial planning tradition in the country and in the city of research itself are the foundation of the possible implementation of Ecosystem Services.

The comparative research that will be undertaken in this research is therefore also focused on the tools that are available in planning. The tools that are suitable for the implementation of Ecosystem Services will be selected in the comparative analysis. In this way the context of how spatial planning is currently implemented can be taken into account. This is of great importance for the research of how to implement ecosystem services because the tools provide the practical context of how this can be done. Nonetheless this context of available tools is not restricting, it offers merely a framework and alternatives can certainly be introduced.

The comparison in this case-study research will be done by comparing how ecosystem services are addressed in London and Rotterdam on the different policy levels. There are three types of plans that will be compared, namely the strategic plan, the sectorial plan and the specific plan. For both London and Rotterdam one or more plans on each level has been analyzed to the extent, and the matter of ecosystem services that are addressed and a comparison is made. Also comparisons can be made between the different policy levels within the same planning context.

3.3 Policy content analysis

The content analysis is a method to analyze documents or other text documents. In this case policy documents will be analyzed with regard to the cases of London and Rotterdam in planning. The content analysis searches for quantitative data through categories, codes or indicators which are set beforehand in a systematic and representative way. In the theoretical framework a research is executed which provides a knowledge base to determine the categories or indicators which can be used for the policy content analysis (Bryman, 2001).

The objects of research for this content analysis are policy documents on the cases of London and Rotterdam. The aim of the analysis is to analyze if and how ecosystem services are incorporated in coastal planning in London and Rotterdam and by what means. Therefore a framework is set up in the theoretical framework to be able to assess how this is done so far and to be able to fill possible gaps. In chapter 2 a classification of ecosystem services and is conducted and a framework of possible planning tools is established. This is combined into one framework of ecosystem services and planning tools. This framework is now rather empty; the purpose of the content analysis is to fill this framework. In short, the aim of the policy content analysis is to come up with a set of tools of how ecosystem services can be implemented in planning by taking lessons from the cases of London and Rotterdam. The aim of this comparison is to result with a recommendation on what tools are best valued to incorporate ecosystem services in spatial planning.

The categories, codes or indicators that will be used in the content analysis will mainly be expressed in words and pieces of texts. These ‘codes’, which I will call them from now on, will be based on the ecosystem services and their characteristics. At first the codes will be based on the classification of ecosystem services provided in chapter 2. Once a code is recognized in the text, this piece of text will be interpreted and analysis will be executed on how this ecosystem service is implemented by means of a tool in planning. With this information the particular ecosystem service can be completed in the

framework. The aim is to eventually be able to fill in the framework and to have a picture of how ecosystem services can be filled in with what tools.

Secondly, the codes will be based on the tools that are available in planning, in which a table is also provided in chapter 2. In this manner an analysis is executed on which tools exist in the policy documents. The piece of text in which this code is recognized and it can be interpreted in what way an ecosystem service is possibly implemented through this particular tool.

In this way the policy documents will be analyzed from two perspectives. This will give a more holistic view on the ecosystem services that are implemented in the policy documents. A one sighted coding only with regard to ecosystem services can overlook some services that are executed but are not explicitly mentioned as ecosystem services. This is a great difficulty in the research. Ecosystem services are widely acknowledged to be of significant value in planning, but they are not always mentioned very explicit and direct. A lot of indirect indicators for ecosystem services can occur in the policy documents. To be able to cover a wide array of indicators I choose to take this two-sighted research. In this way ecosystem services which are hidden can be found if they are expressed in tools. Indirect ecosystem services will remain difficult to assess though. In order to better assess the indirect services, a list of examples can be made to recognize indirect ecosystem services in the text.

The research always contains a degree of interpretation. How an ecosystem is addressed and how tools are really implemented is not always mentioned directly. Sometimes a mix of services can also occur, there can be overlap. It will be very interesting to assess such an overlap. An overlap points at a certain degree of incorporation of the services.

3.4 Qualitative research with Atlas TI

The acronym CAQDAS, Computer Assisted Qualitative Data Analysis is broadly known as software which is designed to assist the analysis of qualitative data. Software under the CAQDAS umbrella takes on a qualitative approach to qualitative data. This data includes text, visual and multimedia forms of non-numerical information. A qualitative approach often includes the need to interpret data through the identification and possibly coding of themes, concepts, processes, contexts etc. This is in order to build explanations or theories or for instance to test an existing theory (Lewins & Silver, 2007).
Atlas TI is used as software to conduct this qualitative policy content analysis because it is a powerful program to analyze large bodies of textual, graphical, audio and video data. In this case large bodies of textual data will be analyzed. Atlas TI offers a variety of tools for accomplishing the tasks associated with any systematic approach to unstructured data. In this research it is mainly the aim to recognize ecosystem services in the text in order to be able to assess how these ecosystem services are incorporated in the policy documents at different scales. The program helps to explore the complex phenomena that are hidden in the data. Atlas TI helps to focus on the analyzed materials and it offers tools to manage, extract, compare, explore and reassemble meaningful pieces from large amounts of data in creative, flexible, yet systematic ways (*Source: Atlas TI manual*).

3.5 Policy documents

A selection is made of policy documents for the cases of London and Rotterdam. In this selection a few criteria have been taken in mind. The selected documents are regarded are representative, authentic and credible. The policy documents are executed by governmental parties, authorities or agencies with a leading position in the field of planning. The documents are divided in the scope of the plan. First the strategic plans will be analyzed to see how ecosystem services are addressed at this top level of policy

documents with a focus on the structural vision on spatial planning. Secondly the sectorial plans will be conducted to an analysis. These sectorial plans include topics on water and the (natural) environment with the main focus on water. The choice for water is made because this is a very influential aspect in the coastal zone. Due to diverse developments in the recent past, water has created high pressure on coastal cities and it also has a huge potential of incorporating ecosystem services. Thirdly specific policies about delta and coastal management will be analyzed. Both London and Rotterdam are situated in a delta area; the estuary is the prime linkage of the city with the sea. This geographical situation poses great challenges and opportunities for the city. Due to this importance of the special situation of London and Rotterdam the plans on how to deal with this delta network are analyzed and compared in this research. The management of the rivers, the catchment area and the estuary determine to a large extent how the harbor and the urban areas in the proximity are able to function. In table 3.1 an overview is presented of the selected policy documents of London and Rotterdam. The table shows what documents are used in this comparative analysis and tells what government, authority or agency is involved in the realization of the plan. What follows is a short description of each plan to inform on its aims and its decision context.

Rotterdam

Strategic

The *Ruimtelijk plan regio Rotterdam 2020* (RR2020) and the *Groenblauw structuurplan regio Rotterdam 2011-2020* are the strategic plans of Rotterdam that are used for comparison. The RR2020 is established in 2005 by the province of South-Holland as a regional plan in collaboration with the city-region of Rotterdam which has set it as a regional structure plan. The territory of this plan stretches to all the municipalities that belong to the city-region of Rotterdam. This regional structure plan has evolved from the law on spatial planning (Wet op de Ruimtelijke Ordening WRO). In this policy document the province defines its policy on spatial planning for the area. This plan is obligatory for the city-region of Rotterdam and will become legally binding for citizens and private parties if they are adopted and implemented in the zoning plans of the municipality. The province will control if the municipalities comply to the policies in the RR2020, the city-region gives advice to the province in this assessment. The responsibility of the implementation of spatial development is in the first place in the hands of the municipalities. The province and the city-region give the conditions to which the municipalities must conform. The Groenblauwe structuurplan is established by the city-region of Rotterdam and has also derived from the law on spatial planning.
Due to the new law on spatial planning (nWRO) in 2008, the planning authority of the city-regions has expired. The provincial structural vision now replaces the RR2020 as planning framework. So the judicial context has changed in recent years, but the content of the plans is still highly topical and is mostly covered in the new plans as well. The Groenblauwe structuurplan has been revised in 2011 due to developments in spatial planning and the judicial framework. This plan can be regarded as a further policy development of the provincial structural vision in the region of Rotterdam. The plan will serve as a self-binding agreement by the region and the province (Ruimtelijk plan regio Rotterdam 2020, 2005 & Groenblauw structuurplan regio Rotterdam 2011-2020, 2011).

Sectorial

The *Waterplan 2* and the *Groen, water & Milieu in beeld 2010: Water* (GWM) are the two sectorial plans that are analyzed. The Waterplan is composed by the water boards in the region in collaboration with and on behalf of the municipality of Rotterdam. This Waterplan is a renewal of the first Waterplan and is composed in a reaction to the developments in policies on water management by the EU and national

and regional governments. The municipality and the water boards state that there is a high awareness among them that water and spatial planning are interrelated. That is the reason why this plan focuses on an integration between spatial design and the management of water resources. This policy document also contains a realization strategy with an implementation program that sets out what needs to be done in the next five years. The Waterplan 2 provides frameworks, a vision and a detailed program of measures to be taken in the water management. Over the years this plan has become a forum for the diverse partners in water management with space for discussion and consultation. To secure that the vision of the Waterplan will be implemented a program will be established in which the municipalities, water boards and spatial planners will be integrated. The GWM 2010 plan contains measures for spatial development of the nature, water and environment management in the province of South-Holland. The plan focuses on the water management and can be seen as a spatial treatise of the water policies in the province (Waterplan 2, 2007 & GWM in beeld: water, 2010).

Specific

The *Deltaprogramma 2012* and *the concept Strategische Agenda Kust Zuid-Holland 2010* are the two specific plans on delta and coastal management that are conducted to a policy document analysis. The Delta program is a national program; national government, provinces, municipalities and water boards collaborate with contributions of public organizations and private parties. The plan is set by the national government. Many decisions that are made in the management of water in the delta are political, the Delta program translates these political conclusions into a comprehensive plan. The planning of necessary measures and services are part of the program. The Delta program develops itself into a more concrete plan for water management. The strategic agenda for the coast of South-Holland consists of the provincial ambitions for the future of the coastal area. With this agenda the province aims to give substance to a climate resilient and sustainable land use, in order to contribute to the national Delta progra. (Deltaprogramma 2012 & Strategische Agenda Kust Zuid-Holland 2010).

London

Strategic

The London Plan is the plan at a strategic level that is analyzed for the comparative case study research. The London plan is established by the Greater London Authority (GLA) and is named as a spatial development strategy for greater London. In the foreword the Mayor of London states that this plan focuses on strategic planning that is of London wide importance and it does not try to manage aspects that can better be sorted out locally. It sets clear outcomes, but it also allows for flexibility and doesn't constrain policy makers with strict targets. 'Strategic planning in London is the shared responsibility of the Mayor of London, 32 London boroughs and the Corporation of the City of London.' (The London Plan, 2011, p. 10) The London Plan is the spatial development strategy and falls under the legislation that the GLA has established. The local development documents of the boroughs have to be in 'general conformity' with the London Plan. This plan is also part of the development plan, this plan has to be taken into account when decisions in London are taken. The general objectives for the London Plan and the processes of setting up are set out in the Greater London Authority Act 1999 (The London Plan, 2011).

Sectorial

The two sectorial plans are the London water strategy (2011) and Water, for people and the environment (2009). The London water strategy is established by the Greater London Authority. This water strategy is part of a series of strategies that together want to make London the best big city in the world. It is a

strategic framework to improve the living conditions in London and to protect the environment. This water strategy complements other plans and strategies and presents a water management specific to London. This plan aims to improve the water management and wants to influence future development (London water strategy, 2011).
The plan 'Water, for people and the environment' gives a strategy for water resources for England and Wales and is established by the Environment Agency (EA). This strategy is set out for England. The Environment Agency has the job to look after the environment and making it a better place. The agency is a non-departmental public body that is responsible for the implementation of government policies. This agency collaborates with business, government and the society as a whole. The strategy sets out how the water should be managed in the view of the Environment Agency. The Agency explains its responsibility as the following: 'The government has given the Environment Agency the duty to conserve, manage and secure the proper use of water resources in England and Wales. We are the central body with responsibility for long-term water resources planning.'(Water, for people and the environment, 2011, p. 6) The document provides a direction for the management of water in England (Water, for people and the environment, 2011).

Specific

For the specific plan the Thames Estuary 2100 and the River basin management plan is analyzed. The Thames Estuary 2100 plan is the replacement for the Shoreline Management Plan (SMP) in the London region and is also established by the Environment Agency. The document sets out recommendations for flood risk management in London and the Thames estuary to the year 2100 and beyond. This plan is the first major flood risk management plan to incorporate climate change adaptation as a core issue. The plan also contains an Action Plan which has been designed to support and facilitate an approach to engage multiple partners in securing a successful implementation of the Thames Estuary 2100 plan (Thames Estuary 2100, 2012).
The river basin management plan was conducted in December 2009, by the Environment Agency and the Department for Environment food and rural affairs. The Department for Environmental food and rural affairs is a ministerial department of the UK government and is responsible for policy on environmental, food and rural issues. The river basin management plan investigates on the pressures that the water environment faces in the river basin district of the Thames and sets out actions to manage the water resources. It is established under the Water Framework Directive and this plan is the first of a series of six-year planning cycles. In establishing this plan the Environment Agency has collaborated extensively with local stakeholders (River basin management plan, 2009).

Policy document	Rotterdam		London	
Strategic plan	Ruimtelijk plan regio Rotterdam 2020	December 2005, door de provincie Zuid-Holland en de stadsregio Rotterdam	The London Plan, Spatial development strategy for Greater London	July 2011, by the Greater London Authority
	Groenblauw structuurplan regio Rotterdam 2011-2020	Oktober 2011, door de stadsregio Rotterdam		
Sectorial plan	Waterplan 2 Rotterdam, werken aan water voor een aantrekkelijke stad	Augustus 2007, opgesteld in opdracht van gemeente Rotterdam, waterschap Hollandse Delta, Hoogheemraadschap van Schieland en de Krimpenerwaard en Hoogheemraadschap van Delfland.	The London water strategy: securing London's water future, The mayor's water strategy	October 2011, by the Greater London Authority
	GWM in beeld 2010: Water	2010, door de provincie Zuid-Holland	Water, for people and the environment	Water resources strategy for England and Wales, March 2009, by the Environment Agency
Specific plan	Deltaprogramma 2012: Werk aan de Delta, Maatregelen van nu, voorbereiding voor morgen	September 2011, een uitgave van het ministerie van Infrastructuur en milieu en het ministerie van Economische Zaken, Landbouw en Innovatie	River Basin Management Plan: Thames river basin district, Water for life and livelihoods	December 2009, by the Environment Agency and the Department for Environment food and rural affairs
	Concept strategische agenda kust Zuid-Holland	Oktober 2010, een uitgave van de provincie Zuid-Holland	Thames Estuary 2100, Managing flood risk through London and the Thames estuary	November 2012, by the Environment Agency

Table 3.1: Overview of policy documents of Rotterdam and London which will be qualitatively analyzed through AtlasTI.

3.6 Coding

In this research ATLAS.ti (version 7.0) is used for the policy document content analysis. With this program for analyzing qualitative data the aim is to operationalize the conceptual framework that is developed in Chapter 2. The Hermeneutic Unit (HU) is the basic structure of the program. The HU, or idea container, consists of everything what is relevant to a particular project or research topic. ATLAS.ti can be operated in two principal modes, the textual-level mode and the conceptual-level mode (van den Brink, 2009). For my research I used the textual-level mode in order to recognize aspects of ecosystem services.

There are basically two types of coding. The first is coding in vivo, these codes apply to the codes that are found in the text itself. The second type of coding is in vitro, in which the researcher constructs codes from the text. Another important tool at this textual level of the data analysis is the 'family' tool. The point of creating a family is to manage large numbers of objects and to classify them into subsets. In this way families can help to cluster documents, memos and codes and to get a clearer overview of the entire project (van den Brink, 2009).

The textual-level research includes segmenting the documents into quotations, adding comments or memos to passages and in the end coding the selected passages to facilitate the analysis. This coding phase is the most important phase of the analysis in the textual-level mode. Because codes capture the meaning in the data and they can be used as a classification. In my research I basically used the classifications from the theoretical background to get a renewed classification of what is available in the policy documents. With this classification a comparison can be made between London and Rotterdam and how they implement ecosystem services. New insights can arise from these classifications of how ecosystem services are addressed in policy documents and what tools are currently available in planning (van den Brink, 2009).

For the coding frameworks that will be used in Atlas.ti, at first four families consisting of the four basic categories of ecosystem services that are common in literature are constructed. To know: Provisioning services, regulating services, cultural services and supporting services. Within each family codes were created based on the tables above in the methodology. These codes can be adjusted during the process if new information is added. For each code an investigation for words which gave an indication of the existence of the code in the text was executed. The research was aimed to find specific words with regard to the different services. This research was done by searching on the internet, by scanning the documents and with the available knowledge on the subject. The tables 3.3 and 3.4 are the result of all the codes with the specific words which will be used to recognize the different ecosystem services and tools in the policy documents.

The coding was started based on the coding frameworks that have been established. In these frameworks it is written down what the key words are in which the four categories of ecosystem services and the different tools can be recognized. These codes stem from the literature research and from other empirical research done with regard to ecosystem services such as Hauck et al., (2013).

Further a second coding was executed which is also based on the conceptual framework form chapter 2, but in this case with regard to the tools that are available in spatial planning. Based on the literature review a framework could be established based on a division of basic planning tools into financial, regulatory and communicative tools. Based on the literature codes have been added to these tools which can be seen as the practical implementation of the framework. These also serve as a way to recognize the different tools in the policy documents.

The purpose of coding is to qualitatively analyze the policy documents and to find how ecosystem services are addressed in these policy documents and by which tools. This qualitative data analysis will be executed by means of the ATLAS.ti program. With this program the policy documents will be analyzed with the codes which have been established from the conceptual framework. In table 3.2 an overview is given of the different steps that are taken in the analysis with Atlas.ti.

Bottom up approach of the research	Conceptual framework	Analytical strategies	Method	Chapter
Step 1	Situational actor/ researcher experiences	Selection of cases, collecting policy documents	Research	
Step 2	Selection of data per city	Creating a Hermeneutic Unit in Atlas.ti. Making document families	Coding	3
Step 3	Reading policy documents	Reading data, writing memos. Try-out coding	Atlas.ti	3
Step 4	Language coding of policy documents	Coding in Atlas.ti, using the auto coding dialogue with the coding scheme as the fundament	Coding	3
Step 5	Creating output of coding	Coding in Atlas.ti,: use the family tool and network manager to create output	Describing output in text	Results, chapter 4
Step 6	Analysis of textual output	Completing comparative case-study for London and Rotterdam	Textual analysis	4

Table 3.2 : Interpretative moments of the qualitative research with Atlas.ti (Adjusted by myself, taken from Van den Brink, 2009 in Visser, 2012)

Coding Frameworks

Family	Codes	Specification	Dutch translation
Provisioning	Soil	Soil fertility, soil, earth crust, vegetation, land contamination, pollution, nutrient, medium, subsidence	Bodem, vruchtbaarheid, voedingsbodem, bodemverontreiniging, aardkorst, vegetatie, vervuiling, voedingsmedium, bodemdaling
	Energy production	Energy, green energy, biomass, efficiency, wind, solar, hydro energy, hydroelectric, power, energy, renewable, waste/residual/surplus heat, durable, sustainable, wind turbine	Energie, groene energie, biomassa, efficiënt, wind, zon, waterenergie, waterkrachtcentrale, kracht, energievoorziening, duurzaam, restwarmte
	Food and resources Production	Product, raw materials, food, farming, agriculture, process, make, manufacture, produce, horticulture, greenhouse, sustainable, durable, fishery, iron ore, refinery	Product, grondstoffen, voedsel, landbouw, agricultuur, proces, maak, fabricage, vervaardigen, glastuinbouw, duurzaam, visserij, ijzererts, raffinage
	Water supply	Water, fresh water, purification, groundwater, drinking water, surface water, water purification, blue, teal, green blue, water test, residential, industrial, desalination, water quality,	Water, zoetwater, grondwater, drinkwater, oppervlaktewater, waterzuivering, blauw, groenblauw, watertoets, zoetwater retentie, residentieel, industrieel, ontzilting, waterkwaliteit,
	Coastal space for industry, development and infrastructure	Space, construction, site, coastline, port, industry, infrastructure, transport, harbor, terminal, marine, platform, bridge, tunnel, coastal agriculture, accessibility, maritime, land reclamation, main waterway,	Ruimte, bouw, constructie, plaats, kust, haven, infrastructuur, transport, industrie, terminal, marine platform, brug, tunnel, kust-landbouw, bereikbaarheid, maritiem, ontsluiting, landaanwinning
Regulating	Waste treatment	Waste, incineration, combustion, neutralization, removal, discharge, storage, disposal, waste products, harmful, waste management, sanitation, dilution, assimilation, chemical re-composition, recycling, pollution, sewerage, dumping, effluent, biomass, sludge, composting	Afval, afvalverwerking, verbranding, neutralisatie, afvoer, opslag, weggooien, verwijderen, afvalproducten, schadelijk, afvalbeheer, sanering, verdunning, assimilatie, chemisch, hergebruik, verontreiniging, riolering, scheiden, recycling, lozen,
	Climate regulation	Climate adaptation, climate change, sea level, temperature, average, carbon footprint, gas regulation, co2 neutral, balance, ozone layer, degradation, air quality, particulate matter, fine dust, atmosphere,	Klimaat, adaptatie, klimaatverandering, zeespiegel, temperatuur, gemiddeld, gas-regeling, co2 neutraal, ozonlaag, koolstof sekwestratie, opslag
	Flood, storm prevention and coastal protection	Flood, risk, storm, prevention, protection, control, coastal, dike, reinforcement, seawall, storm surge, shelter belts, coastal defense, inundation, outside the dikes, evacuation, emergency plan, supplementation,	Overstroming, risico, storm, vloed, regen, preventie, bescherming, controle, kust, dijk, versterking, verdediging, zeewering, windsingels, inundatie, overlast, waterveiligheid, compartiment, evacuatie, noodplan, suppletie,
	Erosion and	Soil erosion, prevention, island, green	Bodemerosie, preventie, eiland, groene

	siltation control	vegetation, duinen, soil retention, arable land, maintenance of productive soils, root system, foliage, compaction, plants, shoreline, sediment, supplementation,	vegetatie, duinen, bodem, bouwland, onderhoud van productieve bodem, wortel systeem, bladeren, verdichting, planten, kustlijn, sediment, suppletie
	Water purification	Artificial wetlands, water purification, pollution control, ecological remediation, water storage, river ecological restoration, eco-control of rivers, water source protection area, filter, dredging, reed bed, saltmarsh, filter bed, discharge	Kunstmatige watergebieden, waterzuivering, bestrijding van verontreiniging, ecologische sanering, waterberging, rivier ecologisch herstel, eco-controle van de rivier, waterbron, beschermingszone, purificatie, filter, bagger,
	Water regulation	Mitigation, softening, buffer, reduce, reduction, offset, compensation, mitigation, relief, alleviation, regulation, adjustment, normal condition, provision, standard, hydrological flows, drainage, irrigation, aquifer, stream, filter, basin, atrium, rain water, precipitation, fluctuation, drain, outlet, permeable, watercourse, catchment, river, runoff, tributary, estuary, delta, aquifer, discharge, watershed	aanpassing, normale toestand, water purificatie, Mitigatie, verzachting, mitigeren, buffer, verminderen, reduceren, reductie, compenseren, compensatie, leniging, verlichting, water regulatie, hydrologische stromen, drainage, irrigatie, aquifer, watervoerende laag, stroom, filter, doorstroming, boezem, bassin, hemelwater, fluctuatie, afvoer, regenwater,
Cultural	Education/science	Education, science, learning, development, research, training, doctrine, process, course, knowledge, teaching, expertise, field laboratories, excursion, monitoring, cognitive, reflective, evaluation,	Educatie, wetenschap, leren, onderwijs, ontwikkelen, onderzoek, research, vorming, leer, proces, cursus, opvoeding, kennis, expertise, veld laboratorium, excursie, monitoring, cognitief, reflectief, science, evaluatie,
	Aesthetic/spiritual	Aesthetic, spiritual, beauty, nature, green, value, landscape, feeling, sense, tasteful, clean, spiritual, spirit, soul, incorporeal, unique, pretty,	Esthetisch, spiritueel, schoonheid, natuur, groen, waarde, landschap, gevoel, smaakvol, schoon, geestelijk, ziel, onlichamelijk, beleving, mooi, uniek,
	Recreation/tourism	Recreation, tourism, leisure, pastime, spending, outdoors, scenery, relaxation, fun, enjoy, entertainment, recreation, vacation, tourists, travel, walking, hiking, fishing, swimming, camping, eco-tourism, sea sports,	Recreatie, toerisme, vrije tijd, besteding, openlucht, landschap, ontspanning, plezier, vermaak, tijdverdrijf, vakantie, toeristen, reizen, entertainment, wandelen, vissen, zwemmen, kamperen, eco-toerisme, watersport
	Cultural heritage and identity	culture, history, identity, heritage, historical site/building, folk, festival, archeology, traditional, characteristic, authentic	cultuur, historie, geschiedenis, identiteit, erfgoed, heritage, locatie, gebouw, festival, volks, archeologie, kenmerkend, karakteristiek, belvedère status, traditioneel,
Supporting	Maintenance of biodiversity	Biodiversity, flora, fauna, wildlife, animals, plants, rich, species, types, habitat, biotic, a-biotic, fish, population, variation, range, biological, ecological system, diversity, ecological network, ecosystem, organic, refugium, nursery, living space, breeding, nursery, fish population, reserve, sanctuary, roosting, feeding, marsh, conservation	Biodiversiteit, flora, fauna, dieren, planten, rijk, soorten, habitat, biotisch, a-biotisch, visstand, vis, variatie, biologisch, ecologisch systeem, verscheidenheid, ecologische hoofdstructuur, bescherming, biotoop, kweken, schuilplaats, broeden, getijdennatuur, visstand,

	Nutrient cycling	Food chain, ecosystem, recycling, circuit, food, nutrients, supply, provision, resilience, maintain, elements, minerals, organic matter, algae, migration, robust,	Voedselketen, ecosysteem, kringloop, voeding, voedingsstoffen, voedselvoorziening, voorziening, accumulatie, organisch materiaal, bodemvorming, sediment, veerkracht, organische stof, algen, migratie, mineralen, robuust,
	Storage/ Retention	Storage, store, stock, retention, restrain, delayed release, dispense, hold, temporarily absorb, drain, drainage, collect, capture, atrium, capacity, basin, water drainage, artificial, reservoir,	Opslag, bewaren, voorraad, Retentie, terughouding, ophouden, vertraagd afgeven, vasthouden, tijdelijk opvangen, afvoer, waterafvoer, Retentie, terughouding, ophouden, vertraagd afgeven, vasthouden, tijdelijk opvangen, afvoer, waterafvoer, berging, capaciteit, bekken,

Table 3.3: Ecosystem services framework

Tools coding framework

Family	Codes	Specification	Dutch translation
Tools	**Financial**	Money, subsidy, fund, tax, stimulation, profitable, compensation, public-private, partnership, financial, fee, cooperation, economic stimulus, entrepreneur, budget, cost-benefit analysis, investment, fine, grant, pricing policy, deal, tariff, trust,	Geld, financieel, subsidie, fonds, belasting, stimulans, winstgevend, compensatie, publiek-privaat, partnerschap, samenwerking, economische impuls, ondernemer, euro, vergoeding, budget, kosten-batenanalyse, investering, boete, prijsbeleid
	Regulatory	Legislation, regulation, license, law, rule, permit, impact assessment, multi-criteria analysis, regulatory, mitigation, environmental, EIA, norm, standard, EIA, quota, legal, directive, mandatory, buffer, test, regime, analysis, zoning plan, land use plan, covenant, agreement, voluntary agreement, contract, compensation, restriction, license, appraisal,	Wetgeving, regelgeving, vergunning, effectbeoordeling, effectrapportage, multi-criteria analyses, regulerend, regelgevend, reglementair, mitigatie, compensatie, milieubescherming, MER, norm, quota, juridisch, richtlijn, MIRT, verplicht, toets, buffer, methodiek, regime, analyses, convenant, afspraak, contract, bestemmingsplan,
	Communicative	Government campaign, PR-program, public relations, awareness, willingness, public support, NGO's, consensus, communication, information, forum, involvement, resident, user, voluntary, consultation, platform, media, attention, publicity, education, lobby, workgroup, public-private, partnership, awareness, behavior change, liaison panel,	Overheid campagne, PR-programma, publieke relaties, betrekkingen, public relations, bewust, besef, bereidwilligheid, bereidheid, publieke support, ondersteuning, NGO, consensus, overeenstemming, draagvlak, communicatie, forum, participatie, informatie, betrokkenheid, inwoners, gebruikers, vrijwillig, overleg, platform, media, aandacht, publiciteit, voorlichting, lobby,

Table 3.4: Tools coding framework

Chapter 4 Comparative Analysis

For the analysis of the practice of the Ecosystem Services Approach in coastal planning the harbor cities of London and Rotterdam will be investigated. This is done in order to get an understanding of how current planning incorporates the notions of Ecosystem Services and how this is implemented in decision making.

London & Rotterdam are both harbor cities and have dealt with the benefits and drawbacks of being a major economic driver in the coastal zone. They also both have a great history in spatial planning. The planning systems in the Dutch and the British institutional context have developed significantly in the last century. Especially in the last decades a lot of developments have occurred in planning practice.

4.1 Institutional Context

London

The UK has a planning tradition of land use management. In this planning tradition there are no general rules, local planning is negotiable. This means that there is a limited role for the government. In the Dutch planning tradition the main role of the government is to protect individual rights. This is very different from the UK approach in which the government supervises. The only guarantee is that there will be a negotiation. Planning in the UK is about influencing change, this is what they call development. There is some development control by planning permits of a local planning authority. Without a planning permit you cannot obtain the right for a development. This is very different from the Netherlands, in the Netherlands ownership means that you can develop your land as well. This is your fundamental right if you own a piece of land, in the UK this is different. Ownership in the UK is no monopoly on the use of land; you still need a right for development. These characteristics of the UK planning system make it challenging to implement Ecosystem Services in planning practice because it is all based on negotiation. Negotiation also incorporates a notion of uncertainty, it is dependent on the interests of private stakeholders. There can be various possible outcomes of the process of negotiation, a shared solution is often difficult to establish and implement. A central tenet in the process of negotiation is to create a basis of support for the overall best solution. Creating awareness and willingness under private owners to collaborate seems to be key to establish a sustainable coastal zone.

The UK planning system can be described with three main characteristics. One characteristic is the involvement of public and private actors in negotiating planning projects. Another characteristic includes the potential to increase planning successes, to package interests, and to redistribute values. For example profits from commercial development can be used for the benefit of local infrastructure including parks. The idea is that private parties take on an extra obligation within their project to compensate for the environment. With the commercial benefit they gain from their development they can invest to improve the area in which the development takes place. A third characteristic is that planning in the UK is very development-oriented and political (Janssen-Jansen & Woltjer, 2010).

In the Thames Gateway where London is situated, there is a lot of spatial development in the coastal zone. The gateway is used extensively and a great urban expansion has taken place in the past and expansion is still going on. A lot of the spatial development is done by private owners. The water defense mechanisms are managed by individuals and are established through negotiation instead of control by a public body. This is the heart of the planning practice in the UK and in the case of London. This planning tradition has benefits and drawbacks with regard to the Ecosystem Services Approach which will be discussed in the comparative study (Lavery & Donovan, 2005).

Figure 4.1 below shows a satellite photo of the Thames estuary in which London is situated. This estuary narrows down and becomes the Thames River when it approaches London. The river runs through and forms a river basin with London as main city in this area. The London area is very dependent on the Thames river for their harbor activities, water supply and for natural and cultural functions. It can be said that the greater London area is very much influenced by the Thames estuary in social, economic and ecological aspects.

Figure 4.1: Satellite photo of the Thames estuary (http://www.geodus.com/en/kent-thames-estuary-map-planet-observer_POZGB05.htm)

Rotterdam

In the Netherlands there is a comprehensive integrated approach in planning tradition. The planning system is a systematic and formal hierarchy of plans; it is a public sector investment. The government has a high responsibility and many planning issues are governed top-down. In recent years decentralization took place and there was a shift towards governance instead of government. But still a major responsibility belongs to the government. The main task of the government is to secure the citizens of the Netherlands of safe and good living conditions. The planning practice in Rotterdam is also focused on this principle, though the responsibilities are now more divided due to the subsidiarity principle. The Dutch planning is now moving away from regulatory planning to a development oriented planning. This also has major consequences for the planning practice in Coastal zones such as Rotterdam. It is very interesting to see how this development takes place and what the impact is on the implementation of the Ecosystem Services Approach. Figure 4.2 shows the situation of Rotterdam in the Rhine-Meuse Delta. The water from the rivers and the location close to the sea is very important for the city of Rotterdam and the region. The harbor is of great economic value and therefore it is very important that the new challenges that are imposed on the area can be managed in an integrated way. With a comprehensive approach the values and qualities of the area can be maintained and can be improved for our human wellbeing.

Figure 4.2: Satellite photo showing the Rhine and Meuse Delta of Rotterdam. With at upper the left the Europoort and Hoek van Holland, on the right you see the city of Rotterdam (http://rhine.riverama.com/rhine-netherlands.php)

Dutch spatial planning has recently made a shift towards a more action-oriented approach. Still this shift has not been easy. Regional plans typically do not aim to actively shape investment, but they function largely as testing and legitimacy framework for project proposals. This has for years been the way in which the Netherlands executed spatial planning, by setting up legislative frameworks and zoning plans which gave restrictions for future developments in their desired direction. In the Netherlands alternative ways of planning instruments have been discussed in new plans on spatial planning. Dutch planning currently reflects a strong awareness of the need for a more balanced and sustainable spatial development with flexibility for future development. But there is increasing attention for market involvement to resolve planning problems instead of the state (Janssen-Jansen & Woltjer, 2010).

In the Dutch planning system there is a high demand for project coordination because planning often takes place in areas larger than municipalities and smaller than the state. A comprehensive approach is therefore desired in Dutch planning practice. Traditionally the public sector is largely involved in the spatial planning. This is the result of French rule from the past, this rule prescribes that the national government guarantee legal protection for individual interest. This public sector involvement and responsibility still plays a pivotal role in the planning culture nowadays. Another aspect of the Dutch planning system is that planning projects do not formally take the form of a negotiable agreement, although there is interest to move in that direction. Generally developers have to make plans that fit in the legislative framework and are conforming to local and regional spatial plans. These binding frameworks make it difficult to innovate and to carry out alternative solutions. The Dutch planning system highlights protection in a very standardized way of considering projects and there is little discretion in projects. Currently a change is wanted in the Dutch planning culture towards spatial planning that is focused on project coordination, partnerships between public and private parties and more discretion and flexibility (Janssen-Jansen & Woltjer, 2010).

4.2 Comparative Analysis Ecosystem Services

After having an understanding of the background of the spatial planning context of London and Rotterdam, we will now proceed to the comparative analysis of the case studies. This comparison will be executed on three different levels of plans. The first plan is the strategic plan, followed by the sectorial plan, and the specific plan on delta and coastal management. For each type of plan will be analyzed what ecosystem services are lacking in the policy documents and what ecosystem services are emphasized in both London & Rotterdam. Also the differences and similarities between London and Rotterdam will be discussed. As a result of this comparison, a summary will be given of how ecosystem services are addressed in policies on spatial planning.

Strategic plan

Strategic Level	London	Rotterdam
Provisioning		
Soil		
Energy production	- Energy efficiency in supply and demand - Renewable energy technologies, biomass and hydrogen - Utilize energy from waste and residual heat - Retrofitting of buildings	- Wind turbines - Energy efficiency through integration - Use residual heat from industry
Food and resources production	- Urban agriculture - Local food production	- Small, green and urban agriculture - Local food production - Multifunctional agricultural business
Water supply	- Minimize use of water, demand management - Additional sustainable water supply - rainwater harvesting and using dual potable and grey water recycling systems	- Fresh water supply
Coastal space for development	- waste processing industry - land reclamation and coastal defenses	- Clustering and co-siting - Double land use - Land reclamation and elevation - Project Main port Rotterdam
Regulating		
Waste treatment	- waste processing industry - waste hierarchy, demand and supply management - dual potable and grey water recycling systems	- rehabilitation of greenhouses
Climate regulation	- Green roofs and urban greening - mitigation measures, reduce emission	- Reduce emissions - Reduce heat stress in urban area with greening - Climate buffers, to make a higher fluctuation level possible - Green roofs, to improve the micro-climate
Flood and storm management	- strategic flood risk appraisal - development of flood prone areas	- ‘ Zandmotor’ additional broadening of the coast - Gain insight in flood risk areas - Additional row of dunes
Erosion and siltation control	-	-
Water purification	-	- Natural purification at inlet points - Reed filters for purification and habitat

Water regulation	- Sustainable urban drainage system (SUDS) - Restore Blue Ribbon Network (BRN) - Open culverts and naturalize river channels - attenuate rainwater and discharge	- Broadening of watercourses - Hold, store and discharge water - Flexible fluctuation level management
Cultural		
Education/science	- BRN is a valuable educational resource - Enhance education for healthcare and bio-technology - promote clusters of research and innovation	- Urban agriculture can teach the youth about food production - Information signs in nature and excursions
Aesthetic/spiritual	- identify landmarks - creating a sense of place	- River is panorama of the city, gives identity - Create extra viewpoints - Wind turbines can have negative impact on the view
Recreation/tourism	- BRN is suited for leisure activities - Green Arc vision, creates and protects recreational landscape - Regional parks, recreation and nature	- Agro tourism - Regional parks, recreation and nature - Green and recreational infrastructure
Cultural heritage and identity	- Landmarks, world heritage value - BRN has value to local character	- Historical delta landscape - Belvedere sites
Supporting		
Maintenance of biodiversity	- Agro-environmental stewardship - Green belt, green infrastructure - Regional parks, recreation and nature - Areas for conservation, biodiversity maintenance	- Agricultural nature management - Flowery field margins can improve biodiversity and prevent pesticides - Water pearls, aquatic value - Improve tidal and intertidal natural vegetation - Create and protect marsh habitats - Improve vegetation on riverbanks - Monitor fish stock and population - Protection of rare species
Nutrient cycling	-	- Closure of cycles
Storage/retention	-	- Peak storage in polders - Water balconies at fringe of urban area - Temporarily storage rainwater and recover naturally, in combination with nature

Table 4.1: Comparative analysis of ES in the strategic plans of London and Rotterdam

What Ecosystem Services are lacking?

Both London and Rotterdam don't address the ecosystems related to *soil* and *erosion and siltation control*. These are two services that can be suitable to implement at a small scale. Especially in coastal zones where water has great influence on the quality of soil and the watercourses these ecosystem services can be beneficial also in urban areas. Erosion can cause land degradation in coastal zones and siltation can decrease the quality of the water, vegetation measures can contribute to the maintenance and improvement of this ecosystem service. But these strategic plans do not address these services in the structural policy documents. Indirectly these service can be recognized in other categories of ecosystem services, this will be discussed in more detail later in this chapter.

The ecosystem services that serve *nutrient cycling* are also missing in these policy documents. The London Plan does emphasize waste treatment and recycling and thereby indirectly touches upon nutrient cycling, but the plan doesn't specifically address the nutrient cycling as a supporting service. In the London plan also the ecosystem services that address *water purification and storage and retention* are

not mentioned. Although there is attention for ecosystem services with regard to water supply and regulation, the purification and storage aspects of water are not recognized in the document.

What stands out from the comparative research is that Rotterdam barely addresses ecosystem services that address the *water supply*. The policy documents have mentioned the water supply in general by stating the importance of protecting groundwater areas and the supply of freshwater. These two points are not receiving specific attention on how this can be implemented. This can be seen as a visionary statement in which the actual decision-making on the spatial planning still needs to be taken. Especially in the RR2020 the 'superficial' attention to the regulation service of water supply can be recognized. This policy document gives a strategy for the future. It provides a structure in which the municipalities can determine their own operationalization. In those more specific documents these services are more likely to be addressed directly.

What Ecosystem Services are emphasized?

In the London Plan there is a great emphasis on *energy production and waste treatment*. Waste treatment is regarded as a regulating service in the breakdown and filtering of polluted substances. But it can also partly be a provisioning service when it is related to energy production. These two services can to some extent show overlap in recycling activities and in using energy from processing waste. There is a close linkage between both services and they are hard to separate. In the planning documents this close linkage was recognized and was presented as such in the London Plan policy document. The energy production services that are mentioned in the strategic plan of London are mainly focused on energy efficiency in supply and demand and in utilizing energy from waste and residual heat. The purpose of these services is to use less energy and to produce it more clean and efficiently with less pressure on raw materials and other resources. The reason why this vision on energy production receives a lot of attention can be that there is a high economic value linked to this benefit. By using energy efficiently, residents can save a lot of money. And also industry can minimize the costs by using energy sources that are renewable and will be sustainable for the future. The London Plan shows that it is possible to have a strategic vision on waste treatment with regard to socio-economic and ecological benefits.

Rotterdam takes multiple measures in *coastal management*, the focus is more on an additional broadening of the coast with supplementation of sand which can develop itself in a natural way. This can partly serve the same purpose as erosion and siltation control, because it makes room for natural vegetation on the coast to prevent the Netherlands from getting smaller and to protect against flooding. This coastal management is aimed to provide multiple ecosystem services. In the development of this land reclamation areas a lot of attention is given to extend the coastal area and to improve habitats and biodiversity. In the RR2020 plan this multiple land use is very much advocated, in the Groenblauwe Structure plan more attention is given to the maintenance of biodiversity in the sites of land reclamation and other coastal areas.

Differences: London – Rotterdam

What stands out is that for both services, energy production and waste treatment, a *supply and demand management* is proposed in the policy document of London. The vision of London focuses not only on the industry and on the major players, but it also focuses on the residents by trying to decrease the demand for energy of households, here the emphasis on efficiency is also noticeable. This is in contrast to Rotterdam where the main focus is on energy supply through efficient production in industry and by adding green alternatives to generate renewable energy. The vision from the strategic plans does not target the energy use of the residents.

Rotterdam pays in contrast to London very little attention to *waste treatment*. The policy documents on the strategic level mention the rehabilitation of the greenhouses which has the aim to reduce ground pollution. The policy doesn't mention a strategic vision on waste processing industries or recycling measures although these ecosystem services can generate great benefits for a harbor city like Rotterdam.
In contrast to the focus on waste treatment in the plans of London, Rotterdam focuses strongly on industrial clustering, co-siting, double land use and land reclamation and elevation. These services are under the category of coastal development, but are very much linked to waste treatment and efficient use of energy. With this focus on effective and multiple land use other services can also benefit. The use of residual heat from industry for instance can give great benefits in establishing an energy efficient system through integration of the industry network and land use.
The reason for the focus on multiple land use in coastal development in Rotterdam is because space is scarce in the harbor of Rotterdam, therefore their vision is to use this space effectively. The harbor can be regarded as a pivotal economic driver for the city and for the Netherlands as a whole. Governments are keen to ensure the potential of the harbor and to improve the economic activity of the harbor. This is different for the city of London, whereas London focuses on efficiency in the energy production, Rotterdam focuses chiefly on the effective use of land. A reason for this can be that for London scarcity of land is not the main issue. The quality and quantity of water for the city with well-developed waste treatment activities receives more attention in London.

Similarities: London – Rotterdam

The *Green roofs* are mentioned in both cities in the strategic plans. Green roofs can have a regulating function for the climate because it can reduce emissions and it can reduce the heat stress in the urban area. Together with other urban greening measures the green roofs are emphasized as necessary services in urban areas to use less energy and to mitigate the higher temperatures in the city due to the climate change. Both cities also address the issue of climate regulation and the reduction of emissions in combination with the green roofs.

Small and urban agriculture is also a measure that returns in both cities. Rotterdam focuses especially on small and urban agriculture together with local food production and even links an educational aspect to this form of agriculture. They want to involve agriculture in sustaining and improving the landscape and the quality of nature. London also focuses on urban agriculture and local food production and mentions agro-environmental stewardship as a means to involve the agriculture in improving the quality of nature. So for both of them it applies that agriculture can function as a mediator between the production of food and resources and in providing a good quality of nature for the maintenance of biodiversity.

Sectorial plan

Sectorial plan: water	London	Rotterdam
Provisioning		
Soil	- Soil compaction, improve recharge to groundwater	- use underwater drainage to reduce soil subsidence
Energy production	- Retrofitting buildings - Maximize energy recovery of sludge - Waste as source of low carbon energy	- green roofs
Food and resources production	- Urban agriculture - Sewage sludge for agricultural use	-
Water supply	- Freshwater catchments - Rainwater harvesting - Grey water recycling - Desalination - Water abstractor groups	- Separation of clean and polluted water - Construct new surface water possibilities with new development - Drinking water supply
Coastal space for development	-	- Industrial and harbor sites are elevated - Land reclamation: 2e Maasvlakte - Adaptive solutions: Floating alternatives - Create extra space by filling in harbor basins
Regulating		
Waste treatment	- Sewage sludge for agricultural use - Wastewater as source of low carbon energy	- Disconnect paved surface as a clean alternative to sewerage - Obligations in taking care of effluents - Remediate contaminated sites - Disposal of moderately contaminated water through soil or roadside passage - Dredging, sewage, phosphorus removal
Climate regulation	- Eco-marshals to monitor air quality - reduction of carbon emissions	- Green roofs, positive effect on micro-climate
Flood and storm management	- Increase the area of flood plains and wetlands	- Land elevation - Urban design to reduce harmful effects of flooding - Flood beams - 'Zandmotor', natural land supplementation
Erosion and siltation control	- Broadleaved woodland to improve water quality and reduce siltation	
Water purification	- At source initiatives to reduce pollution - Broadleaved woodland to improve water quality and reduce siltation	- Water quality images - Natural purification
Water regulation	- Sustainable Drainage Systems (SUDS) - Greater local and inter-basin connection - Improve base flows in rivers - Attenuate and discharge rainwater - natural water corridors, wetland, reed beds and ponds - Slow the water down - Wider buffer strips adjacent to rivers	- Flexible management of fluctuation level - Increase discharge capacity - Function follows water level - Broadening of main water course with natural banks - Increase pumping capacity
Cultural		
Education/science	- Innovative and informative metering	- Educational program: 'Living with water'

	- Improve understanding of flood risk - Develop science based understanding, i.e. through experiments and pilot projects	- Water squares make the problem visible for residents
Aesthetic/spiritual	- Water contributes to the quality of life	- People experience rest along the water
Recreation/tourism	- Water related recreation	- Recreational route along the river - Water pearls: space for recreation - 'Zandmotor' will create extra space for nature and recreation - Make coast more attractive
Cultural heritage and identity	- Protect archaeological features	- Water gives region identity - River is the life blood of the city
Supporting		
Maintenance of biodiversity	- Restore degraded tributary rivers - Provide ecological 'stepping stones' - Landscape-scale approach to manage habitats - Improve freshwater ecology adaptation	- Places for pike spawning - Fish stock and population management - Water pearls: improve ecology - Ecological network (EHS) - Construct a fish migration facility - Dune compensation to improve biodiversity
Nutrient cycling	-	-
Storage/retention	- Restore wetlands to slow run-off and protect peat	- Water squares in urban area, water gardens, Wadi's - Seasonal storage, slow discharge - Emergency atrium - Retention area for surplus of river water

Table 4.2: Comparative analysis of ES in the sectorial plans of London and Rotterdam

What Ecosystem Services are lacking?

On the sectorial plans on water the ecosystem service of *erosion and siltation control* is not mentioned in the documents of Rotterdam. Similar to the strategic plan this regulating service is not directly addressed in policy. Natural land supplementation can indirectly contribute to this service in that the coastal area can provide space for a natural development of vegetation along the coast and in this way can become more resilient and adaptive. Although the ecosystem service of erosion and siltation control can find some overlap in other services it seems striking that this service is not mentioned in sectorial plans on water. Because of the different sea conditions and the rising see level, literature emphasizes the vulnerability of the coastal zones as is explained in chapter two. Erosion and siltation control could be a key factor in keeping the see away and preserving the inlet of water. For harbor cities this also has an impact on the supply of water, the water quantity and quality are affected by erosion and siltation. By controlling these services in a more natural way the water supply can become more cost efficient and the quality of the water and the quality of the biodiversity in the area can be improved.

Further it is remarkable that London does not address services for *coastal space and development*. The reason for this can be that the sectorial plans for London are merely focused on the use of water for the people and the environment and to protect the Londoners for the water. These policy documents do not discuss new developments in the coastal zone but the focus is on regulating services mainly with regard to water regulation, climate regulation and flood and storm management. In the context of London coastal development receives little attention compared to Rotterdam, a reason for this could be the different institutional context. In London the land ownership in coastal zones is divided between many private parties as well. Here for the responsibility to develop the coastal zone becomes more a private business.

Rotterdam is very short in the sectorial plans on *energy production* and on *food and resources production*. Only the concept of green roofs is mentioned, but the emphasis on urban agriculture is lacking in these documents. The Waterplan 2 and the GWM in beeld 2010: Water are the two sectorial plans that have been analyzed for Rotterdam and these plans are narrowed towards the water management. They focus explicitly on water and the water boards fulfilled a major role in these sectorial plans. The regulation of water, storage and retention areas and the clean water supply are a few areas that are much addressed in these plans. This can be a reason why services like energy and food production are not dwelt upon. The services related to water do touch upon the energy and food production services, but this occurs in a more indirect manner.

What Ecosystem Services are emphasized?

In London the *water regulation* service is emphasized and the policy documents mention the Ecosystems Approach as a means to manage resources on a catchment scale. The plan 'Water, for people and the environment' is the only document that mentions the Ecosystems Approach directly. It states that an ecosystems approach should be taken in order to manage water resources on a catchment scale. In the following the plan mainly elaborates on water supply and water regulation services with a focus on the catchment scale of the river basin of the Thames.

The 'Zandmotor' is an important project of Rotterdam in the sectorial plans. This project has overlap with different services. It is mainly a regulating function, because the natural land supplementation contributes to an increased flood and storm protection. In the light of climate change and the higher sea level it is important for the region of Rotterdam to construct a large coastal zone to absorb a possible flooding. And this sand supplementation also contributes indirectly to improve coastal habitats and to extent the coastal zone for nature and recreational use. And at the same time it also provides space for industrial coastal development for harbor activities. In this way the harbor can keep up with the growth and expand and improve their activities.

Differences: London – Rotterdam

Rotterdam focuses more on the *provisioning* and *supporting services* in their sectorial water plans. Whereas Rotterdam gives explicit and very practical measures for how to *maintain the biodiversity*, London remains rather superficial in improving habitats and restoring rivers. London does have one practical measure to maintain the biodiversity and that is the concept of ecological 'stepping stones'. This can be compared to the ecological network (EHS) in the Netherlands. Rotterdam is very explicit in its ways on how to maintain biodiversity. For example it points out spaces for pike spawning, water pearls are introduced and they aim to construct a fish migration facility. Also the *storage and retention* service is discussed in detail in the policy documents on a sectorial level in Rotterdam. Different storage and retention possibilities are mentioned whereof the water squares stand out the most. The *water squares* are an innovative idea to design an urban space which can be used as public space in normal conditions and when there is a surplus of water this can be stored in the water square. Rotterdam follows with this concept other coastal cities like Hamburg, who developed a similar concept. Rotterdam emphasizes very much its image of a city living with the water in the sectorial plans. The city lives with the water which can be seen as the beating heart of the city, or better as the blood vein of the city.

The sectorial plan of Rotterdam is merely *directed to the harbor and the industry* rather than the people and the environment. This can be identified in the documents in the attention that Rotterdam pays to *coastal space for development* and *waste treatment*. Besides these provisioning and regulating services

the supporting services are also highly addressed in Rotterdam in emphasizing the supporting and ecological aspects of water. To guarantee a sufficient water quality and quantity for the citizens is the responsibility of the Dutch government. To establish this a tailored water management is needed and the sectorial plans aim to do this by starting at the source. The source for water pollution in Rotterdam mainly stems for the industrial activities at the harbor and on the rivers. The plans focus on management in these sectorial areas to improve the water regulation and supply for the citizens. The London plan is more directed to the local communities in London, this is expressed in the attention they give to forums, marshals and community programs. More than in Rotterdam London involves the residents in their mission to manage and provide water in a sustainable way.

In contrast to Rotterdam, London does mention the *erosion and siltation control* in their policy documents. The sectorial plans for London provide us with an initiative to reduce siltation with natural measures. Namely by creating broadleaved woodland that can improve the water quality and reduce siltation. The document on Water for People and the Environment has taken this example from other countries in order to implement this in London as well. Land that is used intensively now by i.e. agricultural cultivation, have to be converted into woodland an grassland. The woodland measure can provide water quality benefits in accordance to their assessment of this approach. But this measure can have adverse effects as well, the benefits should be considered against the impacts.

Similarities: London – Rotterdam

The regulating services receive most attention in both London & Rotterdam. Both cities mention possibilities to purify water in a natural way and especially focus on water regulation in addressing flood and storm management. This seems to be the major challenge for the cities in the near future. Because of the ongoing change in the coastal zone the pressure to regulate the water and to protect the people for flooding and the harmful consequences of floods, has increased. Still the coastal zone is a very attractive place to live and to expand harbor and industrial activities. The urgency of adaptive water management increases due to this ongoing increasing pressures on the coastal zone. This makes the regulating services of water to a key challenge for these cities in the near future.

Specific plan

Specific plan: Delta and coastal management	London	Rotterdam
Provisioning		
Soil	-	-
Energy production	-	- Transition to biomass as energy carrier - Wind and tidal energy - Develop clean technologies to produce energy
Food and resources production	-	- Mineral extraction
Water supply	- Balance water abstraction - Improve fresh water supply - Aquifers supply drinking water	- Increase freshwater storage in winter and supply in summer - Dunes alternated with coastal areas for water abstraction
Coastal space for development	- Provide deep water facilities - Strong emphasis on high tech industries	- Supplementation and local coast development - Multiple land use - Developments in red contour in coastal area - 'Zandmotor' with spatial planning in the immediate hinterland - Primary defenses shape the conditions for further development in the coastal zone
Regulating		
Waste treatment	- Grey water recycling - Re-engineer existing discharges - Residents should take waste oil and chemicals to a municipal recycling facility - Waste bioremediation center	-
Climate regulation	- Adaptation and mitigation - Reduce emissions, carbon footprint	- Accommodate sea level rise by sand supplementation - reduce heat stress in urban area with greening
Flood and storm management	- Physical modification of water bodies - Tidal flood storage - Intertidal habitat can absorb wave and surge energy - Thames barrier: reduce fluvial flood levels	- Multifunctional use of dikes and dunes - Prevention, spatial design and disaster management - Reduce harmful effects of flooding with spatial design - Sand supplementation: 'With sand where possible, hard where necessary' - Multiple land use
Erosion and siltation control	- Use sediment to create bankside enhancement to form soft vegetation	- Supplementation to prevent coastal erosion - 'Zandmotor', natural distribution of sediment
Water purification		
Water regulation	- Aquifers provide flow for rivers and wetlands - Reduce surface water run-off - Create a mosaic of tidal, brackish and freshwater habitats - groundwater flooding via permeable superficial deposits that connect the estuary with the floodplain	- Priority sequence for occasional drought - 'building with nature' - Control drainage at farm level - Level maintenance and flushing of atria

Cultural		
Education/science	- TE2100 catalogue with information and data - Input of local data and knowledge - Guidance and training for local authorities - Share knowledge with liaison panels	- Integrated supply and demand of knowledge - Scientific and practical knowledge - Use of a common method for research - Develop new knowledge on delta technology
Aesthetic/spiritual	- River habitats improve beauty of the estuary	- Coast is an original and unique landscape with special value
Recreation/tourism	- Recreational fisheries - Fish pass structure combined with canoe pass to support recreation - create habitats for nature and recreation	- Quality impulse for coastal areas to improve recreation - Robust dune landscape with coastal resorts - Green and recreational infrastructure
Cultural heritage and identity	- Protect the historic environment	- Cultural and historical valuable area
Supporting		
Maintenance of biodiversity	- Bankside enhancement to improve biodiversity - Retain coastal grazing marshes - Intertidal habitat creation - Provide sites for feeding and roosting of wintering wildfowl - Monitor and identify the species - Fish pass structures	- Improve monitoring of habitats - Robust dune landscape with good ecological quality - Sand supplementation with ecological development - Ecological network (EHS), green infrastructure
Nutrient cycling	-	-
Storage/retention	- Use of marsh area for flood storage	- Increase capacity for river water storage - Seasonal storage - Water buffers - Multiple land use: robust design of parking garage as water storage

Table 4.3: Comparative analysis of ES in the specific plans of London and Rotterdam

What Ecosystem Services are lacking?

London addresses very little *provisioning services* in their specific policy documents on delta and coastal management. The plans do not mention any direct ecosystem services that address *energy production* and *food and resources production*. In delta and coastal management it is not strange that these services are less emphasized. But also through specific qualities of the delta and the coast there are sources for renewable energy for instance, that can gain benefits for our human wellbeing. Only with regard to water supply and coastal space for development London addresses these provisioning services. These services are mainly directed to the community and local stakeholders.

For both London and Rotterdam the service of *water purification* within the regulating services is not addressed. London does address *waste treatment*, but in the specific plans of Rotterdam on delta and coastal management this service is also not addressed. This is remarkable to my opinion, because delta and coastal areas have an important role in providing clean water for the people. The water purification and waste treatment services can deliver benefits for people and the environment in processing the water in a natural way, for instance by filtering utilities. The specific plans in Rotterdam focus mainly on the protection against water, to prevent the area from flooding. In this regard services that deal with land reclamation, drainage and storage and retention areas receiver more attention. In different ways the regulation of water and its quality does receive attention in both cities, but this is addressed by means of different ecosystem services.

What Ecosystem Services are emphasized?

The regulating services receive a lot of attention in the plans for delta and coastal management for both Rotterdam and London. Clearly the regulations of water together with flood and storm management are two important services in these policy documents. When planning the delta area, the estuary and the coastal zone; the protection of people against the water is the most important task. In the plans the attention to process surpluses of water is evident. The propositions that are made to manage the water are in particular aimed at natural measures. These measures focus at creating more space to let nature do the job. By creating greater river habitats and tidal flood storage areas, floods can be absorbed and the adjacent area will encounter fewer difficulties as a result. Rotterdam also focuses on reducing the harmful effects after a storm event. Multifunctional use is favored to combine multiple functions, to improve the biodiversity in the area and to be more resilient to eventual high water circumstances. The specific plans from Rotterdam also have a great focus on an increasing storage capacity, these measures can also contribute to give water more space in order to adapt to high water circumstances and prevent citizens from harmful effects.

Differences: London – Rotterdam

Rotterdam focuses merely on the provision of sand supplementation, building with nature and spatial design as measures to provide an excellent delta network. In the policy documents of Rotterdam it is mentioned that there is a desire for a robust design to regulate water. Robust can be defined as a system which is powerful and that can take a beating without losing its function and getting out of balance. This can be linked to the construction of a resilient ecosystem. The aim of this approach to involve natural development and spatial design in the regulating service is to make it sustainable for the future. Technological innovations need to be improved over time when the pressures become higher, natural systems can adapt to the changing circumstances.

London also focuses on more natural systems, but what can be pointed out from their policy documents is that they emphasize the involvement of the residents and local communities. For many services they mention how they want to involve the community in establishing the ES. In the cultural service of education and science this is becoming clear through the demand for local data and knowledge, by providing training and guidance and by establishing liaison panels. In this way the expertise of local residents are taken into account in creating other services that serve to maintain and improve the delta and coastal area. Rotterdam is working towards an integration of knowledge between scientific and practical knowledge, further development and innovation on delta technology is desired. There is less emphasis in collaborating with the locals to gain more knowledge in this field of expertise. But Rotterdam does aims to combine scientific knowledge with the practical and local knowledge in different programs.

Similarities: London – Rotterdam

Both London and Rotterdam focus in their specific plans on delta and coastal management on preventing the cities from harmful effect due to storm events or other high water conditions. This management is directed to natural measures in which additional areas are created to give water the space that is necessary. These regulating services go hand in hand with cultural services. In both cities a combination of functions is admired. Robust and natural landscapes can have regulating and supporting functions, but the cultural services are also very important to make the people aware that nature is essential and that this should be maintained for the future. The need to adapt to the water and to give it the space that is needed, is reflected in the specific plans of both London & Rotterdam.

4.3 Conclusions of the Comparison of the ecosystem services

After this comparative analysis of the ecosystem services that are addressed in the different plans from London & Rotterdam a short conclusion of this comparison will be given. At first some general conclusions will be drawn. After this the different ecosystem services will be discussed on each level for both cities. Starting with the strategic level it will be analyzed what are the most important ecosystem services for London and what services are lacking in the strategic plans of London. The strategic plans of Rotterdam will be discussed in a similar way. This will be followed by the same analysis for the sectorial and the specific plans. In this manner differences on the three plan levels can be discussed for both cities. Concluding to this some general differences between London & Rotterdam will be provided with regard to the ecosystem services.

Nutrient cycling, *soil* and *erosion and siltation control* are ecosystem services that receive very little attention in all the policy documents that are analyzed and especially in the strategic plans these services are missing. A reason for this can be that the valuation of these services is hard to express in socio-economic value. Overall it can be said that the policy documents indirectly do acknowledge the possible benefits of these services, some overlap can occur with other ecosystem services. In this manner the services can be addressed indirectly.

The provisioning services and the regulating services overall receive most attention in comparison with the cultural and supporting services. The provisioning of *energy production* services and *food and resources* services are highly addressed in the policy documents except for the specific plans on delta and coastal management. These services indicate the importance of dealing with the scarcity in resources. This is a major issue in current environmental assessments and the provisioning services can be used to provide efficient production measures and innovative clean technologies to make optimal use of the resources that are available. Recycling measures and waste treatment also fulfill an important role in this process. The regulating services give more space to water and try to manage the water systems in a sustainable way. The urgency to adapt to the water to maintain and improve the water quality and quantity is recognized in the policy documents. An approach is often taken to create more natural waterways by improving the natural quality for instance through vegetation measures. This water management is often combined with cultural and supporting services that address the biodiversity and recreational opportunities.

Strategic

At a strategic level the absence of ecosystem services related to soil and erosion and siltation control are most obvious in the policy documents of both cities. The reason for this can be that the strategic plans rather unfold a vision and a framework in which these services are difficult to take place because of their often small scale operationalization. They often can be incorporated in very diverse plans and are housed in more specific plans. Although this difference in scale matters for the particular services, by addressing them in the strategic plans the importance of the service can be emphasized and is more likely to be addressed in other plans. The strategic plans in both London and Rotterdam often have a superficial nature. The strategic plan can in this sense have a guiding function for plans at a more specific level in determining what services they address. With other services like food and energy production that relate more directly to human benefits this is being significantly addressed in the policy documents of both cities.

Sectorial

The sectorial plans are often still very strategic in nature but also give notion to the operationalization of the ecosystem services with possible measures. It is not merely a vision or framework like the strategic plans, but narrows its scope to the area of implementation. In the sectorial plans on water the ecosystem services of erosion and siltation control is more addressed in both cities. Especially London gives more attention to the service in a direct manner, for Rotterdam this service can be recognized indirectly and in overlap with other services. In these plans the focus of both cities becomes more clear in how the water issue is addressed in policy of spatial planning.

A focus on coastal space and development can be recognized in the sectorial plans of Rotterdam. In the vision from the strategic plans these services already received significant attention, in the sectorial plans this is worked out on a smaller scale. The plans are merely directed to the harbor and the industry, these sectors are of great importance for the economy of Rotterdam and the Netherlands. The supply and regulation of water is op pivotal importance for the development of these sectors, and overlap can be recognized between multiple service. Especially with regard to supply of water in a qualitative way is very much linked to coastal developments in Rotterdam and especially in the harbor area. For Rotterdam the function of the harbor is also incorporated in their image building for Rotterdam as a city living with the water. Water plays a central role in the area of Rotterdam and this is widely acknowledged in the policy documents. So also cultural values influence how water is addressed in these policy documents.

In London the ecosystems approach is literally mentioned in the sectorial plan. This is the only time that a document uses the term of the ecosystems approach in all analyzed documents. The approach is mentioned with regard to managing water resources at a catchment scale. In the sectorial plans of London the main focus is on the regulation of water. The regulating services in the river basin of the Thames and options for operationalization of these services are thoroughly discussed. London is very much focused on the people and on how to collaborate with the local community and stakeholders in establishing a safe and sustainable catchment area. This can be linked to the planning tradition of London which is based on negotiation and on development.

Specific

These specific plans focus mainly on delta and coastal management, flood and storm prevention and on river basin management. In this field of planning the regulating services receive a lot of attention for both London and Rotterdam. The regulation of water is very much addressed in relationship with flood and storm management. Both cities recognize the urgency of protecting people against the water as a key task of government in the near future. For Rotterdam this is directly linked to the protective task of the government. In London this task is more a collaborative achievement of different stakeholders who have various types of ownership and interest in the area. Many defense systems for instance are privatized in London, so the protection is not merely a governmental responsibility. Within management on flood and storm protection, the focus of both cities in their specific plans is on preventing the cities from harmful effects due to storm events or other high water conditions. Measures that are addressed are mainly directed to natural measures in which space for the water is regarded to be of paramount importance in a sustainable regulation of water. This need for adaptation to the water is reflected in the specific plans and hereby a linkage is often made between this regulating services and cultural and provisioning services. Multifunctional use, the expanding of natural river banks and improvement of biodiversity are favored to be combined with water regulation measures. Also services that are linked to recreation and deal with the aesthetical value of the area are taken into account.

What distinguishes the specific plans is that they focus very in depth on the water issue that is at stake in the area. To resolve the problems that exist with regard to the water quality and quantity and especially the impact that it has on the people living in the area and their safety. The specific plans zoom in on different areas and pose detailed descriptions of the area and its characteristics. In this sense the broader frameworks which have been set out in the higher level plans are given handles to be carried out. The specific plans can be reflected upon as the closest to the actual implementation of the visions and plans laid out before. In the Dutch context the specific plans are still on national and provincial level, but they are very much targeted for the water management. From the water perspective the Dutch specific plans on delta and coastal management give substance to the visions and frameworks that were outlined before. In the London case both specific plans are designed by the Environment Agency, they are a non-departmental public body that is responsible for the implementation of government policies. In this sense the specific plans for London are more aimed towards operationalization in comparison to the specific plans for Rotterdam.

Differences: London – Rotterdam

London focuses more than Rotterdam on the involvement of people and the community. Many services are linked to contributions that citizens can make to gain benefits from an ecosystem services. Thereby supply and demand management plays a pivotal role in the provisioning services of London. For Rotterdam the policy documents show that demand management is a minor part of the spatial planning. The main focus of Rotterdam is on the supply side. This can be recognized in several services such as the production of energy. This ecosystem service is mentioned in the plans of Rotterdam by using strategies to produce energy very effectively with the help of clustering, co-siting and industrial ecology. And Rotterdam mainly addresses how the public sector can protect the Netherlands from the water and to use innovative alternatives for this. The involvement of residents and local communities is still in the early stages and does not get the highest priority.

Similarities: London – Rotterdam

For both cities the combination of different ecosystem services are favored. The policy documents show that the services do not stand alone, but find their meaning in the wider context of the planning area. When a new storage or retention area is constructed, this can serve multiple services. It can serve as water regulating service, as a service for flood and storm management and it can serve in maintaining the biodiversity. This overlap in services is addressed very often and indicates that the policy documents envision the ecosystem services as an integrated approach. Although the concept of the ecosystem services approach is only mentioned once in all policy documents, this can be seen as recognition of the importance of the ecosystem services approach.

Little to no difference was found in the addressing of cultural services in London & Rotterdam. The cultural values are widely acknowledged in both cities on all levels of scale. These services are mainly addressed in combination with other services. This combination is reflected in the mutual relations between the cultural services of education, aesthetics and recreation. And also outside the category of cultural services there is much interrelationship with services from other domains. Recreation and tourism for instance is very often combined with the supporting service of maintaining the biodiversity. For these services often practical measures are being proposed mainly in the sectorial and specific plans.
In the policy documents of Rotterdam that are analyzed, the concept of ecosystem services is never mentioned. For London the ecosystems approach is mentioned once in the sectorial plans. From this finding it can be stated that the mainstreaming of the ecosystem services approach is staying behind in spatial planning policy.

4.4 Comparative analysis of the tools

A next step in this comparative analysis is to compare what tools are available in the planning context that can be used for the implementation of ecosystem services in spatial planning. The tools are divided in financial, regulatory and communicative tools and for each kind of tool the possibilities for both countries are discussed. From the policy documents different measures were addressed in the policy documents. These did not necessarily aim to implement ecosystem services. The analysis of tools was executed on the basis of general information of currently used tools in spatial planning. This analysis results in an overview of what tools are used most in both cities and an attempt will be made to select what tools are suitable to implement ecosystem services in spatial planning. Both countries will be compared, as well within the different tools; financial, regulatory and communicative. This analysis of the tools that are available can contribute in building a framework of possible tools to implement the ecosystem services approach.

Tools	London	Rotterdam
Strategic plan		
Financial	- Innovative funding techniques: tax increment, tax in an area to support local development - Public funding - Building at risk grants	- Sanitation fund - Green funds, compensation and subsidies - Business investment as compensation -Direct income support for farmers - sLoK-uitkering: stimulation local climate initiatives
Regulatory	- Target Emission Rate (TER) - Development proposal must comply with flood risk management - Areas for conservation and protection - Integrated Impact Assessment (IIA) - Strategic Environmental Assessment (SEA) - biodiversity action plans, control of species	- Red-for-green constructions - Water test, Water pearls - Environmental Impact Assessment (EIA) - Strategic Environmental Assessment (SEA) - Areas for conservation and protection - Ecological corridor, Ecological network (EHS) - Compensation measures for nature - Green belt, green buffers around urban area - Governments can give incentives for the use of local products - Groundwater protection areas - Ecological network (EHS)
Communicative	- The Mayor promotes to raise awareness and promote behavioral change: Green Enterprise District, sustainable energy use, Food to fuel alliance program and a demolition protocol - London Hydrogen Partnership - Forum of academics and other stakeholders - Independent panel to give consultation - Empower communities, neighborhoods, voluntary groups, local businesses and organizations and other interest groups	- RR2020 toolkit with information for the communication with citizens - Early involvement of residents and business - Create area profiles with target scenarios - Develop tailored market campaigns - Stimulate rural entrepreneurs to develop small agriculture - Improve the image of a green and recreational region
Sectorial plan		
Financial	- Tariff based water charging system (Rising block tariffs and seasonal tariffs) - Brokerage service to encourage the use of biodiesel in public sector transport - Water companies should be required to contribute to a water efficiency commitment where companies fund efficiency measures	- Extent sewage charge to a water charge to finance groundwater measures - Prospective ISV funds - Subsidy programs for dredging and green roofs - Water fund with a savings box to compensate for additional paved surface in a developing area. - Project team for the acquisition of European

	- Fund water companies to protect and improve water quality - Abstraction license charges, water pricing	subsidies
Regulatory	- Obligation for energy companies to install 'smart' energy meters - Compulsory metering of water to balance supply and demand - Water resource management plan (WRMP) - Abstraction license for water companies - Planning permission required for impermeable surfaces in front gardens larger than five square meters. - Temporary restriction on the use of irrigators, hosepipes and sprinklers - Age limit for 'black cabs' - Ofwat introduced water efficiency targets for water companies - Reviewable permits for water abstraction - Abstraction licenses for hydropower and heat pumps - Age limit for ' black cabs' and new buses with green technology - Adaptation and mitigation strategies	- Implementation of European Water Framework (WFD) is an obligation of result - 5 year safety review - Safety norms and standards - Duty of care for untreated discharges - New or renovated buildings with flat roofs will be obligated to construct a green roof - Water test - Include water targets in building permits and regulations - Environmental Impact Assessment (EIA) - Water act, water management plans, zoning plan - Safety test every 6 years
Communicative	- Raise Londoners awareness of the financial benefits of water efficiency and of the risks of flooding - Green Lease Toolkit - Smart metering - Drain London Forum, consistent and creative approach to flood risk - Informative water bills - London on Tap campaign - Demand management - Energy labeling - Website where consumers can evaluate their water footprint - Twin track approach: supply and demand management - Adaptation and mitigation strategies - Community Flood Plan Program	- Evacuation and emergency plan - Quality image and region profile - Communication plan with a calendar - Public brochure for flooding and safety - Create support through pilot projects - Cooperation of government with citizen organizations - Knowledge for climate program - Involve schools and locals for innovative projects - Consultative forum with water associated partners - Communication through evacuation plans - Map to indicate how much storage capacity is needed
Specific plan		
Financial	- Cross-compliance, give subsidies to farmers to comply with a range of directives to reduce pollution from agriculture	- Cost-benefit analysis - Water board as co-financers for flood defense - Delta fund is budget fund in the Delta Act - Short-term cash transfer - Funds available through MIRT program
Regulatory	- Cross-compliance, give subsidies to farmers to comply with a range of directives to reduce pollution from agriculture - Designate and enforce Water Protection Zones	- 'Room for the River' PKB - Water safety norms and standards - Safety test of flood defense system - National Assessment Report - Landward reservation zone

	- Soil and nutrient management plans - The Energy Efficiency Scheme - Habitats Regulations Assessment - Mitigation measures against diffuse pollution include promotion of Codes of Good Agricultural Practice (CoGAP)	- Area for conservation and protection - Environmental zoning around harbor activities - Risk zoning around the waterway
Communicative	- Awareness and behavior change campaigns - Voluntary initiative of 'best farming practice' - EA will work with the Farming Wildlife Advisory Group - Liaison panels with input of local data and knowledge - Consumers can report pollution to the Environmental Agency (EA) - Training and education - Maximum involvement and action from locally based organizations and people, because implementation requires activity 'on the ground' - Test flood risk management measures - Provide information to local communities - Flood forecasting and warning system	- Quick scans give insight in water safety and climate - Intensive interaction with residents and businesses - Expert groups, consultative bodies - Consortium Eco shape can contribute with knowledge on natural water safety - Design research and strengthen the collaboration between partners - All sub-programs organize the input of civil society organizations on their level

Table 4.5: Comparative analysis of the tools available in spatial planning in London and Rotterdam

Financial tools

Financial tools are widely acknowledged in spatial planning and can be regarded as strong incentives to negatively or positively support implementation with money based tools. Financial resources are very important in the establishment of a project. Both London & Rotterdam address these tools and acknowledge the importance of financial incentives. In the following these financial tools will be analyzed and it will be discussed how they contribute to the implementation of ecosystem services.

Tax based incentives can support the involved actors to collaborate in the plan. In London an example of such a technique is the introduction of tax in a specific area which can be utilized to support local development. In this way the tax that is paid by the residents is used to develop the area in which they live in. The *strategic* plan of London shows that through supporting one specific area, the local involvement increases. In Rotterdam tax-based measures play a central role in collecting financial resources for the implementation of a project. There are several national taxes and governments on a local level also receive money from local and regional taxes.

Innovative *funding* techniques can also contribute to support collaboration in a project. In Rotterdam Green funds are a measure to provide for compensation and subsidies. In this green funds, money can be set aside to invest in nature compensation and agricultural stewardship. This type of funding is introduced in the Ruimtelijk plan regio Rotterdam 2020, which is one of the strategic plans of Rotterdam. The Green funds are continued in the sectorial plans and in the specific plans of Rotterdam. London also has several funding techniques with a main focus on compensation measures. The funding in London is often accompanied by development measures that have to be taken. Private stakeholders receive funding to build new facilities and in reward they develop the infrastructure in the area for instance.

Tariff based charging systems are introduced in the London water strategy and the plan on Water for people and the environment. These tariff based charging systems is an example of supply and demand management and in this sense can be seen as a combination of financial and communicative measures. The incentive is finance based with great involvement of the people. By providing information to the Londoners through smart metering systems, Londoners get more insight in how much energy and water they consume. With this information a more efficient use of resources can be promoted with the reward of cost savings. The tariff that must be paid is based on the amount of use in a certain place and period of time. There are different types of tariffs that can be used, the London water strategy describes the 'rising block' tariffs, with this system the increasing water use becomes progressively more expensive. Another measure is the 'seasonal' tariff, where water is more expensive in summer than in winter, reflecting the seasonal availability of water.

Subsidies and grants can be paid out to stakeholders and businesses to finance measures to improve natural quality. Ecosystem services like the maintenance of biodiversity need investment because in itself they often gain little economic value. For farmers it is therefore not attractive to improve natural quality instead of making the most efficient use of their land. Subsidies can be an incentive to promote natural conservation within agriculture. This financial tool can be seen as a compensation measure to reimburse for the loss in productivity that farmers for instance can experience through improving the natural qualities of their land. In Rotterdam direct income support is also used to support farmers to retain their historical livelihood activities. In London the specific plans address cross-compliance measures in order to help farmers to comply to legislation through subsidies.

Both cities address public private partnerships in the investment for new development. Business parties can contribute to invest for public developments in a partnership. The planning tradition of London has a high involvement of public-private partnerships. The spatial planning is based on negotiation between government parties and private businesses. Through financial incentives private businesses can be encouraged to extend their project in developing an aspect in the project area. In Rotterdam the spatial planning is merely regarded as a public investment. Recently there has been more attention to utilize private parties for investment in projects. The specific plan of the Delta program discusses the possibility of using private parties as co-financers.

Regulatory tools

Regulatory tools can serve as strong incentives by setting out the framework in which planning can take place. With the regulatory tools a set of rules can be established to guide a project in a preferred direction. Rules can set boundaries and can be restraining, and they can also be seen as directives towards a shared objective.

Regulatory tools in the analyzed policy documents are primarily used to set *targets*, determine *norms and standards* and to *test* whether the results meet the requirements. The Target Emission Rate (TER), the Integrated Impact Assessment (IIA) and the Strategic Environmental Assessment (SEA) are examples from the London plan and the last two are also mentioned in the strategic plans of Rotterdam.

Red for green constructions is a tool which is mentioned only in the policy documents of Rotterdam. The Ruimtelijk plan regio Rotterdam 2020 addresses how this regulatory tool can be incorporated in the implementation of spatial planning. In the sectorial and specific plans these constructions are utilized in a more local and regional scale. Red for green constructions are aimed to compensate new building developments with nature development.

The green belt and *green buffer* areas are addressed in both London and Rotterdam. These tools aim to preserve a certain area for nature and to put restriction on economic developments in this area. The goal is to maintain and improve the natural quality of the area and to keep a green buffer in between urban areas. In order to preserve the ecology in the area Rotterdam also addresses measures with regard to the ecological corridor which is set by Dutch government. This corridor gives a framework for the main ecological structures in the Netherlands. These areas that belong to this corridor receive attention to maintain and improve the natural quality and biodiversity. In London ecological 'stepping stones' are introduced in the sectorial and specific plans. These stepping stones mainly have the same purpose as the ecological corridor in Dutch planning. The ecological stepping stones can function as a means to create areas in which the ecological functions should be maintained and improved.

Energy companies can be obligated to install smart energy meters. *Smart metering* is introduced in the plan of Water for people and the environment in London. This tool has the aim to provide information to the Londoners on their energy use. London has obliged the energy companies to install these smart meters in order to respond to the current energy use of the citizens.

Rotterdam uses different instruments to establish regulations in spatial planning. The regulatory framework from the policy documents show that zoning measures and zoning plans have a key function in spatial planning. The documents show that safety norms and standards are very important in protecting the region for the risks of water. The implementation of these regulations are often the responsibility of the municipality level.

In the sectorial plan of London it was mentioned that a change was made in the legislation on impermeable surfaces of front gardens larger than five square meters. At first this was a permitted development and this could in general be carried out without permission. Due to a growing recognition that this gradual loss of permeability in urban areas, known as 'urban creep', has increased flood risk, the government decided to amend the planning legislation. Currently a planning permission is required for such an impermeable surface.

The Habitat and Birds directive, Natura 2000 and the Water Framework Directive from the European Union are mentioned in all documents. So those are regulatory tools that are of importance in both cities and in all the plans. They are mostly just mentioned without given further notice for the practical implications of this legislation. In a the strategic plans in the Netherlands it was explained which authority is responsible to implement this legislation and for what purpose.

Communicative tools

Communicative tools are aimed *raise awareness* and to *involve the citizens* in spatial planning. This can be done by providing information to the residents. Providing information can happen in many different ways, Rotterdam for example developed a toolkit for the plan of RR2020 with information for policy makers on how to communicate with citizens. Also tailored market campaigns can provide information and can raise awareness with the people what can bring about a behavioral change. Programs such as Green Enterprise District and the Food to Fuel alliance program are examples of how the London Mayor promotes behavioral change. From the policy documents of London it stands out that they want to involve the residents in their plans to incorporate ecosystem services in planning. To achieve climate regulation they inter alia include eco-marshals to monitor the air quality. With this measure they involve residents to contribute to regulate climate regulation in a voluntary way.

Raising awareness and involving citizens can also be done by empowering local communities, neighborhoods, voluntary groups, local businesses and organizations and other interest groups to be involved in an early stage of the planning process. In this way the people are involved actively in the planning process and can contribute in the emergence of the plan. Involving citizens can be done through forums, partnerships and liaison panels.

Also *image building* and *marketing campaigns* can play a key role in promoting strategies and to create support. By communicating to the residents what valuable region they live in, more awareness is created to preserve these exceptional values. Rotterdam promotes itself as 'water city' and promotes the campaign 'living with water'. These tools create awareness of the value of water for the city and it informs people on how they can best deal with this water. The behavior of people can be changed when they realize that water is an essential value in the Delta they live in. Rotterdam together with the Netherlands has undergone changes in the perspective on water. Rivers are currently conceptualized as natural flows of water and space for the river is restored to improve its natural quality. This new view on the river is also associated with the protection against the water. By creating more natural riverbanks, aquifers and retention areas high water circumstances can be better absorbed and regulated by the watercourses and adjacent area.
Another communicative measure to be protected against the water in both London and Rotterdam is the evacuation plan. By distributing information to the citizens in advance of a possible high water condition, people become aware of the need to take measures and are better informed in what they must do.

Voluntary initiatives of 'best farming practices' mentioned in the specific plans of London, create more support to make a change. Guidance and training can in this aspect also help to inform farmers and other residents in how to implement ecosystem services on a small scale. With local data and knowledge there is much that can be achieved as these London policy documents make clear. In Rotterdam there is also a focus on local food production, farmers are encouraged to retain their small scale agricultural activities and to sell their products on the local market. Citizens are also stimulated to grow their own vegetables in for instance city gardens or on the green roofs.

Conclusion

The policy documents show that a combination of financial, regulatory and communicative tools often occurs in the policy documents. For the implementation of spatial planning in practice it is pivotal to be able to invest, to have a regulatory framework that gives the possibility for innovative solutions and to build upon the support of stakeholders. All three aspects contribute to a successful implementation of the ecosystem services in the practice of spatial planning.

4.5 Linking the Ecosystem services with the tools

From the previous paragraph where the different tools are discussed it was seen that a combination of tools is necessary for a successful implementation of ecosystem services. In this paragraph some best practices will be discussed to show how such an integration of different tools can contribute in the implementation. It is also addressed how a combination of tools can address multiple ecosystem services.

Tariff based charging and smart metering can be regarded as an integrated attempt of combining tools to implement ecosystem services. These tools relate to supply and demand management with regard to the ecosystem service of energy production and water supply. By making the price of energy and water explicitly clear in the bills, people become more aware of the costs of energy and water. And by making a distinction in seasonal tariffs, people become more aware of the scarcity of, in this case, water in the summer for instance. People become to understand that these resources are not infinite and the use of these products should be limited in order to be sustainable. This can be an incentive to change their behavior and to promote an efficient use of energy and water in households and businesses. Smart metering contributes to this in providing extra information to see how much energy is used in particular buildings and in parts of time. With this information a new strategy can be carried out to use as less energy and water as possible and to become more efficient. Tariff based charging and smart metering can be regarded as a combination between financial and communicative tools. By informing people on their energy and water use and by prizing to the extent they utilize, they will become more aware of the importance to be more efficient with the resources. The financial incentive is a strong support for many people to use less water and energy in order to save money.

The construction of *green roofs* is an example where all tools are integrated. Green roofs are aimed to reduce heat stress in an urban area, to use less energy through better isolation and by allowing food production in urban sites. The tools with regard to green roofs are integrated in financial, regulatory and communicative aspect. In financial aspect people and businesses who construct a green roof will receive subsidies. In regulatory aspect there will be new legislation. This legislation holds that for new or renovated buildings with a flat roof, there will be an obligation to construct a green roof. And in communicative aspect citizens and business are stimulated with tailored promotion campaigns to construct a green roof. So, when a green roof is constructed this is a voluntary act, if the building is not new or renovated. By doing this voluntary act you receive a subsidy from the government, which makes it attractive to create a green roof. This gives a high sense of awareness and willingness to private stakeholders to get involved in constructing green roofs with the benefits they will gain.

Figure 4.3: Promotion campaign for green roofs in Rotterdam

Small and urban agriculture and ecological stewardship is also an example of a combination of multiple ecosystem services and different tools in planning. By promoting small and natural agriculture for instance through promoting a 'best farmers practice', the involvement of farmers in establishing nature of a high ecological quality is increased. Farmers are mostly willing to co-operate in contributing to improve the ecological quality, but incentives are needed to make it attractive to do so. Subsidies can also be of great importance, because with extra subsidies farmers can afford to use the land less efficient and pay more attention to the natural development of their land. With ecological stewardship also training and guidance is provided to farmers and other agricultural users. This is an educational service that also contributes to the awareness of farmers in valuing nature. These measures that are mainly directed at maintaining biodiversity and on food production can also be combined with recreational and aesthetic services. In short these measures are supported by means of all possible tools and the ecosystem services are a combination of provisioning, cultural and supporting services.

Water squares are an example of urban spatial design which contributes to a supporting ecosystem service. The design is very robust and can be used for multiple functions. When the water is low, the water square is a public area where people from the neighborhood can spend their time. When the water is high, the water square can serve as a retention area. The tools for this service are mainly communicative towards the residents, because it creates an awareness of the importance to manage the water in a secure way. It is important that people have a sense safety in knowing what will happen to their neighborhood in case of high water. With this plan the consequences of this are made very visible. Figure 4.4 below shows the water square as a public playing ground and on the right the water square functions as a retention area.

Figure 4.4: The left picture shows the empty water square and the right picture shows the water square serving as a retention area.

A major challenge for the Rotterdam harbor is the scarcity of space. Therefore different concepts and strategies are introduced to solve this problem by making efficient use of the space that is available. *Multiple land-use* is an example of how available space can contribute to multiple functions of use. Also land reclamation takes place to add more land for coastal development and industry for harbor activities. An example of land reclamation is the second Maasvlakte as shown in figure 4.5. This piece of land is reclaimed from the sea and will be used for new development at the harbor of Rotterdam.

Figure 4.5: Tweede Maasvlakte, land reclamation with new development at the harbor of Rotterdam (http://spido.nl/nl/dagtocht-tweede-maasvlakte-2013

Ecological industry, clustering and co-siting are also examples of making efficient use of the available space. Together with this regulating service for coastal development also a provisioning service is addressed with these measures, namely energy production. In association with waste treatment, the efficient production of energy receives a lot of attention in both cities under research. In the policy documents there is a focus on using the resources to a maximum. Resources are recycled and used over and over again, residual heat is used as a source of energy and product-pooling finds place to make more effective use of raw materials. In accordance with this also new technologies are examined to provide renewable and clean energy. Tools that can establish these services can be communicative in nature. By providing information and knowledge on how to make more efficient use of space and energy, these measures will become attractive for businesses. By investing in new technologies they can cut back on their energy bill.

Conclusion

London and Rotterdam try to integrate ecosystem services by combining multiple tools. The best practices that are discussed above can serve as an example of such an integration of tools and ecosystem services. The services cannot be addressed separately and in the same way separate tools cannot address an ecosystem service. They have a mutual relationship so to say.
From these best practices it can be recognized that London mainly combines financial incentives with communicative measures. Financial measures never stand alone, a great involvement of the people is necessary to make it work and to make them collaborate in the project. In Rotterdam the main focus is still on regulatory measures, but there are many initiatives that focus on a combination with financial and communicative measures. New projects that are established show that financial and communicative measures are integrated to create investment and support for the project.
The examples show that most tools for the implementation of ecosystem services address artificial measures. Strict natural measures were hardly incorporated in policies of spatial planning. Urban design plays an important role in the planning practice and is also highly involved in the implementation of urban ecosystem services.

Chapter 5 Discussion and Reflection

In this research an attempt was made to fill the implementation gap that existed because the current understanding of ecosystem services did not answer to the needs of current governance and management in spatial planning. I tried to fill this gap by analyzing policy documents in order to search for ecosystem services and associated tools. In this manner I was able to analyze which tools would be able to manage certain ecosystem services. I have to be modest in this research and reflect that more elaborate and extensive research is needed in order to fill the implementation gap.

In this research I have chosen to use qualitative research methods to gain in depth understanding on the concept of ecosystem services and how they are being addressed in policy documents. The main reason for this was because these services contribute to human benefit, therefore the value we assign to these services is the central issue of this research. With qualitative research it is possible to understand the value of the services and to investigate by what means they are addressed in policy documents. In order to come with an attempt to close this implementation gap it is of paramount importance to understand the different services and to understand how these can be incorporated in planning. Although qualitative research is of great importance in this research it also has some shortcomings that can be discussed. Namely that qualitative research is a matter of interpretation, I am the one who made the codes and I chose which ecosystem services where suitable enough to compare. The theory from literature in chapter two was utilized to create a framework with indicators and criteria. This makes that the research can be assessed based on this framework. The theoretical underpinning is essential for the value of the outcomes of this research. Without a basic understanding of the ecosystem services and an understanding of the context of the planning system, a comparison would be useless. Shortly, it is very important to consider that to a certain extent the choices that are made in this research are subjective. But, based on extensive scientific literature the foundations for this research are laid in an objective framework. This is necessary in order to generalize the research and to make it helpful in the contribution to understand how the implementation of ecosystem services can be improved. These characteristics of ecosystem services made the analysis of ecosystem services in the policy documents rather complex. This complexity is acknowledged in this research, and demands some modesty in the conclusions of this research. Nevertheless, this research has succeeded in contributing to the understanding of how ecosystem services can be implemented in spatial planning in the coastal zone.

The comparative case-study research that I have done is just a small part of the big picture of ecosystem services in the very differing fields it is occurring. The coastal zone in combination with coastal planning is one of these fields. And Rotterdam and London are two harbor cities of many in the world. A lot of differences exist in coastal zones and their ecosystem services all over the world. Multiple ecosystem services are mentioned in the policy documents of London & Rotterdam, but often the reason why this ecosystem services is favored instead of others is lacking. Additional information on the working of these ecosystem services and how they can render benefit for human use is often unclear. The implementation of these services are therefore sometimes hard to identify in the different policy documents in both cities. In the strength of the ecosystem services also lies its difficulty for me as a researcher. The ecosystem services are strongest in collaboration, this often results in overlap between different services which makes it hard to distinguish the different services. In addition to this a part of the ecosystem services was hard to recognize in the policy documents because of their indirect influence to human benefit. Some ecosystem services i.e. supporting or ecological services often don't have a direct influence

on human benefit. In relation to this it is difficult to give value to these kind of services, because our society is mainly based on economic aspects. Therefor it is challenging to establish policy that addresses the ecological importance of ecosystem services on the same standards as other direct ecosystem services i.e. with regard to energy and food production.

In my opinion the comparative research has succeeded in providing some examples of how ecosystem services can be implemented in a right way through the combination of different tools. An ecosystem service never stands alone, it is always in connection with other functions, services and benefits. Communication, collaboration and integration are three key words in the implementation of ecosystem services. This research aimed to create a framework of tools to implement in coastal planning. The framework is there based on the results of the document analysis. The framework is no panacea, but it can give an insight in what tools are suitable to implement ecosystem services in coastal planning.

Still there is a lot that needs to be done. Governance has to change their policy on implementation in order to close the implementation gap successfully. The emphasis must be directed at collaboration between different services, tools and stakeholders. Scientists and other stakeholders should share their knowledge on ecosystems and the communication to the public is also very important. In this manner the social context can be shaped and reformed, stakeholders can become aware of the paramount importance of implementing ecosystem services and may come together with all their perceptions, resources and knowledge to work towards one goal. Because in the end the ecosystem services get their value through the benefits people derive from the services.

Chapter 6 Conclusions and recommendations

6.1 Conclusions

The ecosystem services approach is currently widely acknowledged due to several contributing programs. The mainstreaming of the ecosystem services approach in policies was one of the aims of the millennium ecosystem assessment program and this has led to increased attention for the ecosystem services in spatial planning. Although the ecosystem services are increasingly addressed in policy in general, from the literature research it was found that an implementation gap exists between current policy in spatial planning and the operationalization in practice. The biggest challenge was to integrate the ecosystem services approach and to enable operationalization of the concept of ecosystem services into policies and to implement this in practice. This is a very big challenge in the field of spatial planning and mainly considers the linkage between knowledge, policy and practice. The contribution to the knowledge part can mainly be addressed to the millennium ecosystem assessment and other programs. Also in policy contributions to mainstreaming have taken place. But till now, these developments have not yet resulted into operationalization of the ecosystem services approach in spatial planning. This study has taken up the challenge to gain more understanding in the linkage between policy and implementation of the ecosystem services.

This research has focused on how ecosystem services are addressed in policy on different levels in London & Rotterdam. Both London & Rotterdam are situated in the coastal zone which is of high interest for this research. Coastal zones are highly vulnerable areas due to the high amount of people living in the coastal zone and to the high pressures that exists because of climate change and ongoing changes in the environment. Ecosystem services have great potential in creating more sustainable spatial planning solutions for the future especially with regard to water management. Through an analysis of the ecosystem services and tools that are addressed in policy documents the implementation gap is investigated in order to learn lessons and establish a framework that gives direction for future implementation.

The main purpose of this research is to establish a framework of tools for implementing ecosystem services in spatial planning. This framework will be presented in the end of this chapter. The concept of ecosystem services is very diverse and comprehensive. There are four basic categories that can be distinguished to divide the different ecosystem services, that are the provisioning services, regulating services, cultural services and provisioning services.

The comparative case study analyzes how the ecosystem services are addressed in current policy documents, and the tools that are currently available in spatial planning are analyzed. What can be found from this research is that ecosystem services are widely addressed in the policy documents, but mostly indirect and much overlap exists between different services. In addition to this the linkage between existing policy and the implementation in practice is lagging behind. Due to the complexity of ecosystem services in valuing and translating them into practical services for human well-being, the operationalization of ecosystem services asks for integrative and explicit management. Although the analysis of the available tools in spatial planning shows that there are measures with the potential to incorporate ecosystem services for implementation. The most important aspect in closing the implementation gap for ecosystem services is to combine different tools in addressing multiple

ecosystem services. Ecosystem services don't stand alone, its potential can only be realized through the integration of different measures on different scales and levels. This research provides a framework of which tools can be utilized for the different ecosystem services as a result of the comparison of ecosystem services and tools in London & Rotterdam.

It can be said that the provisioning services were addressed predominantly in the policy documents at all the scales of policy levels. The provisioning service are in a direct relationship to the needs of people. People rely for instance on food and water. This makes them rather dependent on the these provisioning services. This direct and tangible linkage makes that these services can more easily be recognized by the people to be of great importance. In addition to this relatively few supporting services were found in the policy documents. The adverse reasoning could be used to explain why there is little attention for the implementation of the supporting services. Although there are acknowledgements in the documents on the importance of supporting services, operationalization of these services is lagging behind.

A result of the comparative case study is that ecosystem services are highly context specific, especially with regard to measures that can be taken. The institutional context in spatial planning is already focused on specific types of measures. The ecosystem services approach is fitted into this context and to this existing measures. England for instance has a large tradition in land use management which is highly based on negotiation. From this tradition the communicative tools receive a lot of attention. With these tools the spatial planning can extend its attainment on communicative tools with the implementation of ecosystem services. What is reviewed in the comparative case study is that an integration of tools is acknowledged to be of great importance to operationalize ecosystem services in practice. So besides using tools which planners are already familiar with, alternative tools can be incorporated in the planning context to improve the methods of implementing ecosystem services. The ecosystem services approach ask for a different focus because it aims at a shift in addressing indirect and direct services to be integrated in the planning context. The ecosystem services need to be the central tenet in the spatial planning. In the current planning ecosystem services are addressed to a certain extent, but to use its full potential is still a great challenge. To be able to operationalize the planning system in order to utilize its full potential it is most important to search for alternative methods and to incorporate these with the existing methods. A decision context has strengths and weaknesses, the successful tools can be expanded with alternative measures to centralize the ecosystem services within the existing methods.

Finally this research has sought an answer to the main question; 'how to establish a framework of tools for implementing ecosystem services in spatial planning?' From this research it can be concluded that such a framework can be established by means of a comparative case study research. This framework is an attempt to indicate how various tools can serve the implementation of multiple ecosystem services. The results show that there are many possibilities in addressing a combination of ecosystem services with a combination of tools. The implementation of the ecosystem services in practice mainly can be improved through integrating the tools and services. What stands out from the study is that no ecosystem service stands alone, the interrelationship between the different services is of pivotal importance in understanding and implementing the services. In order to render benefit for human use, we need to consider these inter-linkages between the ecosystem services and integrate tools in policy for operationalization. Basically the tools for implementation are already available in the current practice of spatial planning. In order to solve the implementation gap it is important to join forces regarding to tools and to the ecosystem services themselves. As said before the ecosystem services are very much interlinked, often show overlap and differences are noticeable in whether they are directly or indirectly influencing human benefit. These characteristics of ecosystem services make it rather difficult to capture their operation in terms of measures. This is very important to incorporate in setting up policies for

implementation with regard to the ecosystem services approach. The characteristics and the interrelationships of the services must be understood and furthermore translated into operationalization. This research has modestly contributed in setting up a better understanding of the characteristics of the ecosystem services with regard to the operationalization in spatial planning. The comparison and the best practices have offered different manners to implement different (urban) ecosystem services. Finally the framework has offered an overview and guideline in what ecosystem services can be implemented by what tools. From this research we can conclude that in order to achieve implementation of ecosystem services an integrative approach is needed. The great potential of the ecosystem services lies in the fact that they gain strength in collaboration. Therefore different tools must be used in collaboration as well, to be able to utilize the full potential of the ecosystem services.

6.2 Recommendations

Recommendations for Rotterdam include and increased focus on supply and demand management. By involving the residents in the quest to a more efficient use of energy, the demand of energy can be reduced. The problem with the current supply of energy is that we will run out of raw materials to produce energy, therefore we must find new renewable sources of energy to keep up with the production that is needed. This is one side of the story, the other side is that by decreasing the demand for energy less supply is needed. From this perspective demand management and more effective use of energy can help in solving the problem of insufficient energy supply in the future. This is not a direct provisioning service, but it can contribute in improving the benefits of the ecosystem services for human wellbeing.

London has a great tradition in planning with a focus on communicative tools of planning. The process of negotiation plays an important role in this planning context. This has also emerged due to the divided ownership of land, here for the different private stakeholders have important powers in the debate. To reach one goal a consensus is needed and therefore negotiation is the basis to reach such a common objective between the different stakeholders. This planning system has some benefits, but also has its drawbacks. Discretion in planning and packaging of interests are important features in the spatial planning of the United Kingdom. These features allow for a more flexible approach towards the planning and implementation of new projects. But this planning approach can lead to uncertainty and ambiguity in the planning practice. Different objectives are achieved by the different stakeholders. In order to achieve a shared objective in addressing the potential of ecosystem services in the implementation of spatial planning, a more stable framework can be helpful as a basic fundament. The supply and demand management in London can be very accommodating in creating a clear structure with involvement of the citizens. Also financial and regulatory measures in relation to communicative measures can contribute in the creation of an efficient planning system in which ecosystem services are implemented.

The planning context of Rotterdam can achieve a better integration and sustainable management through early incorporation of multiple stakeholders and by enhancing the focus on the process of negotiation. In this manner the awareness of the potential for ecosystem services can increase by learning from different fields of knowledge and expertise. A form of discretion in the Dutch planning system can improve the flexibility in planning processes and it can create a possibility for alternatives. The use of forums, innovation platforms and partnerships with private stakeholders can contribute to understand and implement the full potential of ecosystem services. Alignment within governance in establishing policy for implementation is of key importance. The communicative measures can be embedded in financial and regulatory measures which have been widely developed before.

The communicative measures mainly have the aim to convince governments, stakeholders and citizens that the ecosystem services have great potential to render human benefit and implementation of this is necessary. A great number of possible tools is currently available in both planning contexts that have the potential to implement ecosystem services. The best practices show that an integration of different measures that address different types of ecosystem services are most likely to implement ecosystem services. Different tools are very much complementary and the same can be said about the ecosystem services. Therefore no direct distinction can be made between which measures to address which ecosystem services. For tools and ecosystem services are not fixed, they change continually. Rather the lesson of this research is to collaborate, to keep our eyes open and to remain flexible for alternatives.

Finally this research can recommend to the policymakers from both cities to incorporate combined ecosystem services in the spatial planning practice by means of combined tools. From thorough research in scientific researches their turned out to be an implementation gap with regard to ecosystem services. The mainstreaming had already mainly taken place in policy documents. From the comparison between London & Rotterdam it became clear that ecosystem services indeed are widely addressed, although the operationalization is lagging behind. First of all the characteristics of different (urban) ecosystem services must be addressed more detailed in the policy documents. This can give a concise and clear view on the potential of these services and what measures they require. Also the interrelationships between the different ecosystem services and how they can be combined to render their full potential must be investigated. From this the link can be made to the available tools in the practice of spatial planning. In combining financial, regulatory and communicative tools, ecosystem services are most likely to be addressed with regard to their full potential. Interesting characteristics in spatial planning that can help in the implementation of ecosystem services are for instance the packaging of interests. In my opinion it can be very helpful to involve private stakeholders in the operationalization of ecosystem services. Often business parties have possibilities for investment and have a differential knowledge base, which can be complementary to the resources of governments. In this manner the strengths of both parties can be combined in order to implement ecosystem services. Different tools can be combined, as said before collaboration is very important in utilizing the full potential of the ecosystem services. In spatial planning these kind of collaborations can render benefits for both parties in enabling them to benefit from the ecosystem services to a higher extend. The packaging of interests is already often taking place in Londen, whereas in Rotterdam these types of collaboration are mainly happening in the public-private partnerships. Both planning systems do account for types of collaboration to join forces and to combine both the tools and the ecosystem services in order to utilize the full potential in implementing the ecosystem services. Combining forces is of pivotal importance in establishing a framework to implement multiple ecosystem services with multiple tools in the practice of spatial planning.

6.3 The Framework

The framework, as is shown in table 6.1, now provides an overview of what tools can be linked to the different categories of ecosystem services. It thereby also addresses who is involved in implementing the tools and with what aim. At last some benefits and drawbacks will be mentioned in short. This framework is a summary of the literature review and the following comparative case study research that is presented in this thesis. It is not established to cover the complete picture of measures to implement ecosystem services. This framework is set up with regard to the specific context of both case studies. This framework can serve as a guideline that indicates measures that can be taken in the implementation of the ecosystem services approach in the coastal zone.

The guideline can be used by policy and decision-makers in the field of planning. For each category of ecosystem services it is outlined what type of measures can be taken with a division in financial, regulatory and communicative measures. With this basic set-up it the framework follows the pattern of this thesis in the classification of ecosystem services and tools. Policy and decision-makers can utilize this guideline in a situation where implementation of ecosystem services is intended. Through determining the type of ecosystem service, a decision-maker can easily recognize the possible tools that are appropriate for the implementation of that type of ecosystem services. The involved parties are included to clarify what stakeholders are included in this process and who can be held responsible for the performance. Further on specific tools and instruments are mentioned to give some tangible ideas and examples of methods for implementation and the objective of these measures are shown. In addition to this a short description of the benefits and drawbacks are displayed in order to contribute to the understanding of the impact of the tools and instruments. This framework provides policy and decision-makers with an overview of the tools and instruments that can apply for the ecosystem services and addresses some key characteristics of the measures that can be taken. As a result, the framework can be utilized as a guideline in the planning process in selecting the tools and instruments for the implementation of ecosystem services.

Ecosys-tem Service		Who is involved?	Tools & Instruments	Aim	Benefits	Drawbacks
Provisioning						
	Financial	Government Private companies local residents	-charging based tariff system -funding	Less and more efficient energy use	Strong incentive	No binding framework
	Regulatory	Government private companies local residents	-abstraction licenses -twin-track approach -compulsory metering	Minimize demand Efficient supply	Proper adjustment of demand and supply	Legislation leaves little space for innovation
	Communi-cative	Government Private companies Local communities	-innovation platform -smart metering -hydrogen partnership -energy labeling	create awareness and willingness	Private involvement Collaboration	Not binding
Regulating						
	Financial	Government Private parties	-subsidies -water fund -cost-benefit analysis	Alternative sources of investment	Partnerships can provide larger investment	Dependable on market
	Regulatory	Government Private parties	-building permits and legislation -safety reviews -mitigation	Guarantee safety Direct new developments	Public sector responsibility	Lack of community involvement
	Communi-cative	Local communities	-educational program	create awareness and	Voluntary tool, support and	Difficult to get investment

			-provide training and guidance -design contest -forum	willingness generate knowledge and expertise	involvement of the people	
Cultural						
	Financial	Government Private companies	-compensation -private investment -subsidies	Restore and improve cultural value	Collaboration	Difficult to get investment Low profit
	Regulatory	EU policy Government Environmental organizations	-directives -frameworks -restrictions	maintain cultural value mainstream cultural services	Giving responsibility	Lack of community involvement Harsh measure
	Communi-cative	Government Private companies Local communities Environmental organizations	-forum -liaison panel -political campaign	create awareness and willingness	Voluntary tool, support and involvement of the people	No strong incentive
Supporting						
	Financial	Government NGO's	-Subsidies and grants -cross-compliance	Invest in ecological quality	Reward makes it attractive to invest	No economic trade-off
	Regulatory	Government Environmental organizations	-Buffer and conservation zones -habitats regulations	habitat protection Improve ecological quality	Regulation is binding	No space for innovative solutions
	Communi-cative	Local citizens NGO's Environmental organizations Local communities	-best practices -eco-marshals	Promote behavioral change	Attractive to invest voluntary	No economic trade-off

Table 6.1: Framework of implementation of ecosystem services

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Appendix: Results

Ecosystem services addressed in London policy documents

Strategic plan

Category	London
	The London Plan
Provisioning	
Soil	-
Energy production	- Energy efficient buildings, buildings using natural systems including passive solar design or local ecosystems - Decentralised energy, such as district heating and combined heat and power, Identify heat loads and possible heating and cooling networks - On-site renewable energy technologies: biomass heating, solar water heating, wind and heat pumps, etc. - Energy Hierarchy: 1 Be lean, use less energy; 2 Be clean, supply energy efficiently; 3 Be green, use renewable energy. - Decarbonise energy supply - Energy assessments - Retrofitting energy - Utilise energy from waste - Electric hydrogen fuel cell vehicles and hydrogen supply - Advanced conversion technologies for waste treatment - Green roofs
Food and resources Production	- Green roofs - Local food production - Food production on the fringe of the city
Water supply	- Minimise use of mains water (demand management) - reaching cost-effective minimum leakage levels - provision of additional sustainable water resources - minimise the amount of energy consumed in water supply - Promote the use of rainwater harvesting and using dual potable and grey water recycling systems - Incorporate water saving measures and equipment
Coastal space for industry, development and infrastructure	- Higher order uses of inert waste in conjunction with land reclamation or coastal defences.
Regulating	
Waste treatment	- recycling facilities at aggregate extraction sites

	- utilise energy from waste using advanced conversion technologies - reuse of construction materials - producing renewable energy for organic/biomass waste - Reduce amount of waste. Or follow the waste hierarchy: re-use waste, recycling and composting, before energy recovery and disposal. - dual potable and grey water recycling systems - New construction, excavation and demolition (CE&D) waste management facilities - using mineral extraction sites for CE&D recycling
Climate regulation	- retrofitting the substantial stock of existing buildings - expansion of 'green' business sector for sustainable energy - green roofs - mitigations measures to reduce climate change impact, through reducing emission of greenhouse gases - Follow cooling hierarchy: for example reduce the amount of heat entering a building through natural measures as green roofs. - urban greening and green infrastructure can adapt and mitigate the impact of climate change - Cleaner hybrid and hydrogen buses and fitting older buses with equipment including filters to curb pollution and improve air quality - increase the use of the Blue Ribbon Network
Flood, storm prevention	- sustainable urban drainage systems - Strategic Flood Risk Appraisals - Redevelopment of sites at risk of flooding
Erosion and siltation control	-
Water purification	-
Water regulation	- green roofs - Blue Ribbon Network (BRN) London's strategic network of water spaces, where water bodies are linked. - Open culverts and naturalize river channels - protect the foreshore of the Thames and tidal rivers and resist the impounding rivers - Sustainable Urban Drainage Systems (SUDS) - Drainage hierarchy: - store rainwater - use infiltration techniques - attenuate rainwater and release gradually - discharge rainwater to a watercourse or surface water sewer/drain
Cultural	
Education/ science	- BRN is a valuable educational resource - enhance education in particular to healthcare and bio-technology - promote clusters of research and innovation
Aesthetic/ spiritual	- Identify landmarks that make aesthetic and cultural contributions to the view. - creating a sense of place and make greater appreciation possible
Recreation/ tourism	- BRN is an appropriate setting for leisure activities and public art and performance - Green Arc vision, creates and protects recreational landscape - Regional parks
Cultural heritage and	- BRN has value to local character

identity	- landmarks, world heritage value - Townscape heritage initiative, Heritage funds
Supporting	
Maintenance of biodiversity and nature	**-** agri-environmental stewardship, green belt - Brown/green roofs - Green infrastructure - mitigation of new development - Improvements in biodiversity in BRN - Regional parks: combining recreation with nature - Special areas for conservation or protection and biodiversity action plans - control of invasive species - removal of toe-boarding
Nutrient cycling	-
Storage/ Retention	-

Sectorial plan: water

Category	London	
	The London water strategy, securing London's water future	**Water, for people and the environment**
Provisioning		
Soil	-	- Soil compaction, improve recharge to groundwater
Energy production	- retrofitting existing buildings - waste as source of lowcarbon energy - sludge strategy: maximise energy recovery and minimise sludge volumes - convert UCO into biodiesel	- abstraction licenses for hydropower and heat pumps
Food and resources Production	- sewage sludge for agricultural use, as fertiliser	- urban agriculture
Water supply	- freshwater catchments - Reducing water demand, changing behaviour - Reduce demand for bottled water, install publicly accessible drinking water To increase water supply: - Increasing abstraction - Desalination - indirect re-use with temporary storage in watercourse - Raw water transfers - Groundwater recharge	- Water abstractor groups - twin track approach: supply and demand management - rainwater harvesting - grey water recycling - Tighter standards for water efficient fixtures, fittings and appliances - Reduce and control leakage - Desalination -
Coastal space for industry, development and infrastructure	-	-
Regulating		
Waste treatment	- Sewage sludge for agricultural use, as fertiliser - Wastewater as source of lowcarbon energy	- more re-use of highly treated effluent
Climate regulation	- age limit for 'black cabs' and new bus of London with green technology - Low Emission Zone - Eco-marshalls to monitor air quality	- adaptation and mitigation - Effective use of available water and reduce risks - Encourage resilience in the face of uncertainty - reduction of carbon emissions
Flood, storm prevention	- Drain London Forum, consistent approach to flood risk, creative approach - Community Flood Plan Programme - Urban greening measures - Local Flood Risk Zones	- soil compaction can reduce risk of flooding - increasing the area of functioning flood plains and wetlands

Erosion and siltation control	-	-
Water purification	-	- 'At source' initiatives, i.e. reduce nitrate and phosphorus losses from agriculture - Broadleaved woodland can improve water quality and reduce siltation, pesticides, euthropication etc.
Water regulation	- Sustainable Drainage Systems (SuDS), mimic natural drainage Drainage hierarchy: - Store rainwater for later use - Infiltration - Attenuate rainwater - Discharge rainwater, to watercourse, to a drain and to the sewer - Use rainwater for non-potable use - Licenses to take surplus groundwater	- Sustainable Drainage Systems (SuDS) - Green roofs - rainwater harvesting - permeable pavements - restore and create natural watercourse corridors, wetlands, reed beds and ponds. - slow water down - wider buffer strips adjacent to rivers - greater local and inter-basin connection between supply infrastructure - improved base flows in rivers through land management techniques - **Ecosystems approach** to managing resources on a catchment scale
Cultural		
Education/ science	- Innovative and informative metering	- improve understanding of the risks of climate change - People must understand that water is vital to the economy - develop science-based understanding, continued investment - Develop new technologies, promote best practices, execute pilot projects
Aesthetic/ spiritual	-	- water contributes to the quality of life
Recreation/ tourism	-	- protecting flows also provides for recreational activities - water related recreation
Cultural heritage and identity	-	- protect archaeological features
Supporting		
Maintenance of biodiversity and nature	- restoration of degraded tributary rivers	- developing coherent ecological networks that link large-scale functioning habitats and provide **'stepping stones'** to help ecology adapt as the climate changes - protection of bird and wildlife trusts - restore wetlands to help rare habitats and species - improve freshwater ecology adaptation - landscape-scale approach to managing habitats
Nutrient cycling	-	
Storage/ Retention	-	- restoring upland wetlands will help to slow run-off and protect peat, which is an important carbon store.

Specific plan: Delta and coastal management

Category	London	London
	River Basin Management Plan	**Thames Estuary 2100 plan (TE2100)**
Provisioning		
Soil	-	-
Energy production	-	-
Food and resources Production	-	-
Water supply	- aquifers supply drinking water and provide flow for rivers and wetlands - reduce surface water run-off - balancing of water abstraction	- enhancement of freshwater and grazing marsh
Coastal space for industry, development and infrastructure	- providing deepwater facilities for international marine traffic - strong emphasis on high tech industries	-
Regulating		
Waste treatment	- waste bioremediation centre - grey-water recycling systems in homes or workplaces - Re-engineer existing discharges to avoid direct discharges of pollutants to groundwater - improve sewage works to reduce inputs of nutrients and improve shellfish waters - Take waste oil and chemicals such as white spirit to a municipal recycling facility: don't pour them down the sink or outside drains - Imply measures in households to prevent pollution	-
Climate regulation	- agriculture will respond to changed climate	- climate change adaptation and mitigation - reduce emissions and carbon footprint to slow the rate of change
Flood, storm prevention	- physical modification of water bodies - flood defence structures to protect against abnormal high tides	- test flood risk management measures - Improve existing defenses - tidal flood storage - new barrier - barrier with locks - Increase standard of protection to 1:10.000 year level - provide advice to local communities on what to do before, during and after a flood - Thames barrier: to reduce fluvial flood levels

		- secondary tidal defenses along the Thames frontage - flood forecasting and warning system - intertidal habitat can absorb wave and surge energy and protect the land and defense structures behind
Erosion and siltation control	- Sediment used to create bankside enhancement to form soft vegetated margins	-
Water purification	-	-
Water regulation	- aquifers supply drinking water and provide flow for rivers and wetlands - Hydro morphological conditions of the flow and form of the water - enforce Nitrate vulnerable zones in catchments - Catchment Sensitive Farming - restore floodplain habitat - physical modification of rivers and estuaries	- Restore estuarine ecosystems - maximize benefits of natural floods - creating a mosaic of tidal, brackish and freshwater habitats - groundwater flooding via permeable superficial deposits that connect the Estuary with the floodplain
Cultural		
Education/ science	- further investigation of habitat restoration - input of local data and knowledge - guidance and training for planning authorities - Share knowledge with liaison panels	- TE2100 catalogue on information and data sets
Aesthetic/ spiritual	- bankside habitat will improve aesthetics along the canal - iconic river	- River habitats make the estuary a beautiful and valuable place
Recreation/ tourism	- Recreational water activities - fish pass structure with canoe passes to support recreation	- recreational fisheries - habitat creation provides opportunities for recreation and visitors' centres
Cultural heritage and identity	-	- enhancement of historic environment - Natural England and English Heritage
Supporting		
Maintenance of biodiversity and nature	- bankside enhancement to improve biodiversity - provide sites for feeding and roosting of wintering wildfowl - monitor non-native species - create reed bed and wetland scrapes - Eat fish from sustainable sources - Fish pass structures - Disseminate and develop species identification guides	- Coastal grazing marshes - Habitat creation identified by the Greater Thames Coastal Habitat Management Plan (CHaMP) - Intertidal habitat creation - retain marshes as important green space
Nutrient cycling	-	-
Storage/ Retention	-	- use of marsh area for flood storage

Tools in London spatial planning policy

	Tools	Financial	Regulatory	Communicative
London				
Strategic plan	*The London Plan 2008*	- Innovative funding techniques: Tax increment financing, allowing future tax income in an area to support local development. - Community Infrastructure Levy - Public funding - Heritage Economic Regeneration - Buildings at risk Grants	- Target Emission Rate (TER) outlined in the national Building Regulations - Development proposal must comply with the planning policy statement on flood risk management - Special area of conservation (SAC) - Special protection area (SPA) - Integrated Impact Assessment (IIA) covers the legal requirements to carry out a Sustainability appraisal (SA) including a Strategic Environmental Assessment (SEA) and a Habitats Regulations Assessment (HRA) - Government has put legislation to introduce a Community Infrastructure Levy (CIL)	*The Mayor aims to raise awareness and promote behavioural change* -The Mayor promotes: - Green Enterprise District - sustainable energy use - Food to Fuel Alliance Programme (turning London food waste into renewable energy) - Demolition Protocol (to support recycling and reuse of construction materials - London Hydrogen Partnership - London Heat Map tool - The Mayor lobbies for public funding and institutional investors - Public-Private partnership - The Mayor and the Greater London Authority (GLA) will provide information and communication technology - Forum of academics and other stakeholders - Independent panel to give consultation on the London Plan - Empower communities, neighbourhoods, voluntary groups, local businesses and organisations and other interest groups
Sectoral plan: Water	*The London water strategy*	- Meters combined with tariff based water charging system, with incentives and rewards for water efficiency - 'rising block' tariffs - 'seasonal' tariffs - brokerage service to encourage the use of biodiesel in public sector transport fleets - (Government) funding - WaterSure is an existing water	- Government has committed energy companies to install 'smart' energy meters in all UK homes by 2030. - Compulsory metering of water to balance supply and demand - Water Resource Management Plan (WRMP) - Environment Agency (EA) regulates the release of sewage effluent by providing 'consents to discharge' - Climate Change Act 2008 - The Floods Directive	- The Green Lease Toolkit enables landlords and tenants to work together to improve the energy efficiency of buildings to the benefit of both parties. - Smart metering increases the understanding of water for their customers - Drain London Forum: Developing a Community Flood Plan and providing demonstration projects to show how urban greening measures can help to manage surface water flood risk. - Mapping, identifying and prioritizing flood risk areas

		affordability assistance scheme, it works by capping bills for people who struggle to pay their water bills.	- Standards for the low Emission Zone - Abstraction license for water companies - Planning permission is required for impermeable surfaces in front gardens larger than five square meters. - temporary bans or restrictions on the use of hosepipes and sprinklers for watering private gardens - Age limit for 'black cabs'	- Indicative Potential for Elevated Groundwater (IPEG) should improve the awareness and understanding on the risks of groundwater flooding. - Raise Londoner's awareness of the financial benefits of increased water efficiency - Improve water company customer engagement by providing useful information on efficient use for example by informative water bills. - London on Tap campaign was launched in February 2008 by the Mayor and Thames Water to promote tap water in London's restaurants, cafes and pub - The ConnectRight campaign brings together a range of partners to tackle water quality problems. - The Mayor will lobby government to ensure that improving the water efficiency of homes is promoted and supported in the Water White Paper and the Green Deal.
	Water, for people and the environment	-Smart metering with integrated or complementary future tariffs for energy and water (variable conservation tariffs). With future opportunities for retail competition - an element of the energy companies' income is put towards a fund for the installation of efficient devices and energy saving technology. - Water companies should be required to contribute to a water efficiency commitment where companies fund efficiency measures for their customers and act in a service provide role - Water companies should be funded to make payments to land managers to use land management practices that protect and improve water quality and water resources. - for the longer term abstraction	- UK Carbon Reduction Commitment (CRC) - Water companies are legally required to prepare water resources management plans. - Ofwat is introducing water efficiency targets for water companies, where each company has an annual target to save water. - European Water Framework Directive (WFD) - The European Habitats and Birds Directive - EA has duties to protect and improve designated sites. - turning abstraction licenses into reviewable permits which can be modified regularly. - impose restrictions on irrigators along with associated charging agreements - shift towards public ownership of key utilities	- Smart metering with multi-utility information to be displayed in the home and on bills - Simple demand management measures have huge potential to improve water and energy efficiency and to reduce the carbon footprint of water supply, use and disposal. - Smart meters can give consumers better information about the water they use and can encourage households to use water more efficiently. - energy labeling - energy saving trust - it is critical that the public accepts treated effluent as a way of sustaining the water environment. - Voluntary initiatives such as the England Catchment Sensitive Farming Delivery Initiative (ECSFDI) can provide financial incentives and advice for land managers to adopt practice. - websites where consumers can evaluate the water footprint of their shopping habitats. - the Consumer Council for Water suggests that water conservation programs should focus to move users to become 'able' and 'willing' to conserve water. - Water Saving Group, they suggest that there is a

		license charges to fund the costs of integrated catchment management. - capital grants - Water pricing for the abstraction and use of water acts as an incentive for the sustainable use of water resources. - Not-for profit model where financial surpluses generated are invested back into the water business to reduce financing costs. - Voluntary changes to water company licenses that are needed to meet the requirements of the Habitats Directive can be funded through the 2009 water company price review process.		need for one organization to coordinate messages to make sure there is a consistent and more effective approach - allow water companies to address affordability issues with customers - allow people to use water more efficiently, and improve the efficiency of fixtures, fittings and appliances
Delta and coastal management plan	*River Basin Management Plan Thames district*	- Cross-compliance, give subsidies to farmers to comply with a range of directives to reduce pollution from agriculture. - the EA funded a dredging program	- Government can consider further restrictions of activities with chemicals - Cross-Compliance, to help farmers to comply with a range of directives to reduce pollution from agriculture - Designate and enforce Water Protection Zones - Water Framework Directive - Measures to mitigate against diffuse pollution include promotion of Codes of Good Agricultural Practice (CoGAP) and the use of soil and nutrient management plans. - The CRC Energy Efficiency Scheme is a legally binding scheme, which covers large business and public sector organizations, and is intended to promote energy efficiency and help reduce carbon emissions. - New European Floods Directive - implementation of the Sustainable Use of Pesticides Directive - Implement the water related actions of the Invasive Non-native Species Framework Action Plan for Great Britain (Defra, Environment Agency). -	- Pollution prevention campaigns and other voluntary agreements - Voluntary Initiative best practice on pesticide use by land managers within the agricultural and amenity sectors - Promote the 'Best Farming Practice' - Maintain a nationally funded advice-led partnership under the England Catchment Sensitive Farming Delivery Initiative. - EA will work with the Farming Wildlife Advisory Group to promote soil and nutrient management plans to local farmers - Voluntary campaigns and mechanisms - EA works with the river basin district liaison panels and welcomes the input of local data and knowledge from other parties. - Reduce leakage through active leakage control and customer supply pipe repair policies to help ensure sufficient water for people and wildlife - Implement Communities and Local Government (CLG) Planning Policy Guidance Statement 23 (PPS23) - Local campaign to decrease input of nitrates to

				groundwater body - work with other public bodies to develop good links between river basin management planning and other relevant plans and strategies - Environment Agency should encourage public bodies to include Water Framework Directive considerations in their plans, policies, guidance, appraisal systems and casework decisions. - Consumers can report pollution or fly-tipping to the Environment Agency on 0800 807060 - Establish invasive non-native species forum to coordinate action across Thames River Basin District and produce a non-native species management plan - Disseminate and develop species identification guides and train key groups, to improve early detection of invasive non-native species (Natural England) - Where appropriate, industry will participate in pollution prevention campaigns and to investigate further actions. - Other local measures aimed at reducing demand for water will be centered on working in partnerships to promote and encourage water efficiency through campaigns and advice. - environmental organisations can influence environmental quality through the land they own or manage - river basin liaison panels - maximum involvement and action from locally based organisations and people, because **implementation** requires activity 'on the ground' - Join a river group to spot pollution, invasive non-native species, and take part in practical tasks.
	Thames estuary 2100 plan		- Greater Thames Coastal Habitat Management Plan (CHaMP) - Habitats Regulations Assessment (Appropriate Assessment) Under the Habitats Directive	- providing advice to local communities on what action they can take before, during and after a flood. - Public awareness should be raised to facilitate emergency planning and response. - There is also a need to raise awareness of the flood risk for residents, commuters and tourists.

Ecosystem services addressed in Rotterdam policy documents

Strategic plan

Category	Rotterdam	
	RR2020	**Groenblauwe structuur**
Provisioning		
Soil	-	-
Energy production	- Wind turbines - energy efficiency through integration - use residual heat from industry	- wind turbines
Food and resources Production	- sustainable resource management - small and 'green' agriculture	- locally produced food - urban agriculture - multifunctional agricultural businesses, include, home sales, care, recreation and education
Water supply	- Water hierarchy: cleaning, separating and purifying - groundwater protection area	- fresh water supply
Coastal space for industry, development and infrastructure	- clustering and co-siting - More intensive use of scarce space in harbour - double land use - Land reclamation:2e maasvlakte with compensation measures - Project Mainport Development - City harbour	- Areas outside the dikes are incremented - Main ports, brain ports and green ports
Regulating		
Waste treatment	- sanitation of greenhouses	- sanitation of greenhouses
Climate regulation	- develop salt loving nature to capture the loss of freshwater due to climate change - urban areas should retain rainwater - Emission limits - Efficient traffic flows, promote public transport	- reduce CO2 emissions - Reduce heat stress in the city by providing green areas that offer cooling - robust water system - climate buffers, to make a higher fluctuation level possible - green roofs
Flood, storm prevention	- improve coastal defenses - gain insight in flood risk for areas outside the dikes - risk of inundation	- 'Zandmotor', additional broadening of the coast - improve coastal defenses - additional row of dunes
Erosion and siltation control	-	-
Water purification	- natural purification at inlet points - reed filters - surface water purification	- reed bed for purification and habitat
Water regulation	- broadening of watercourses	- broadening of watercourses

	- regulation hierarchy: hold-store-discharge - temporarily increase of water level	- main catchment channels keep polder system together - flexible management of the level of fluctuation - dynamic waterflows through estuary and harbors
Cultural		
Education/ science	-	- Agriculture can offer education - urban agriculture can teach youth about food production - information signs on in nature and recreation areas - excursions in nature - knowledge centre for recreation
Aesthetic/ spiritual	- river gives identity to the region, panorama	- wind turbines have great impact on the experience of the view - highlight the natural qualities in the region - create extra viewpoints to enlarge the amenity
Recreation/ tourism	- Agro tourism - transform 5000 hectare of agricultural land into nature and recreation area - regional parks - infrastructure for recreational use - Green infrastructure with recreational function	- ecological and recreational infrastructure - multifunctional agricultural use, agro tourism and recreation - agricultural nature management - Touristic transit points - nature areas outside the dikes have arisen as result of reclaimed dredging
Cultural heritage and identity	- historical delta landscape - belvedere areas	- historical delta landscape - archaeology, historic urban design and historic landscape - cultural and historical pearls
Supporting		
Maintenance of biodiversity and nature	- water pearls: aquatic value - Ecological network (EHS) - Regional parks - green infrastructure - transform 5000 hectare of agricultural land into nature and recreation area - create 2000 extra hectare of wet nature - replant and ecological management on peninsula	- improvement of tidal natural vegetation - marsh habitats - diverse biotopes - reed bed for purification and as habitat - ecological infrastructure - vegetation on riverbanks - agricultural field edge management - Flowery field margins can improve biodiversity and can prevent pesticides - high natural values linked to the dynamics of the sea and the tidal rivers, rich fish population. - construction of habitats for different species - protection of rare species - construct stable ecosystems
Nutrient cycling	-	- closure of cycles
Storage/ Retention	- Peak storage in polders - Water balconies at fringe of urban area - water retention combined with nature and recreation	- temporarily storage rainwater and recover naturally

Sectorial plan: water

Category	Rotterdam	
	Waterplan 2 Rotterdam	**GWM in beeld 2010, water**
Provisioning		
Soil	-	- area-oriented approach to reduce soil subsidence - use underwater drainage to reduce soil subsidence
Energy production	- green roofs	-
Food and resources Production	-	-
Water supply	- supply freshwater through intake points that are less affected by the changing salt regime - separate clean and dirty water - construct new surface water with new developments	- protect the supply of drinking water
Coastal space for industry, development and infrastructure	- Intensive restructuring of business parks - Land reclamation: tweede Maasvlakte - adaptive solutions: floating alternatives - create extra space by filling in harbour basins	- industrial and harbour sites are (artificially) raised above NAP
Regulating		
Waste treatment	- decrease effluent from sewage water - Disconnecting paved surface can be a clean alternative to sewer - disposal of moderately contaminated water through soil or roadside passage - duty of care for effluents	- remediate contaminated sites - research on pesticides
Climate regulation	- flexible management fluctuation level - control rainwater temporarily - adaptive strategy - increase discharge capacity - green roofs establish a better micro-climate	-
Flood, storm prevention	- land elevation - Urban design to reduce harmful effects of flooding - sea walls as part of landscape - communication through evacuation plans - flood beams	- safety test every 6 years on primary coastal defenses - 'Zandmotor': natural sand supplementation - improve coastal defense with spatial quality
Erosion and siltation control	-	-
Water	- Water quality images	-

purification	- dredging, sewage, phosphorus removal - natural purification	
Water regulation	- function follows water level - increase pumping capacity - identify bottlenecks in water system - broad main water course with natural banks - Room for the river - increase discharge capacity	- Room for the river - prevent dike reinforcements by taking measures in the riverbed
Cultural		
Education/ science	- 'living with water' educational aim of urban water - water squares make it visible for residents	-
Aesthetic/ spiritual	- Along the water people find rest, experience - water gives region identity	-
Recreation/ tourism	- recreative route along the river - water pearl: natural banks, better ecology and more space for recreation - water regulation and purification with recreation	- 'Zandmotor' will create extra space for nature and recreation - coastal vision to make the coast more attractive for recreation
Cultural heritage and identity	- river is the life blood of the city	- cultural interests are taken into account in spatial plans
Supporting		
Maintenance of biodiversity and nature	- pike spawning places - fish stock management, diverse fish population - water pearl: natural banks, better ecology and more space for recreation - Ecological infrastructure - realize a fish migration facility	- 'Zandmotor' will create extra space for nature and recreation - dune compensation for 2e maasvlakte - broader dune area with space for nature and recreation
Nutrient cycling	-	-
Storage/ Retention	- water squares in urban area, green roofs, watergardens, 'Wadi's' etc. - seasonal storage - storage and slow discharge of rainwater - emergency atrium	- Retention area for surplus of river water from Rhine and Meuse - map with indication how much storage capacity is needed to comply with the standard for flooding

Specific plan: Delta and coastal management

Category	Rotterdam	
	Deltaprogramma: Werk aan de delta	**Concept strategische kust Zuid-Holland**
Provisioning		
Soil	-	-
Energy production	-	- transition to biomass as energycarrier - develop clean technologies - Wind and tidal energy
Food and resources Production	- mineral extraction	-
Water supply	- extra retention of freshwater in winter - increase freshwater supply in summer by greater variation in the water level - priority sequence for occasional drought - extra freshwater needed to flush the water system and for drinking water	- Dunes alternated with coastal areas for water abstraction
Coastal space for industry, development and infrastructure	- sand supplementation and local coast development - multiple land use - Multifunctional use of dikes, with business investment	- seaside resort can develop in red contour - intensify infrastructure along the coast - pilot project 'Zandmotor' together with spatial planning in the immediate hinterland - the primary coastal defences shape the conditions for further development in the coastal zone
Regulating		
Waste treatment	-	-
Climate regulation	- accommodate sea level rise by sand supplementation - reduce heat stress in urban area	- dunes will get a different character through the climate change
Flood, storm prevention	- multifunctional use of dikes - Prevention, spatial planning and disaster management - reduce harmful effects of flood through urban design (water storage in parking garage) - increase safety standards - improve bottlenecks -	- multifunctional use of dunes - sand supplementation - "with sand where possible, hard where necessary" - multiple land use, i.e. parking combined with a flood defense function
Erosion and siltation control	- supplementation to prevent coastal erosion, maintain its function and not let the Netherlands become smaller - 'Zandmotor' natural distribution of sediment - let the inner edge of the duner grow with the sea level rise	-
Water	-	-

purification		
Water regulation	- level controlled drainage at farm level - level maintenance and flushing of atria - 'Buidling with nature'	-
Cultural		
Education/ science	- knowledge intensive character in Delta program - interaction between supply and demand of knowledge - scientific knowledge and practical knowledge - use existing knowledge at maximum - use of a common method for research	- implementing new technologies essential in developing new knowledge on Deltatechnologie
Aesthetic/ spiritual	-	- coast is an original and unique landscape with special value
Recreation/ tourism	- quality impulse for coastal areas - coastal defences carry recreational functions	- robust dune landscape alternated with coastal resorts - green infrastructure
Cultural heritage and identity	- cultural and historical valuable area	-
Supporting		
Maintenance of biodiversity and nature	- improve nature monitoring - ecological values	- Robust dune landscape with good ecological quality - sand supplementation with ecological development - Ecological network, green infrastructure
Nutrient cycling		
Storage/ Retention	- increase capacity for river water storage - storage of water in winter, use this water in summer - water buffers - robust design of parking garage as water storage	- multiple land use, i.e. parking garage with water storage

Tools in Rotterdam spatial planning policy

	Tools	Financial	Regulatory	Communicative
Rotterdam				
Strategic plan:	*Ruimtelijk plan regio Rotterdam 2020*	- Sanitation fund - Public funding for recreation area - Green funds - Red-for-green constructions - Cover fund - Investment of businesses as compensation for their development - Private investments with depreciation period of 5-40 years	- Space for space scheme, like Red-for-green constructions - Watertest - Function suitability maps - Strategic Environmental Assessment (SEA) - Environmental Impact Assessment (EIA) - Environmental limits in planning framework - Water Pearls - Global Environmental signal map - Provincial Environmental Regulation - Birds and Habitats Directive - Quiet areas - Conservation areas - Compensation measures for the second Maasvlakte - Ecological network (EHS) - Cultural and Historic Network - Flora and Fauna act - Zoning plan - Ecological Corridor - Regional Green Blue Structure plan (RGSP)	- Municipalities received a RR2020-toolkit with information for the communication with citizens, like presenting material, standard pieces of text and a timeline. - Continuing consultation with stakeholders involved - Creating support for investments in public space
	Groenblauw structuurplan regio Rotterdam 2011-2020	- direct income support for farmers, only give to preserve valuable areas and as a reward for fringe performance in animal welfare and blue and green services - subsidies for agricultural nature management - sLoK uitkering: Stimulation local climate initiatives - Rural Investment Budget (ILG) - Regional cover fund for investments in green projects - Entrepreneur gets subsidy for voluntarily achieving for nature conservation - Land owner gets a compensation if the piece of land has decreased in	- Production quota, to avoid overproduction. These quota will eventually be abolished. - Provincial Structure Vision (PSV) - European Water Framework Directive (WFD) - Compensation of nature - Belvedére areas, to protect cultural heritage - Ecological Network (EHS) - Safeguard areas - Natura 2000 - Birds and Habitats Directive - Provincial landscapes get regulations for the protection of qualities in the landscape - State buffer zone, to establish green buffers between the cities - Governments can give incentives and norms for the use of local products	- Area profiles, concise overview of the spatial structure and the recreational target scenario - Regional profiles to boost the retaining of cultural history - Intensify cooperation with entrepreneurs - Increase the awareness of the nature and recreation areas - Bundling budgets to develop tailored market campaigns - Green Gold Foundation, association of entrepreneurs and local organizations that promotes recreational developments - stimulate rural entrepreneurs to develop small agriculture - The Rotterdam region should make the green and recreational side of the region better known to a wide audience

		value due to its natural destination - area fund for co-financing of social services - Economic boost for enterpreneurs: existing food producers get a direct access to a large market in the immediate vicinity.		- Invest in innovative techniques to help people to experience the nature. - web-based information - information signs in nature areas - early involvement of residents and business in planning process
Sectorial plan: Water	*Water-plan 2 Rotter-dam*	- The municipality will have the option to finance the cost of the groundwater problem with the sewerage charges. For this sewerage charge is extended to a water charge. - Prospective ISV funds - Subsidy schemes for dredging - Combining functions like creating a large public space and a water storage will give financial benefits. - Subsidy programme for green roofs - Water fund to finance the surface water in Waterplan 2. A savings box in which a developer put an amount to compensate for the additional paved surface in a developing area. The deposit can be used elsewhere in the area to construct surface water to compensate the loss. - Project team for the acquisition of European subsidies - Obligatory financial contributions may be enforced only if it satisfies a number of legal frameworks - Contribution from the land allocation contract or through the development plan based on the new land development act (Grondexploitatiewet)	- European Water Framework (WFD), implementation of the WFD is a joint responsibility of all water companies in the Netherlands, it is an obligation of result with significant penalties. - The Law on the Weir requires the Water boards and Rijkswaterstaat to carry out a five-year safety review - Safety norms and standards - Municipal Water Plans - Duty of care for untreated discharges - New or renovated buildings with flat roofs will be obligated to construct a green roof. - Water test - Water section in zoning plans - Examine if requirements for water targets can be included in building permits and regulations - Financial contributions can only be enforced if the plan complies with the legal framework.	- Communication strategy towards citizens with evacuation and emergency plan. - Water Pearls - Multiple use of space - A quality image - create awareness with citizens that a good sewage system serves health, but in very extreme rainfall flooding is inevitable. - Media attention for climate change - Communication plan with a calendar - Develop a public brochure for flooding and safety for all residents in Rotterdam - Develop presentation and information material. - Create support and examples through pilot projects - Cooperation of government with citizen organisations - Public-private partnership - Project team on how to deal with groundwater - Knowledge for climate program - Program in city to support in the form of consultants, information through meetings, brochures, websites etc. - Alert for high water - Involve schools and create interaction with residents and businesses. Innovative projects such as water squares and green roofs serve as example projects. - Water associated partners in a consultative forum
	GWM in beeld	-	- Broadened Municipal Sewerage Plan (VGRP) - The Flood Risk map of South Holland is administratively	- The flood risk map contributes to good and timely information on flood prone areas and

	2010, water		determined - Water act - Natura 2000 - Environmental Impact Assessment (EIA) - Set of standards and norms which are set in the new Water Regulation South Holland - Water management plans - Desired Groundwater and Surface water Regime (GGOR)	possible flooding depths. - Website: www.risicokaart.nl - Special attention is needed for the communication during emergency and for aftercare - Website which informs citizens and tourists on suitable bathing sites in South Holland. Current information is also available via the phone and through teletext.
Specific plan: Delta and coastal manage-ment	*Deltaprog ramma werk aan de delta*	- Cost benefit analysis - The Ecoshape consortium is financed by industry and government to provide knowledge on natural water safety - water boards have become co-financers of the construction and improvement of primary defenses. - Business community as co-financer - Delta Fund as budget fund in the Delta Act - Attract private funds - Short-term cash transfer	- Directive on Floor Risk (ROR) - Key Planning Decision (PKB), where 'room for the river' is provided - water safety norms and standards - Administrative agreement on water - The Water Act requires that the managers of the primary flood defenses execute a test on their defenses every six years. - Legal testing instruments - Spatial Planning Act (WRO) - MIRT framework - National Assessment Report	- Quickscans gave insight in water safety and climate adaptation in the Wadden area - intensive interaction with civil society and the business community - expert groups - Network on Delta technology - Consortium Ecoshape can contribute with knowledge on natural water safety - Design research helps to understand the content and to strengthen the collaboration between partners - All sub-programs organize the input of civil society organizations on their level. - Consultative Body Water and North Sea (OWN)
	Concept strategi-sche kust Zuid-Holland	- Pilotproject 'Zandmotor' is financed by state and province. - Delta Fund - No sectoral financing structure by the state - Through MIRT funds are made available	- Landward reservation zone - Delta Program and Act - Natura 2000 - Marine Strategy Framework Directive (MSFD) - MIRT - Nature Conservation Act - Envirionmental Zoning around the harbor activities - Risk Zoning around the waterway	-