LANDSCAPE CHANGE AS A RESULT OF THE SUSTAINABILITY DISCOURSE
Landscape change as a result of the sustainability discourse

1st examiner:
**Prof. Dr. Ir. M. (Theo) Spek** (Professor at Centre for Landscape Studies in Groningen)

2nd examiner:
**Prof. Dr. J. (Johan) Woltjer** (Professor Planologie Groningen University)
LANDSCAPE CHANGE AS A RESULT OF THE SUSTAINABILITY DISCOURSE

How the sustainability discourse has influenced landscape development from 1960 to now

MASTER THESIS IN LANDSCAPE HISTORY
Faculty of Arts. Groningen University

BY ARJAN CONIJN
(contact: Arjan.Conijn@gmail.com)

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Since the 1960s thoughts on sustaining the future of the earth and its resources have been an important subject in public debate. This has led to developments in many scientific and political disciplines, which in their turn affect our living environment. Following on the conservation of natural and cultural heritage in the early 20th century, Rachel Carson alerted the public to the effects of pollution. The debate on efficient food and energy production to meet the needs of a growing population has been regenerated repeatedly in the 1970s. In the 1980s these thoughts of environmentalism were introduced to politics by the Brundtland-report of 1987, and at the 1992 earth Summit in Rio climate change and sustainable developments entered international policies in Agenda 21. The sustainability discourse slowly started to affect our surroundings in by policies, but also sustainable developments can be seen more often in the landscapes around us. This report aims to provide an analytical framework in order to identify the effects the sustainability discourse has made on the physical landscape of Europe’s coast.

The analysis of this report on the influence of the sustainability discourse on landscape is focussed on Europe’s coastal landscapes and its dynamics, but the methodology can be copied to other regions. The landscape dynamics can be sub-divided into five main themes in sustainability. 1) Population growth affects the landscape by urban growth, but also increasing tourism increases spatial pressure. 2) Exploitation of resources include the intensification of agriculture and its growing efficiency and upscaling, but also exhausting unrenewable raw materials as resources for fuel. Also overfishing is seen as exploitation of resources. 3) Pollution has hardly no direct effects on the landscape, but through influencing air, soil and water quality it will effect ecosystems and its natural services. 4) The effects of climate change will also influence the landscape. The rising sea level, soil erosion and habitat shifting all demand for adapting or mitigating measures to limit damage on the earth and its resources. And finally, 5) conservation of natural and cultural heritage has had its effects on the development of the landscape. Taking all these driving forces together, many landscape dynamics are driven by the sustainability discourse (figure 1). Therefore, it could be expected that the effect of the sustainability discourse can be seen in the landscape.

Europe’s coastal landscapes are very vulnerable and differ in physical character, but also in landscape dynamics that are affecting the coastal landscapes. Because of these varieties the coastal landscapes are a good research area to test the analytical framework in several circumstances. Physical differences in Europe’s coastal landscapes can be found in elevation, substrate and tidal regimes. In order to identify the changes that occurred in the landscape as a result of sustainable thinking and acting, these changes are analysed in an analytical framework which is developed and operationalized during this research. The Sustainable Transition in Landscapes-framework (STIL-framework) is tested at case studies in Zuid-Holland (The Netherlands), Samsø (Denmark), and Seine-Maritime (France). In addition to an inventory of the sustainable landscape dynamics, the effects on a landscape’s characteristics have been analysed as well. Although the case studies are very different they can be compared by the STIL-framework, because it provides a neutral perspective comparing the same indicating dynamics. Concluding from the STIL-framework it could be said that much of the influence the sustainability discourse has had on landscapes in the case study areas dates from the last two decades. The influence on the landscape’s structure can only be seen in the use of renewable energy sources and flooding defences. However, nowadays a more soft approach is used to prevent the dense areas from flooding, with respect to the current natural land. In the tourism sector this respect to nature can be seen as well, tourism is combined with heritage protection more often. Also the role of landscape as identifier for the region is recognized contributing to the conservative policies. The landscape’s function changes as a result of regulations in order to sustain the earth and its resources.

Comparing the results of these case studies with the theoretical background it becomes clear that the public started discussing sustainability issues and the limits of the earth’s resources. Politics started to take sustainability into their policies only in the late 1980s. This led to slow implementation of the sustainable landscape dynamics and the first effects on the landscape can be seen in the last two decades. Not all effects in the landscape might be visible, because many of the measures in conserving cultural and natural heritage, urban growth, and increasing tourism are closely related to conserving the contemporary landscape. In the exploitation of resources some new technologies can be seen in energy production (for example windmills and tidal basins) and agriculture, although a conservative approach can also be recognized here. Also, the effects of measures against pollution and

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climate change can hardly be seen in the landscape, since these threats are mainly reduced by international regulations. This regulations are in favour of remain balanced ecosystems without distortions by pollution.

All together it could be said that implementation of the sustainability discourse has taken several years to be included in policies and now that they are, the effects are limited. Many landscape influencing processes caused by the sustainability discourse are implemented from a conservative perspective which is taking into account the earth's values to meet the needs of the current and future generations. Although some new technologies have entered the landscape in the last two decades, the most important effect of the sustainability discourse on landscape is its limited changes in the landscape and respect for the existing landscape.

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In a Master Thesis on Landscape History you would probably not expect landscape issues of the present day. But the debates on landscape we are discussing today all find their origin in the past. In this Master Thesis the most recent five decades are studied in order to find the influences of the sustainability discourse on Europe’s coastal landscape. Changes in the landscape are dynamic and occurring processes, which have been continued for centuries resulting in what we see around us in our everyday life. An interaction between nature and culture proving living circumstances for humanity. Started in the past, functioning in the present day and preparing for the future. Just as this Master Thesis does not mark the end of my life as a student, it is just the beginning of a period in which I hope to put my knowledge into practice. This Master Thesis discusses the emergence and early history of sustainable landscapes, and at the same time it offers an analytical framework which can be the fundament of future sustainable landscape development. The neutral perspective demanded in the STiL-framework offers politicians and policymakers the possibility to study landscape from scratch, without any pre-knowledge or any subjective assumptions caused by the promotion of their own ideas. This historic and future-oriented research shows my abilities to analyse landscapes over time and my ambitions to contribute to future landscapes.

Doing this research would not have been possible without the proper preparations during my Master in Landscape History at the Centre for landscape knowledge in Groningen. Under supervision of Prof. Theo Spek and the other staff members the ideas and research questions which form the basis of this research were able to develop into a proper study and landscape analysis. During the process I have received help from local experts from Province of Zuid-Holland, the Energiakademiet on Samsø and the Département of Seine-Maritime in my case studies. Interviews with these experts have given me insight in the practical effects of sustainability on the landscape and contemporary policies on sustainable landscape development and therefore they provided an important contribution to the results of this research. Finally I would like to thank the people around me for the endless discussions on this topic, to their contribution of knowledge on the subject and on doing scientific research. Their challenging questions about my research have given me the possibility to elaborate my results to a higher level. Special thanks to Erik-Jan and Evelien who have supported me during the whole process, from my first thoughts to the final report which lays in front of you.

Have fun reading my Master Thesis, and do not hesitate to be critical on the results.

Arjan Conijn
1.1 - Sustainability is around us

It cannot be denied that sustainability is a much debated subject in contemporary society. Acting with the future in mind is man's daily concern in contemporary discussions. New policies are rejected if they are not defined from a sustainable perspective. Sustainability is a trending topic on conferences and social media. Our lives are affected by visionaries supporting the sustainability discourse and proclaim a more sustainable world is necessary to sustain future life on earth. It is everywhere around us. Not only persons and publications are affected by the sustainability discourse, but also our environment. The landscape surrounding us has been subject to sustainable policies and sustainable technological adaptation since the 1960s.

According to Dutch landscape philosopher Ton Lemaire (2008) the environmental crisis of the last decades has played a key role in contemporary landscape development. Lemaire places his observation in perspective by adding that other forces – like up-scaling of agriculture; construction of residential areas, industry and road networks; and urbanization of the countryside - have changed the landscape as well. In this research it is stated even stronger: these ‘other forces’ have also been strongly influenced by the sustainability discourse (Lemaire, 2008, p.8). Most research on sustainability aims to elaborate on the current debates in the sustainability discourse. This research will also illustrate where the sustainability discourse has brought us. The main topic of this research is how the landscape characteristics around us has developed as a result of the sustainability discourse until the current day. It aims to let visionary scientists and policymakers take into account the effects of the sustainability discourse on landscape.

1.2 - The development of the sustainability discourse

Landscapes are continuously changing, influenced by many cultural groups with various perspectives and interests. Therefore, it is impossible to identify one direction of landscape development. (Antrop, 2005, p. 32). The next paragraph briefly discusses some of the key authors and their literature and debates on the development the sustainability discourse in the Europe’s landscapes over the past century. Developments in sustainable techniques are left out of this historiography in order to retain focus on the effects on landscape.

Early environmentalists in the 19th and early 20th century

At the end of the 19th century the Enlightenment and the Industrial Revolution had influenced the landscape as never before (Antrop, 2005, p.25). Railroads connected the bigger cities to the rural hinterlands and small mining villages expanded to high urbanized areas. Population grew as a result of the Industrial Revolution, which reduced costs for consumer goods and raised wages for labourers. Modern techniques improved the standard of living, they changed the landscape and stimulated the provisioning function of the earth (Vos & Meekes, 1999, p. 6).

The unsustainable combination of exploiting the earth’s resources and the growing population first came to the attention of economist Thomas Robert Malthus during the 19th century. Malthus recognized the equilibrium of growing population on one hand, and decreasing agricultural production as result of environmental degradation on the other (De Steiguer, 2006, p. 6). His predictions were way off time-wise, but a still growing number of economists, scientists, politicians and above all environmentalists continued research following on Malthus’ thoughts.

As a reaction to the industrialization and mechanization the value of nature was explored further. In 1854 Henry David Thoreau explored the regenerative power of nature in his book ‘Walden’ (Schouten, 2005, p.185). Also John Muir separated himself from society studying nature during his period in Yosemite Valley (figure 3). While Muir stimulated nature conservation, his opponent Gifford Pinchot promoted accessibility of natural resources for everybody gaining a lot of support of the majority of the people (De Steiguer, 2006, pp. 11-13). This dispute shows the various perspectives of sustainable development in the late 19th century.

Following on the ideas of John Muir the concept of conserving nature through National Parks arrived in Europe in 1909, when nine parks were established in Sweden (Parks.it, 2014). Several European countries followed the Swedish example and various protected areas were established in the first half of the 20th century. Mainly amateur photographers, researchers and nature lovers protected their field study areas (Van der Windt,
1995, p. 330). Wilderness and nature became more and more important in the first decades of the 20th century, leading to the establishment of nature protection organizations. Similar history can be told about heritage organizations like UNESCO on the protection of cultural heritage. Both aim to protect the interaction between nature and culture in order to meet the needs of future generations.

Due to wars and the economic crisis, the first half of the 20th century did not provide as much developments in environmentalism as the periods before and after have. However, geography developed as a scientific field in that period, increasing knowledge on landscapes (Antrop, 2007, p.14). In the United States environmentalism continued with implementation of the Wilderness Act and the Endangered Species Preservation Act. At the same moment around the 1950s in Europe most money and effort was invested in rebuilding society and the cities after war damage of the Second World War.

In order to prevent their citizens from food shortages six European countries (Belgium, France, Germany, Italy, Luxemburg and The Netherlands) developed an economic cooperation including a Common Agricultural Policy (CAP) stimulating farmers to increase production, leading to intensification of the agricultural sector in these countries. The modernization of agriculture led to several spatial issues: monoculture is vulnerable for plagues; land realotment destroyed the traditional landscape mosaic; and the invention of barbed wire replaced the traditional hedgerows. The increase in production was possible due the invention of artificial fertilizer in the late 19th century (Emanuelsson, 2009, p. 299).

In 1962 it was Rachel Carson who alerted the world on the vulnerability of the earth with her book 'Silent Spring'. Carson pointed out the – at that time not extensively studied - effects of pesticides on health and environment. The agricultural sector needed pesticides to increase production and did not agree with Carson's conclusions (De Steiguer, 2006, p. 34). Carson's book became an inspiration for many environmentalists, and Carter (2007) even argues that Carson started the second wave of environmentalism, introducing the global environmental crisis to the mass public (Carter, 2007, p. 5).

Environmentalists of the 1960s and 1970s

Due to wars and the economic crisis, the first half of the 20th century did not provide as much developments in environmentalism as the periods before and after have. However, geography developed as a scientific field in that period, increasing knowledge on landscapes (Antrop, 2007, p.14). In the United States environmentalism and pollution prevention, but more and more environmentalists started to point out the effects of population growth as a threat for mankind. The most influential book is 'Limits to Growth', published in 1972 by Donella Meadows, also known as member of the Club of Rome. By using complex computer models the authors were able to forecast future perspectives predicting that earth's resources are finite and will exhaust (De Steiguer, 2006, p. 165). In his book 'Small is beautiful' E.F. Schumacher encouraged local economies and thereby included the spatial component in population growth issue. Schumacher argued that population growth would increase the pressure on land. Recently Antrop (2004) elaborated that this growing pressure on land has resulted in either intensification or expansion of agricultural lands at the cost of nature (Antrop, 2004, pp. 13-14).

At first attention was paid to nature conservation and pollution prevention, but more and more environmentalists started to point out the effects of population growth as a threat for mankind. The most influential book is 'Limits to Growth', published in 1972 by Donella Meadows, also known as member of the Club of Rome. By using complex computer models the authors were able to forecast future perspectives predicting that earth's resources are finite and will exhaust (De Steiguer, 2006, p. 165). In his book 'Small is beautiful’ E.F. Schumacher encouraged local economies and thereby included the spatial component in population growth issue. Schumacher argued that population growth would increase the pressure on land. Recently Antrop (2004) elaborated that this growing pressure on land has resulted in either intensification or expansion of agricultural lands at the cost of nature (Antrop, 2004, pp. 13-14).

One of the first landscape designs trying to make optimal use of resources is Lawrence Halprin’s design for the Sea Ranch in California (figure 4). The design fits in its environment the grass of this vacation park was cut by a herd of sheep (Barlow-Rogers, 2001, p. 485). Fellow landscape-architect Ian McHarg got motivated to continue “putting environmental planning into a nature-scientific framework” (Barlow-Rogers, 2001, p. 483). Ian McHarg puts nature in a leading role in his designs and argues that the earth is not an exploitable resource, but that the earth should rather be seen as a source of life (Barlow-Rogers, 2011, p. 482).

The balance between man and nature remained subject of discussion in Barry Commoner’s book ‘The Closing Circle’ and Arne Naess’ ‘Deep ecology’ movement during

Figure 3: John Muir in Yosemite National Park, one of the first National Parks in the United States in 1890 (thecomplativeearth.com, 2014)
the 1970s (Schouten, 2005, p. 209). Putting human life in an equal position to other organisms the deep ecology movement became an important inspiration for ‘green’ politics (De Steiguer, 2006, p. 200). Green parties emerged all over Europe and put the sustainability issue on political agendas and in spatial development plans.

**Contemporary environmentalist ideas**

After the hopeful 1960s cooperation on environmental issues, international cooperation between governments and the various environmental and social action groups decreased in the late 1970s, and started focussing more on ecological problems (Brundtland, 1987, p. xi; Carter, 2007, p. 208). As a result of economic and energy crises in the late 1970s, scientist realized that a holistic approach was necessary to understand the global environmental problems like desertification and global heating. This realization had led to a new urge to cooperate on environmental development (Antrop, 2007, p. 14). The environmental issues returned on the political agenda when the Brundtland Commission re-defined environmental development in their book ‘Our Common Future’ (Brundtland, 1987, p. xi). Issues like the waste of human resources and environmental degradation were analysed and reformed to “recommendations for a sustainable course of development” (Brundtland, 1987, p. xiv).

The report of the Brundtland Commission proposed the popular use of the term sustainable development, leading towards the foundation of the European Environment Agency (EEA). The report became the spine of the Rio Earth Summit in 1992 (Carter, 2007, p. 208). In the Earth Summit ten thousands of people debated what the earth’s future should look like. This resulted in Agenda 21, an extended report containing guidelines for sustainable development. The Earth Summit was an attempt in a more sustainable direction, and Agenda 21 is nowadays implemented in several national policies (Roorda, 2008, p 56). Besides social and economic guidelines, Agenda 21 also contained guidelines for spatial and environmental developments like managing fragile ecosystems, the protection of the quality and supply of freshwater resources, the use of renewable energy sources and the promotion of sustainable agriculture (United Nations, 1992). European commissioner Ray MacSharry promoted sustainable agriculture in the European Union with his CAP reforms of 1992. In these reforms the relation between agriculture and nature became more important, leading towards financial support on organic production and methods that maintain both the environment and a liveable countryside (Lefebvre et al., 2012, p. 6). In Europe natural and ecological values have also been protected by the Natura 2000 network, which aims for the survival of the most threatened species. This resulted in subsidies to develop nature reserve or to maintain ecological connections like in the Dutch Ecological Main Structure [In Dutch: Ecologische Hoofd Structuur, EHS] (European Commision, 2014a).

During the Earth Summit in Rio also a climate convention was signed. This convention recommended multiple organizations and governments to slow down the climate change by reducing the greenhouse gas emissions, which are a response to global heating and sea level rise (Roorda, 2008, pp. 22-27). Because climate change effects landscapes, the 1997 Kyoto protocol continued integral cooperation and expanded the guidelines to keep countries’ emissions within safe limits (Carter, 2007, p. 253). After the Strategic Environmental Assessment protocol of Kiev 2003, climate was brought back to attention by American politician Al Gore with his popular movie-documentary ‘An Inconvenient Truth’ in 2006 (figure 5). In Europe the EEA published ‘The changing faces of Europe’s coastal areas’ showing among other things the effects climate change has on the coastal areas and why a sustainable approach to tourism and landscape development in the coastal areas was necessary (EEA, 2006). In 2007 this was confirmed in EEA’s publication of ‘The fourth assessment’ of Europe’s environment (EEA, 2007). In 2010 agreements were made in Cancun to accelerate immediate implementation of climate change
reducing policies (UNFCCC, 2014). The main points in these agreements are mitigation, adaption, finance, technology development and transfer and capacity building. Despite these protocols CO₂ concentration is currently still increasing (UNFCCC, 2014).

A new perspective on nature and its function for mankind was given by Rudolf de Groot (1992). In De Groot’s book ‘Functions of Nature’ the author provides a complex, but comprehensive overview of the functions of nature, later called ‘natural capital’. De Groot argues that an environmental economic approach is necessary to make planning and decision-making more environmental oriented. (De Groot, 1992, p.253).

After a period of international cooperation future scenarios were modelled, discussed and converted into policy. Some of the scientist of today argue that we have acted too late and that the earth is condemned, because climate change is unstoppable (Klein, 2013). In 2009 Scott Cato defined the three dimensions arguing that society, economy and the environment are interrelated and a holistic approach is necessary to deal with environmental issues (figure 6) (Scott Cato, 2009, pp. 36-37). According to Korowicz (2012) a holistic approach will occur for major problems as the current economic crisis and the future scarcity of resources. That may lead to big scale ignorance of the problems since politicians often listen to the majority of ignorant people (Davey, 2013). Many problems are solved per sector, which equals inefficient use of knowledge resources. For that reason the European Union started with a more coherent approach for coastal issues in 2002: Integrated Coastal Zone Management (ICZM). In 2007 this program was developed to Integrated Marine Policy (IMP), aiming to “achieve the full economic potential of the seas in harmony with the marine environment” (European Commission, 2014b).

Over the years more and more sustainable ideas are developed and executed. This has led not only to a shift in our thinking, but also in our acting. Since humans create their environment the sustainability discourse will definitely affect the landscape. A new sustainable layer will emergence upon the multi-layered landscapes of the past.

1.3 – CENTRAL RESEARCH PROBLEM AND AIMS OF THE RESEARCH

The subject of sustainability has been much debated and a broad scope of ideas has passed media and academic discussions. Also politicians have recognized the concerns of people about the environment. This has led to a still expanding list of measures in order to contribute to a sustainable world, a sustainable environment with sustainable landscape characteristics. Especially in Europe’s vulnerable coastal landscapes. The densely populated coastal areas are subject to the dynamics of water and air and several other pressures the landscape. That is why Europe’s coastal landscapes have a higher urgency for a properly monitored sustainable approach. Virtually all publications on sustainability focus on future developments. But, since landscape dynamics have a temporal aspect, a historic approach is essential to analyse the landscape in a correct context (Burgi, 2004, p. 858). For future research it is useful to monitor interventions thoroughly. For future sustainable developments it is good to analyse what impact former sustainable implementations have had on the landscape. Learning from the past can exclude
future mistakes or add missing components. A sufficient analytical framework is necessary to study changes in landscape as a result of the sustainability discourse.

That is exactly the main theme of this research: to analyse sustainable development and their landscape effects in order to improve sustainable developments in the future. What have we reached so far? What works best and which directions do we have to go in the future? And how far do we have to go? Therefore, this research aims to analyse the landscape dynamics and its effects on landscape characteristics of Europe's coastal landscapes since the emergence of the sustainability discourse in the 1960s until now.

The impact of sustainable development on the landscape is extensive, since landscape contains both the natural aspects as well as the human factor. The research aims to appoint the positive and the negative developments in sustainability by analysing what influence the sustainability discourse has had on the landscape characteristics. In order understand why some developments are better than others, it is first important to illustrate what has changed in the landscape. Despite of multiple attempts no researcher has managed to develop a universal method to study landscape dynamics (Burgi, 2004, p. 857). Therefore, the first aim of this research is to identify sustainable landscape dynamics.

The second part of this research aims to test this analytical framework on Europe's vulnerable coastal landscapes. It is essential to define dynamics of these landscapes in relation to sustainability and their effects on landscape characteristics. So far analysis on Europe's coastal landscape has been fragmented, but in order to analyse the effects of the sustainability discourse a general analysis of the landscape dynamics and characteristics of Europe's coastal landscape has to be concluded. Developing the analytical framework and testing it will provide useful information on the effects of the sustainability discourse on landscape characteristics in Europe's coastal landscapes, which can be used by scientists or policy makers in these landscapes. Besides that, the analytical framework can be used in other landscapes as well in order to analyse the landscape dynamics and their effects on landscape characteristics. Also in non-coastal areas this analytical framework can be used to put landscape dynamics in their correct temporal context. So the two aims in this research are:

- Developing a framework in order to analyse transition in landscapes.
- Identify the landscape dynamics that affect landscape characteristics as a result of the sustainability discourse.

1.4 - Definitions and Theoretical Framework

In this report landscape is defined as it is in the European Landscape convention of Florence:

“Landscape means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors” (Council of Europe, 2000).

The main focus of landscape in this report is the result of interaction between nature (ensemble of animals and plants under certain physical circumstances) and culture (human factors). The landscape characteristics which are discussed and analysed in this research, are spatial or environmental elements that can be perceived by people, being both physical and tangible. This excludes mindscapes and human experience, but focuses on structures (masses, spaces, forms) and functions (Antrop, 2007, p. 56-64). These ‘landscape characteristics’ are formed by landscape forming processes, or as called in this report ‘landscape dynamics’ (figure 7). These dynamics are initiated by one or more driving forces. Such a driving force is an overarching power working on the landscape socio-economically, politically, technologically, naturally and/or culturally (Brandt et al., 1999 cited in: Burgi, 2004, p. 859). The landscape dynamics studied in this research are all related to the sustainability discourse, or the so called sustainability driving force. Since sustainability initiates many landscape dynamics, a categorization is made in this research to operationalize the rather fuzzy concept of sustainability. This operationalization is based on the most important themes in sustainability.

Throughout the last decades environmentalism has developed into the sustainability discourse, and still involves many perspectives. In order to avoid conflicting definitions of sustainability this research uses the term sustainability as it is generally accepted: sustainability as preserving resources and landscapes for future generations (Knox & Marston, 2007, p. 168). To specify this definition in this report the definition of the United Nations is used:
“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” (Brundtland, 1987, article 1)

Using this definition means that although various experts have different opinions on the definition of sustainability, no visions are excluded as long as the general idea is to preserve resources and landscapes for future generations, both on a global and a local scale. Chapter 2 elaborates on the five main themes of sustainability and the resulting landscape dynamics.

Sustainable landscapes can be defined in two ways (Antrop, 2006, p. 1). A sustainable landscape can refer to either a certain landscape type being conserved, or it can refer to sustainability as the most important principle for future landscape development. In this research the second definition will be used, because the effects of the sustainability principle on the landscape is the main subject. This also means when sustainability or a derived term is used it should always be interpreted in relation to the landscape. Landscape development is regarded sustainable when it does not endanger the provisioning capacity by that landscape for future generations. This provisioning capacity includes resources in food, water, energy and housing (EEA, 2012, p. 21). Sustainable landscape developments in this report include landscape policies, but also technological adaptation by farmers and other entrepreneurs.

1.5 - Defining the research object

This research mainly focuses on the effects of the sustainability discourse on landscape characteristics and the landscape dynamics that are causing this effects. Many aspects of landscape are left out because the landscape is also affected by other driving forces than sustainability. For example, economic reasons like more efficient food production and natural reasons like topography makes it hard to expand cities on steep slopes or wet peat lands. Besides that, sustainability is not referred to on a personal level, but mainly on society as a whole.

The issue of sustainability in landscape is studied in the vulnerable coastal landscapes of Europe, which are under heavy pressures of various landscape dynamics as urban growth, tourism and energy production like wind and tidal energy. Besides socioeconomic and technological landscape dynamics also some natural landscape dynamics are working on the coastal area, for example sea level rise and coastal erosion. In addition to this research on Europe’s coastal landscapes the analytical framework can be transferred to other landscapes in Europe. Europe is chosen as a case study because there is much transborder cooperation within the European Union. For example pollution and climate change – important themes in sustainable landscape development – are transnational problems which are not stopping at borders. This supports the overarching European policy on sustainable landscape development.

Since the European Economic Community has been founded in the 1957 treaty of Rome, this research will mainly focus on the period afterwards which corresponds to the emergence of the environmentalism which is commonly set at 1962 when Rachel Carson’s book ‘Silent Spring’ was published (De Steiguer, 2006, p. 3). These last five decades, since the 1960s are therefore chosen as the
time frame in which this research is set.

1.6 - RESEARCH THEMES AND RESEARCH QUESTIONS

This research contains two parts in order to answer the central research question:

What changes in the landscape characteristics have been caused by sustainable landscape dynamics that commenced in the 1960s and how have these dynamics influenced Europe’s coastal landscapes?

This research question is formulated broadly in order to include as much aspects as possible. As a result of this the findings in this research will be some general conclusions, which can be a starting point for more thorough and specified future research. In order to solve the two research problems both problems are discussed in separate parts and in that contribute to the answer on the central research question.

The first part aims to answer the question:

What sustainable landscape dynamics can be detected in Europe’s coastal landscapes and how have these been influencing the characteristics of these landscapes that commenced in the 1960s?

At first the landscape dynamics of Europe’s coastal landscape have to be identified as a starting point for the analysis. The physical-geographic and cultural landscape characteristics and the influencing landscape dynamics will be defined before the analytical framework is tested on three case studies. These three varying case studies will be compared to analyse similarities and differences between various European coastal landscapes. Concluding this second part of the research sufficient information is collected to answer the central research question and define changes in landscape characteristics of Europe’s coastal landscapes, which are caused by sustainable landscape dynamics. A framework of this research is illustrated in figure 8.

1.7 – METHODOLOGY AND RESEARCH STRATEGIES

The first part of this research is a desk survey, a study based on literature and policy reports. Chapter 2 introduces the main themes in sustainability and the most important landscape dynamics are divided among five themes: population growth, exploitation of resources, pollution, climate change, and conservation of cultural and natural heritage (EEA, 2007). These themes are derived from EEA’s fourth assessment. Another important source is the International Panel for Climate Change (IPCC). These two sources provide a solid base of the present sustainable landscape dynamics in Europe’s coastal landscapes. These landscape dynamics are the starting point for the development of an analytical framework in chapter 3.

Chapter 3 operationalizes the analytical framework by selecting several landscape dynamics as indicator-processes and describes how the sustainable approach on these landscape dynamics can be measured and defined. In the end the framework forms a table which is easy to fill in: the landscape dynamics; the sustainable approach; the effects on landscape characteristics, split up in its spatial structure and its function (Burgi, 2004, p. 857). The final result of the chapter is an qualitative framework based on newly defined indicators.

In the second part of the research the main focus is testing the framework in practice on Europe’s coastal landscape. In chapter 4 the landscape characteristics of Europe’s coastal landscapes are explored, mainly based
Testing the framework has to be done in practice, thus three case studies illustrate how the framework works in chapter 5. A qualitative method for research is chosen because it is a landscape research, and as landscape is defined it is influenced by the interpretation of men, meaning it can hardly be measured quantitatively (Boeije et al., 2009, p. 254; Burgi, 2004, p. 858). The fieldwork is prepared with a map analyses and literature exploration, but the main analyses are executed on location. Experiencing the landscape in the real world gives a better understanding of how the landscape characteristics are structured and functioning than maps and photographs do. Besides exploration through the area also interviews with experts are done to get a basic understanding of the spatial developments of the area over the last five decades. To check the validity of the gained information in interviews it is necessary to get multiple interviews from various perspectives and look for patterns in the answers, also known as triangulation (Boeije et al., 2009, p. 275). This part of the research illustrates that landscape research is interdisciplinary by the use of multiple sources such as maps, expert-interviews, literature and policy plans. These variety of sources make it possible to answer the central research question in the final concluding chapter.

**INTRODUCTION:**

Chapter 1: Introduction
What changes in the landscape characteristics have been caused by sustainable landscape dynamics commenced in the 1960s and how have these dynamics influenced Europe’s coastal landscapes?

**PART I: SUSTAINABILITY DISCOURSE:**

Chapter 2: Landscape dynamics within the main themes of sustainability

Chapter 3: The Sustainable Transition in Landscape-Framework

**PART II: EUROPE’S COASTAL LANDSCAPES:**

Chapter 4: Europe’s coastal landscapes and its landscape dynamics

Chapter 5: Sustainable landscape development in practice

**DISCUSSION:**

Chapter 6: Discussion

**CONCLUSION:**

Chapter 6: Conclusions

Figure 8: Research framework
2.

LANDSCAPE DYNAMICS WITHIN THE MAIN THEMES OF SUSTAINABILITY

2.1 – THEMES IN THE SUSTAINABILITY DISCOURSE

Landscapes have always been subject to change (Burgi, 2004, p. 857). Landscapes are formed as a result of the dynamics of nature and culture and their interrelation. Since a landscape exists from its characteristics and its forming dynamics, there has to be an overarching idea that initiates landscape dynamics. This is called a driving force and such driving forces do not only stimulate landscape dynamics. This chapter aims to define the landscape dynamics that are a result of the sustainable development driving force. Therefore the following question has to be answered:

What landscape dynamics are a result of the sustainability discourse that commenced in the 1960s?

The driving force of sustainable development can be divided in several main themes: 1) population growth, 2) resource exploitation, 3) pollution, and 4) climate change have been selected because they are mentioned repeatedly in EEA's fourth assessment: ‘Europe’s Environment’ (EEA, 2007). In addition to these four themes, another theme is included as a result of EEA’s chapter on biodiversity: 5) conservation of natural and cultural heritage. Multiple landscape dynamics are related to natural and cultural heritage and are not covered by the former themes (EEA, 2007).

The landscape dynamics caused by the various themes of the sustainability discourse are discussed in the next paragraphs. The sustainability discourse aiming to conserve the contemporary landscape and its resources for future generations will form the spine of these paragraphs. Each theme's history is explored in literature defining which landscape dynamics are the result of the researched theme. Most of the landscape dynamics are derived from EEA’s ‘Changing faces of Europe’s coastal areas’. This chapter elaborates on the EEA report with several specific case studies and publications, which are used to underpin the defined landscape dynamics and to explore the effects on landscape characteristics (EEA, 2006). All themes are introduced shortly, then the landscape dynamics are defined, followed by the sustainable approach in the relevant theme. In the final paragraph the sustainable landscape dynamics are listed.

2.2 – THEME 1: DEALING WITH POPULATION GROWTH

The alarming effects of a growing population on a finite planet have already been recognized by Robert Malthus in 1798 and by multiple researchers (Ehrlich, Schumacher) in the 1970s. But it was not earlier than in 1972 that Donella Meadows, member of the Club of Rome created broad public awareness of the risks of population growth in her book ‘Limits to Growth’. Through complex computer models the Club of Rome was able to forecast future perspectives on population, agricultural production, natural resources, industrial production, pollution and hundreds of sub-components (De Steiguer, 2006, p. 165). Growth of the population has not only affected population numbers, the growing population also needs food, water, housing and many other facilities. This paragraph mainly focuses on the necessary facilities like the growing demand for housing, infrastructure and recreational space, all contributing to a pressure on land. Details on the increasing production of food, water and materials are excluded, as these will be discussed in the next paragraph on the exploitation of resources. At first the landscape dynamics of population growth and their effects on landscape characteristics are discussed, before the sustainable approach is introduced.

Population growth effecting landscape characteristics

Urban growth became possible from the moment a surplus of food was produced by agriculture (Antrop, 2004, p. 10). It allowed the city's inhabitants to specialize and become successful in trade. Important for urban growth are adequate specialization and accessibility of the city, but also of the hinterland. The concept of cities was spread over Europe in ancient times, the city ruling over the productive hinterland for goods to trade. Wanting to live as closely as possible to markets in the city centre, people started to pile up houses in a vertical direction instead of expanding into the production lands. During the 18th century's industrialization cities expanded rapidly because there was enough work in the city factories and living circumstance improved (Vos & Meekes, 1999, p. 6). Big suburbs were built next to the factories to house all the workers. In this period town planning got more attention. For example Ebenezer Howard introduced the concept of garden cities (figure 10), a design based on the interconnectivity of humans by railways, emerging a network of city cores and their rural suburbs (Barlow-Rogers, 2001, p. 405). At that point it was not the surplus production or jobs that made cities
Figure 9: Population density in Europe’s coastal area’s, 10 kilometers out of the coast (EEA, 2006, p.17)

Figure 10: Ebenezer Howard’s ‘Garden-City’, an attempt to efficient urban planning (Barlow Rogers, 2001)

As Tim Hill and Heather Barrett point out in their book ‘Urban geography’ cities are a key stone in sustainable growth, but mainly the massively increasing population growth as a result of improved living circumstances. Infrastructural connections between cities became more important for transport of goods, but this also led to an urban growth along these infrastructural axis. These lobbies of urban development put the rural countryside in the shadow of urban development (Steel, 2008, p. 7; Antrop, 2004, p. 16).

A sustainable approach on population growth

A sustainable approach on population growth
However, these two most important landscape dynamics from the theme of population growth have become more sustainable since the 1990s. The most important sustainable landscape dynamics are internal urban growth, implementing green belts and combining tourism and heritage conservation, of which the effects on landscape characteristics are studied in the analytical framework.

2.3 – Theme 2: Reducing exploitation of the earth’s resources

One of the main outcomes of ‘Limits to Growth’ is that the earth’s resources are finite. Continuing exploitation of unrenewable resources the way we did in the 1970s would have led to a decline of population and complete exhaustion of the earth’s resources before 2100 (De Steiguer, 2006, p. 166). This chapter focuses on problems caused by increasing demands on unrenewable resources as a result to population growth. At first the effects of resource exploitation on landscape characteristics are discussed, followed by the sustainable approaches in agriculture, energy production and overfishing.

Exploitation of resources affecting on landscape characteristics

During the Second World War there were periods in which food was scarce, because it was needed for military purposes. After the war governments wanted to prevent their people for hunger in the future. Therefore, several countries (Italy, Belgium, Luxemburg, France,
Landscape dynamics within the main themes of sustainability

Exploitation of non-renewable resources has led to deforestation, erosion and soil depletion (Emanuelsson, 2009, p.83). Deforestation and erosion are very old processes that as a result of resource exhaustion of humans have resulted in the poor rocky and hilly landscapes of the Mediterranean (Wilbert, 2013). Also excavation of peat, coal and minerals are examples of nearly exhausted resources of the earth. Only a few wet peat lands and several small coal basins remain in Europe nowadays (European Coals Resource Database, 2012). Not only the classic minerals like gold, silver and iron ore are excavated, but also uranium for nuclear power and columbite for computer chips (Essick, 2001). Since these resources are not renewable, mankind intends to make the same mistake again and exhaust the earth. This causes intense debates between people who exploit from an economic point of view and people who want to sustain the local landscape by continuing traditional exploitations. Mining has still immense influence on a landscape’s characteristics. An example is the Swedish town of Kiruna which has to be rebuilt because of the valuable minerals that can be mined on its current location. Despite of the known impacts of mining a sustainable alternative besides minimizing mining is not yet implemented on an international scale.

A sustainable approach on energy production

In energy production resources are exhausted as well in order to meet the needs of mankind. Growing efficiency and cheaper production costs led to more intensive use of electricity – known as Jevons Paradox - until the growth of efficiency stagnated and electricity became more expensive in the 1960s and 1970s. A transition towards more efficient sources of energy was made; first oil and gas and later nuclear energy. This was stimulated by a growing demand and the rapid development of the power plants efficiency (Williams, 2006). An extended grid of pipes and power lines entered the landscape towards the most distant areas. After the 1970s oil crisis and the nuclear disaster in the Chernobyl power plant a renewed focus was placed on renewable energy sources like wind, sun and hydro power. All affecting the landscape characteristics by new technologies as wind turbines, solar panels and dams. Later during the late 1990s tidal, geothermal and biomass energy entered the landscape, affecting the landscape characteristics with tidal basins and underground geothermal systems. New technologies still enter the landscape. Wind and solar energy...
production methods on a personal and local level, while
dams and tidal basins occur for bigger groups of people.
Also, several wind and solar farms have been developed
to provide more people with sustainable energy. All new
energy sources are still struggling with difficulties like
the transportation and storage of energy. The debate on
the use of sustainable energy resources still continues
among scientists and important industries. European
politicians and the public are more and more convinced
that sustainable energy should be supported by policies
(Council of Europe, 2000, Article 1e). All these methods
for exploiting renewable energy are mapped in figure
11 and their effects on the landscape characteristics are
summed up in figure 12. These renewable energy sources
are effectively unlimited and therefore considered
sustainable.

**Overexploitation of fish resources**

Fish populations cannot restore themselves after
extinction and therefore regulations on national and
European level have been made to sustain fish populations
and nutrient level. Regulations of fisheries are formulated
on a European level in the Common Fisheries Policy
(CFP) since the 1970s (Hadjimichael et al., 2010, p. 796).
Overfishing is a major problem in Europe especially on
the Atlantic shores. These troubles are the biggest in the
almost closed waters of the Baltic sea (Hinrichsen, 2011,
pp. 38-39). Regulations and maximum catch numbers
give fish the opportunity the restore balanced population
numbers. This influences the landscape characteristics to
limited extent.
Landscape dynamics within the main themes of sustainability

All in all it could be said that resources are limited, and this means they might get exhaust. A sustainable approach makes sure the resources are available to meet the needs of future generations as well. European regulations on agriculture do influence landscape characteristics, while fishery regulations don’t. On the contrary to conserving the traditional landscape by agriculture, renewable energy production adds a new layer on the landscape. The development of renewable energy-resources is a sustainable landscape dynamic with extended effect on landscape characteristics.

### 2.4 – Theme 3: Reducing pollution

Pollution is an important theme in sustainability it has caused several landscape dynamics to influence the landscape characteristics. For example because acidification of the earth's air, water and soil affects health and ecosystems. Figure 13 shows various polluted area’s in Europe and a sustainable approach to reduce pollution is needed.

#### Pollution effects on the landscape characteristics

Pollution can unbalance ecosystems and

<table>
<thead>
<tr>
<th>Source of energy</th>
<th>Methods</th>
<th>Effects on Landscape</th>
<th>Preferable place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar power</td>
<td>Energy production</td>
<td>Rooftops</td>
<td>Southern Europe</td>
</tr>
<tr>
<td></td>
<td>Solarfields</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water heating</td>
<td>Rooftops</td>
<td></td>
<td>Southern Europe, local scale</td>
</tr>
<tr>
<td>Air heating</td>
<td>Solar fields and tower</td>
<td></td>
<td>Southern Europe</td>
</tr>
<tr>
<td>Tidal energy</td>
<td>Tidal basin</td>
<td>Big walls on coast</td>
<td>Estuaries on Atlantic coast and British Isles</td>
</tr>
<tr>
<td></td>
<td>Underwater mills</td>
<td>Marine ecosystems disrupted</td>
<td>Atlantic coast and British Isles</td>
</tr>
<tr>
<td>Geothermal energy</td>
<td>Soil heating</td>
<td>Subsurface effects</td>
<td>Iceland</td>
</tr>
<tr>
<td></td>
<td>Earth heating</td>
<td>Subsurface effects</td>
<td>Iceland</td>
</tr>
<tr>
<td>Hydro energy</td>
<td>Streaming energy</td>
<td></td>
<td>Rivers and dams</td>
</tr>
<tr>
<td></td>
<td>Height energy</td>
<td>Dams</td>
<td>Rivers and dams, Mountainous area</td>
</tr>
<tr>
<td>Biomass energy</td>
<td>Waste energy</td>
<td></td>
<td>More populated areas</td>
</tr>
<tr>
<td></td>
<td>Biomass production</td>
<td>Arable lands and forests</td>
<td>Scandinavia</td>
</tr>
<tr>
<td>Wind energy</td>
<td>Windmills</td>
<td>Towers</td>
<td>North Sea area</td>
</tr>
</tbody>
</table>

Figure 12: Renewable energy sources and their effects for the landscape
cause extinction of species. Extinct insects would have limited effects on the visible landscape characteristics, but if the absence of these insects causes diseases by trees or a growing population in disease spreading bugs, the effects can have more impact on the landscape characteristics. Because according to the EEA: “Acidification can result in the loss of fauna and flora, and ecosystems may take many decades to recover after acidifying inputs are reduced to sustainable levels” (EEA, 2007, p. 84). Bad air quality leads to acidification in the air and temperature rise, stimulating climate change. Also salinization of coastal arable lands disturb natural ecosystems (IPCC, 2014b). The eutrophication of rivers, lakes, forests and many other landscape is also strengthened by a bad air quality (EEA, 2007, p. 84). Bad air quality can affect the rainwater and become a danger to water quality.

A sustainable approach in pollution

The effects of pollution became publicly debated after Rachel Carson’s publication of ‘Silent Spring’. Carson pointed out the badly studied effects of pesticides on health and ecology leading to intense debates between the agricultural sector and followers of Rachel Carson (De Steiguer, 2006, p. 34). In some parts of Europe the use of pesticides in agriculture and forestry diminished after Carson’s book, but due to increasing production and the need for efficiency the total use remained constant (EEA, 2007, p.294). After the critique on the use of chemicals regulations have been implemented to reduce emissions and the use of harmful materials.

In the 1970s and 1980s public awareness of pollution
Pollution can also accelerate climate change, but the effects of climate on the landscape are discussed in the next paragraph.

2.5 – Theme 4: Adapting to climate change

Climate change literally means ‘all alternations in climate over time’. However, the United Nations constrain climate change to “changes in climate caused or strengthened by human activity leading to deviations of natural varieties in climate” (United Nations, 1992, article 1). Climate change was formerly known as global heating. However, since more effects of the changing climate become clear the more coherent term climate change is used. As can be read in chapter 1.2, the problem of climate change has mainly become apparent in the 1990s and 2000s. In some countries the measures are limited to mitigation by reducing emissions, but in other countries more measures have been undertaken to adapt the physical landscape from flooding. Although the effects of climate change are still debated in the academic world, various effects can already be seen in the landscape (figure 14). Following in this paragraph, first mitigation measures to reduce climate change will be discussed and afterwards the adaptation measures to deal with climate.

Effects of reducing climate change on landscape characteristics

The effects of mitigation measures in order to reduce climate change have been influencing the landscape. In order to reduce CO₂ policies stimulated decreasing...
use of fossil fuels. This has been done by improving infrastructure for walking, cycling and public transport and discouraging car use, resulting in decreasing car use and growth in the use of public transport (Chapman, 2007, p. 357). Another option which has already been started to reduce CO₂ emissions, is the transition towards renewable energy sources (see also paragraph 2.3). In industry emissions are reduced by the distribution of emission rights. These emission permits can be traded. Industries capable of adapting cheaply to new low-emissions standards can sell their emission permits to bigger polluters (Montgomery, 1972, p. 395). Even though pollution is lowered, progress can still be made. Whether trade in emissions should also be implemented in European agriculture is still debated (Dominguez & Britz, 2010, p. 17). This would distinguish small polluters to adapt to sustainable methods and techniques, but big polluters will continue their pollution.

**Climate change effects landscape characteristics**

Climate change has several direct and indirect effects. These indirect effects are caused by adaptation measures to deal with climate change. Both effecting the landscape characteristics. In this chapter first the direct effects of climate change and their effects on the landscape are discussed. The most important effect is the rising temperature, which in turn has multiple effects like melting of glaciers and polar ice causing sea level rise (EEA, 2006, p. 50). As a result an increasing risk of floods occurs and besides that coastal erosion and wetland loss are also effects on the landscape. Some of the most significant effects of floods and sea level rise are soil
subsidence and salinization, which reduce the quality of arable lands (Nicholls & Klein, 2005, pp. 208-209). Erosion occurs directly at open coasts, but at inlets of closed coasts indirect erosion can occur. In the inlets the sea level rise can also cause that salt or brackish water will move on further inland. This causes salinization in these areas, affecting agriculture, but also natural habitats. Also ground water in the surrounding areas will be affected (Nicholls & Klein, 2005, p.205).

These direct effects of climate change demand landscape dynamics, which effect on the landscape characteristics. Flood risks increases, demanding protection works or lands and cities might be flooded in the future. Most protection works influence the landscape as is done by dikes, dams and floodgates (figure 15). This definitely influences landscape characteristics and for that reason 'soft' measures are implemented more often. Soft flooding defeences are measures that have limited influence the landscape characteristics as a result of natural interventions, for example sand supplention (Provincie Zuid-Holland, 2010a, p. 11). This supplention is also the only adaptation measure which is implemented to prevent erosion. More often the effects of erosion are reduced by emptying the possible eroded lands (Département Seine-Maritime, 2014).

Climate change also causes habitat shifting. This means that new habitats become available for many species, while on the other hand their habitats might decline. Because of weather changes, ecosystems react differently. Already settled species might disappear, creating opportunities for new species. Habitat shifting causes big effects in the migration of birds, since quite specific habitats are necessary for stops during the migration period. The absence of these birds affect fisheries in those regions. Because the birds help fishermen in their search for fish and they compete with the fishermen for the best fishing spots. Which illustrates that climate change affects landscape characteristics (Nicholls & Klein, 2005, p. 205). Habitat shifts are mostly dealt with by connecting various natural areas by ecological corridors. This makes it possible for species to migrate to better suitable habitats.

At current day climate change is a much debated subject. Probably because more and more effects of climate change become visible, as is illustrated in IPCC’s Fifth Assessment (IPCC, 2014c, 23.9.3). Effects of climate change on oceans could also affect the coastal zone, for example oceanic acidification and ocean temperature rise (IPCC, 2014b). All these effects combined show that there are multiple landscape dynamics like climate change causing several natural changes in landscape characteristics. But also landscape dynamics like adaptation to sea level rise, coastal erosion and habitat shifting have been influencing landscape characteristics.

2.6 – Theme 5: Conservation of natural and cultural heritage

Over the years the protection of natural and cultural heritage has been defined in many ways. Several approaches are debated. This research chooses conservation as definition in favour of protection because according to Knox and Marston conservation “implies responsibility to future generations as well as to the natural world itself in the utilization of resources”, which collaborates nicely with the definition of sustainability (Knox & Marston, 2007, p. 139). However, in European policy a distinction is still made between natural and cultural heritage (Catsadorakis, 2007, p. 308). Both natural and cultural heritage are subject to pressure on the land as a result of landscape dynamics.

Nature conservation influencing landscape characteristics

In the late 19th century the urgency of conserving nature was recognized. Various purposes and perspectives initiated these first top-down implemented nature reserves. Purposes were securing resources, protecting the
diversity of life on earth, and protection of natural area for
game hunt (Knox & Marston, 2007, p. 139; Phillips, 2003, 
p. 10). Despite of these various purposes of establishment
the landscape dynamics ‘nature conservation’ resulted in
limited influences on the natural state of the area. In 1968
the ‘Africa Convention on Nature and Natural Resources’
was held in order to collaborate the establishment and
management of nature reserves all over the world. In this
conference the possibilities for tourism in nature reserves
were encouraged. The local people’s use of the area
was often not even concerned. Protected areas in these
times aimed to conserve a wilderness appearance and
therefore human interference was kept outside (Phillips,
2003, pp. 11-12). In some situations local people were
even excluded from the parks, while these parks became
available for tourists and their activities like hunting and
fishing. Tourist facilities like visitor centres and hiking
paths got developed. As a reaction on these developments
more action groups and green parties joined the debated.
Some of them argued that the conservation politics were
to soft and demanded nature preservation in which
human use is excluded (Knox & Marston, 2007, p. 139)

Following on the bird directive (1979) and the habitat
directive (1992) the Natura 2000 aimed for “long-term
survival of valuable and threatened species and habitats”
(European Commission, 2014a). In order to accomplish
the Natura 2000 goals experts started to realize that
ecological networks are essential. These ecological
networks exist of core areas, corridor zones and buffer
zones (Jongman, 1995, p. 1). A corridor can be a hedge,
but also riverbanks or an ecoduct (figure 17). Within the
nature reserves the role of human is recognized, and more

Figure 16: Percentage of the coast as Natura 2000 protected area (EEA, 2006, p. 34)
Concluding, increasing attention for the ensemble of natural and cultural heritage has included the local inhabitants and visitors. This gives a balanced use of the conserved area and it could be combined with a necessary income stream. The most important landscape dynamics are connecting nature reserves, combining tourism and heritage conservation.

2.7 – Conclusions: landscape dynamics as a result of the sustainability discourse

Landscape dynamics have changed landscape characteristics over the years. The landscape characteristics and more a connection with cultural heritage is searched (Catsadorakis, 2007, p. 310; Lowenthal, 2006, p. 81)

Combining cultural and natural heritage conservation as a sustainable approach

In cultural heritage protection the ensemble value have become more important over the last years, even contributing in preservation of natural heritage (Catsadorakis, 2007, p. 317). Before the 1990s cultural heritage was seen separately from natural heritage, worldwide protected by UNESCO (2014). Cultural heritage included great monuments and on natural heritage sites were interpreted as wilderness. Cultural landscapes were included in 1992, but it took until 2005 to balance cultural and natural heritage in the ‘Operational guidelines for implementation of the World Heritage Convention’ of 1972 (Taylor & Lennon, 2010, p. 538). Conserving nature and culture can be done in various ways and so it has over the years. Lowenthal (1993) recognizes identifying, displaying, protecting, removing, embellishing and readapting relics from the past, all with the goal to make the present preserve relics of the past for future generations (Lowenthal, 1993, p. 264). The recreational role in heritage has become more important because it provides some sort of income, which is needed since heritage is often not profitable (Lowenthal, 2006, p. 85). An additional advantage is that it becomes possible to control in which places the heritage is open for public, that way the most vulnerable places can be avoided and protected.

Figure 17: An ecoduct connects two nature areas

Figure 18: Graph with surface area of various natural habitats along the coast (EEA, 2006, p.34)
The various themes within sustainability have provided long lists of relevant landscape dynamics. The selected landscape dynamics are those which effect the landscape characteristics in its structure or function. The selected landscape dynamics all affect on a scale which is higher than a personal scale. The means that the landscape dynamics should affect groups of people. Figure 19 shows the landscape dynamics categorized by the five themes in sustainability: 1) population growth, 2) resource exploitation, 3) pollution, 4) climate change, and 5) conservation of cultural and natural heritage. Also the sustainable landscape dynamics are listed in the table. In the next chapter the selected landscape dynamics will be used in the development of an analytical framework. This framework makes it possible to analyse changes in landscape. In this case changes as a result of the sustainability discourse.

<table>
<thead>
<tr>
<th>Landscape dynamics</th>
<th>Landscape dynamics of sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>- Population growth -</strong></td>
<td></td>
</tr>
<tr>
<td>Urban expansion</td>
<td>Internal urban growth</td>
</tr>
<tr>
<td>Increasing tourism</td>
<td>Combining tourism and heritage conservation</td>
</tr>
<tr>
<td><strong>- Exploitation of resources -</strong></td>
<td></td>
</tr>
<tr>
<td>Intensification of agriculture</td>
<td>Ecological focus area’s in CAP</td>
</tr>
<tr>
<td>Excavation of raw materials</td>
<td>Landscape conservation</td>
</tr>
<tr>
<td>Production of energy</td>
<td>Use of renewable materials</td>
</tr>
<tr>
<td>Overfishing</td>
<td>Production of renewable energy</td>
</tr>
<tr>
<td><strong>- Pollution -</strong></td>
<td></td>
</tr>
<tr>
<td>Deterioration of air quality</td>
<td>Emission regulations</td>
</tr>
<tr>
<td>Deterioration of water quality</td>
<td>Pollution regulations</td>
</tr>
<tr>
<td>Pollution of the soil</td>
<td>Pollution regulations</td>
</tr>
<tr>
<td>Waste collection</td>
<td>Reuse of waste materials</td>
</tr>
<tr>
<td></td>
<td>Separation of waste</td>
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<tr>
<td></td>
<td>Reduce garbage landfills</td>
</tr>
<tr>
<td><strong>- Climate change -</strong></td>
<td></td>
</tr>
<tr>
<td>Dealing with sea level rise</td>
<td>Flooding preventions</td>
</tr>
<tr>
<td>Dealing with coastal erosion</td>
<td>Emission regulations</td>
</tr>
<tr>
<td>Dealing with habitat shifting</td>
<td>Expropriation of potential victims of coastal erosion</td>
</tr>
<tr>
<td></td>
<td>Connecting nature reserves</td>
</tr>
<tr>
<td><strong>- Conservation of natural and cultural heritage -</strong></td>
<td></td>
</tr>
<tr>
<td>Conservation of natural and cultural heritage</td>
<td>Connecting nature reserves</td>
</tr>
<tr>
<td></td>
<td>Combining tourism and heritage conservation</td>
</tr>
</tbody>
</table>

Figure 19: Landscape dynamics and their sustainable approach
Landscape dynamics within the main themes of sustainability
3.

3.1 – AN ANALYTICAL FRAMEWORK FOR LANDSCAPE TRANSITION

Landscape dynamics are defined as processes contributing to changes in structure and function of landscape characteristics. It can therefore be stated that the selected sustainable landscape dynamics have several effects on the landscape characteristics of a certain landscape. Unfortunately research on change in landscapes knows several difficulties: limited research on processes is done, landscape studies are often place and time related, it contains data from social and natural sciences, and one of the most important driving forces behind landscape dynamics is the complexity of culture (Burgi, 2004, p. 858).

In this chapter these difficulties are overcome in order to answer the research question:

How can the effects of landscape dynamics on landscape characteristics be identified?

An extended literature exploration in chapter 2 has led to a selection of landscape dynamics as a result of sustainability. Such a broad exploration can be made for every driving force overcoming the lack of process studies. Exploring the relevant landscape dynamics can be done for every subject, and so the developed analytical framework can be used on various landscapes and various periods. Also the difficulties to connect social and natural data are not an issue in this research. This research focuses on the social science as an exploration for more quantitative further research, which collaborates better with natural sciences. And finally the concept of culture is not used as an whole in this thesis. The term is split up in many landscape dynamics which are related to culture, but these are thus more specified in this research.

The framework is called the Sustainable Transition in Landscapes-framework, in short STiL-framework, to be referred to in future research. This name is chosen because the framework makes it possible to compare the changes in landscape since the transition towards a sustainability discourse started.

The framework basically consists of filling in a standard table, which is derived from chapter 3 about the sustainability discourse. By making an overview table in which the dynamics and the effects on the landscape can be summarized various studies become comparable, which will be necessary to see similarities and differences to draw some general conclusions. More important is that it makes the study reproducible.

The framework contains the sustainable landscape dynamics and their effects on the landscape characteristics, divided in landscape structure and landscape functions, which is further elaborated in the next paragraphs (figure 20).

3.2 – SUSTAINABLE LANDSCAPE DYNAMICS

The main themes in the sustainability discourse have provided a selection of landscape dynamics. This selection is based on the argumentation that these landscape dynamics are initiated from a sustainable approach, and they should have effect on landscape characteristics, especially the structure of landscapes. The themes population growth; exhaustion of resources; pollution; climate change; and, conservation of natural and cultural heritage, remain as leading in the framework in order...
to see which theme is most relevant per time period or geographical area the framework is used on. Most of these landscape dynamics are already mentioned in this report, but to elaborate shortly on the dynamics they are listed shortly below:

Population growth:
- **Internal urban growth**: Urban growth within a city's contours. In order to release pressure on surrounding lands.
- **Implementing green belts**: Green belts in urban areas improve water drainage, air quality and provide recreational space in the urban areas.
- **Combining tourism and heritage conservation**: Touristic functions of heritage are often developed with respect to the heritage, in order to conserve the vulnerable heritage.

Exploitation of resources:
- **Ecological Focus Areas in CAP**: Valuable ecological areas are conserved by farmers in exchange for subsidies.
- **Landscape conservation**: Money is invested to conserve traditional agricultural landscapes.
- **Use of renewable materials**: Raw materials are more and more replaced by renewable materials, diminishing excavations.

- **Production of renewable energy**: Energy production has made a transition towards renewable energy resources. Several new technologies have been developed and added to the landscape.
- **Restrictions on fishing**: In order to give fish populations time to restore regulations and catching numbers have been established by international governments.

Pollution:
- **Emission regulations**: In order to reduce emissions regulations have been established by international governments.
- **Pollution regulations**: In order to reduce pollution of soil and water regulations have been established by international governments.
- **Reuse of waste materials**: In order to reduce waste, more and more products are made of reusable materials. Also waste is reused, for example in energy production.
- **Seperation of waste**: Waste is separated in order to make it more easy to reuse the materials.
- **Reduce garbage landfills**: The dump of waste in the landscape has been reduced since the pollutant effects have been clarified.

Climate change:

Emission regulations is already clarified within other themes.

- **Flooding preventions**: Measures are developed in order to prevent lands from flooding. Both 'hard' (dams and dikes) and 'soft' (flooding meadows and sand supplention) approaches are included.
- **Expropriation of potential victims of coastal erosion**: In order to reduce the victims of coastal erosion houses and lands that are in risk of being eroded are expropriated by governmental funds.
- **Connecting nature reserves**: In order to reduce fragmentation of natural areas these areas are connected by ecological corridors. This enlarges the natural area for species and prevents these natural areas for biodiversity loss.

Conservation of cultural and natural heritage:

Connecting nature reserves and combining tourism and heritage conservation are already clarified within other themes.

These landscape sustainable dynamics influence many landscapes, and therefore the analytical framework can be copied to other landscapes. To monitor how landscape dynamics have influenced mountain areas, coastal landscapes, urban regions the landscape dynamics affecting those landscapes can be selected from this shortlist. For Europe's coastal landscapes this is done in chapter 4.
3.3 – LANDSCAPE CHARACTERISTICS: STRUCTURE AND FUNCTION

In order to monitor the effects of the sustainability discourse on the landscape characteristics a distinction is made between landscape structure and landscape functions (Forman & Godron, 1986 cited in: Burgi, 2004, p. 857). This is done because not all sustainable landscape approaches can be seen directly in the tangible landscape structure. These influences on the landscape characteristics are called influences on the landscape functions. In this research focus lays on the landscape structure, but effects on the landscape function are also mentioned.

The difference between landscape structure and landscape function is illustrated in the next example. For years farmers on the Danish island of Samsø have burned their straw production to collect the ashes as fertilizers. Since Samsø had been appointed as an energy self-sufficient island in 1997, the island’s straw is now collected and burned in a biomass power plant to produce energy for the villages of the island, the remaining ashes are still used as fertilizers (figure 21). The function of the landscape changed and pollution decreased, but the physical structure of the landscape remained similar to how it was before. Optically it seemed like nothing changed in the landscape characteristics, but in reality a sustainable approach has made the landscape of this Danish island function in a more sustainable way. The production of straw on the island has got a new function (Interview with B. Garbers, 2014). This example shows that to understand the influence of sustainable landscape dynamics both the landscape structure and the landscape function has to be taken into account.

3.4 – FILLING IN THE STIL-FRAMEWORK

To study the landscape dynamics as defined in paragraph 3.2 the used method is to fill in a table (figure 22). The table corresponds with a textual elaboration, because only short references can be written in the table. The selected landscape dynamics are listed in the first column. The sustainable approach has to be concluded from expert interviews (policy makers and environmental organizations) and local policy and planning plans. How the sustainable approaches affect the landscape structure and the landscape’s function can be filled in the latter two columns. Results for the landscape structure can be found in evaluation reports and scientific articles, but also field observations and map analysis can contribute to explore the influence of the sustainability discourse on the landscape structure. Change in a landscape’s function should be derived from evaluation report as well, but also interviews with locals and experts are useful. When landscape dynamics affect an area it does not mean that both landscape structure and landscape function are influenced. However, both are covered by the term landscape characteristics.

Both sustainability and landscape are complex and much debated concepts and in order to analyse these subjects in their full extent it is important to do qualitative research instead of limiting to measurable quantitative indicators, as is done in the SUSTAIN-study (Boeije et al., 2009, p. 254; EUCC, 2012). Quantitative research might be a next step if the analytical framework is able to identify all the ongoing processes related to sustainable landscape development.

The table operationalizes the research and makes it possible to compare results, either of different places or of different periods in time. It is a tool for future research and for the monitoring of the effects of sustainability on landscapes. In the next chapter the framework is tested on Europe’s coastal landscapes. At first the relevant landscape dynamics are selected by comparing them to them landscape dynamics working on Europe’s coastal landscapes and then the effects on landscape characteristics are identified in three case studies. The strengths and its weaknesses of the STIL-framework are evaluated in the discussion.
<table>
<thead>
<tr>
<th>Sustainable landscape dynamics</th>
<th>Sustainable approach</th>
<th>Effects on landscape structure</th>
<th>Effects on landscape functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal urban growth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implementing green belts</td>
<td></td>
<td></td>
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<tr>
<td>Combining tourism and heritage conservation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ecological focus areas in CAP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landscape conservation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of renewable raw materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production of renewable energy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restrictions on fishing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emissions regulations for air quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pollution regulations for water quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pollution regulations for soil quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of waste materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Separation of waste</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduce garbage landfills</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flooding preventions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expropriation of potential victims of coastal erosion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecting nature reserves</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 22: STIL-framework a table to create an easy overview in the collected information.
4.

4.1 – Vulnerable coastal landscapes

Coastal landscapes are among the most threatened areas in the world. One of the reasons is that human population growth is causing an increasing pressure on the land (EEA, 2006, p. 11). Almost 60% of the world population currently lives in coastal areas, meaning in a 100 kilometres radius of the seashore and one third of the European people live within 50 kilometres of the European seashores (VLIZ, 2008; Nicholls and Klein, 2005, p. 200). The densely populated coastal areas are home to important ecosystems. At the meeting point of air, water and land combined with the wind, wave and tidal dynamics coming together on the shoreline a unique ecological gradient resulting in extraordinary ecosystems (EEA, 2006, p. 48). The second threat coastal areas have is the important function for fishery and in the tourism industry, which leads to even more pressure on the land and contributes to increasing pollution of water, air and soil. Finally, there is a threat from climate change. The bigger impact of climate change on these areas is the sea level rise. Several coastal areas are threatened by the rising sea level, endangering the dense residential areas with floods and threatening natural and agricultural areas by coastal erosion and wetland loss (Nicholls and Klein, 2005, p. 208). Because of the vulnerability the coastal landscapes are a perfect area to research the effects of implementation of the sustainability discourse in the landscape.

In order to make a proper analysis of the effects of the sustainability discourse on coastal landscapes, these landscapes should be introduced and defined properly. Coastal landscapes cover a wide variety of natural and cultural landscapes influenced by landscape dynamics. This chapter therefore answers the next question:

What sustainable landscape dynamics can be detected in Europe’s coastal landscapes?

First the coastal landscape’s physical-geographic characteristics are identified and afterwards the cultural characteristics are discussed. Both are mainly based on EEA’s ‘The changing faces of Europe’s coasts’. The landscape dynamics that have influenced the coastal landscapes over the past decades are also discussed. At last in the final part of this chapter these landscape dynamics are compared to those derived from the sustainability discourse in chapter 2. The dynamics changed by a sustainable approach are selected for the analysis on several case studies in chapter 5.

4.2 – Europe’s coastal landscapes: a physical-geographic analysis

The European coastal area is very diverse in landscapes due to cultural context, but also because of natural and physical factors. In 1997, The Coastal and Marine Union (EUCC) performed a study to “determine the vulnerability of specific coastal landscape types and habitats in relation to the environmental impacts” (EUCC, 1997). In this research a division in two major groups is made: ‘the cliff and rocky coasts’ and ‘the coastal plains’. Cliff coasts can often be found in hilly areas, although they might include small shingle shores or beaches, like in the Italian Liguria and the Northern Spanish coast. The coastal plains can be found in areas with lower altitudes - closer to the mean sea level - such as the Dutch, Danish and German shore.

A second division can be made by the dominant substrate. Although the dominant substrate causes differences in the coastal plains as well, the differences are more obvious on the cliff coasts. The Irish western coast is made of hard basaltic rock and therefore takes longer to erode (figure 23) than the calcareous cliffs of Southern England. Throughout the years big parts of the Southern English coast have disappeared into the sea, leaving only eroded remains (figure 24). The third dominant substrate are the recent fluvial, marine and aeolian sediments;
loose soils with low resistance to erosion of wind, sea and rivers. A good example are the sandy dunes in France and the Netherlands, formed by sand blowing in the wind and local flora catching it, creating dunes (figure 25).

The third division in the European coasts is the tidal range of the sea. The dynamic micro tidal regime (figure 26) is more resilient to changes than the macro tidal systems along the Atlantic and North Sea coast. The tidal differences of almost 12 meters in Southern England are amongst the highest in the world. The North Sea is characterized by meso-tidal movements and inner seas like the Mediterranean and the Baltic sea have minimal tidal influences.

The top view of the shorelines is influenced by rivers almost everywhere. Rivers fed by melting waters from the mountain glaciers and rain water meet the sea in deltas or estuaries along the shore. Deltas usually emerge in plains with softer rock ground or recent sediment in which riverbed formation and change is easy. This results in an interweaving pattern of tributaries into the sea (Schwarz, 2005, -D). Estuaries can be defined as tidal inlets from the sea into river floodplains. Estuaries are former riverbeds drowned in the sea, usually emerging during higher tides. Then there are lagoons which are on eye tideless brackish ponds partly isolated from the sea (Schwarz, 2005, -E). Both deltas, lagoons and estuaries dominate the coastal landscapes of Europe, contributing to a big variety of landscapes along the coast (figure 27).

4.3 – Europe’s coastal landscapes: a cultural-socioeconomic analysis

The variety in Europe’s coast can also be seen in its cultural developments over the years. Coastal landscapes have always been important places for settlement, economic centres and strategic defence locations that have been important to inhabit. In the late 15th century Spanish, Portuguese, Italian and Low Country’s port cities developed to important players on the world market. These cities became very rich and enormous amounts of cultural heritage can still be found in these port cities today. In this era also distant water fishing for cod and herring developed, as did the exploitation of natural resources. These resources were the cause of the industrial revolution in the United Kingdom in the 18th century (Rhoda et al., 1994, pp. 46-47). These phases in history can still be seen in coastal landscapes: The

<table>
<thead>
<tr>
<th>Types</th>
<th>Tidal Range</th>
<th>Regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>micro-tidal</td>
<td>&lt; 1 m</td>
<td>Baltic and Mediterranean coasts</td>
</tr>
<tr>
<td>micro-tidal</td>
<td>1-2 m</td>
<td>North Sea coasts: Shetlands, western Denmark</td>
</tr>
<tr>
<td>meso-tidal</td>
<td>1-4 m</td>
<td>Atlantic and North Sea coasts</td>
</tr>
<tr>
<td>macro-tidal</td>
<td>&gt; 4 m</td>
<td>Atlantic and North Sea coasts</td>
</tr>
</tbody>
</table>

Figure 26: Table of tidal ranges along Europe’s coasts (EUCC, 1997)
In peaceful times these port cities where flourishing places to be, but in war times the coastal areas were the first areas to be invaded by enemies and therefore heavily defended by fortifications and other defensive buildings, like the defensive works on the Southern coast of England mapped in the 16th century by Henry VIII, figure 28 (BBC, 2010). Also in both the First and the Second World War battles have been fought along the shoreline. Remains of the Normandy landings and the Atlantik Wall, along the Atlantic coast in the Netherlands, Belgium and France are only a few examples of how the wars have impacted the coastal landscapes. These historic cities and fortifications have become cultural heritage and a popular destination.
for tourists in addition to natural aspects of the landscape.

Tourism is the main income in Europe’s coastal landscapes. Especially in the Mediterranean, Southern England, the Low countries, Northern Germany and the Black sea coasts of Bulgaria and Romania (figure 29) (Grote Bosatlas, 2006, p. 91A). The growing tourism industry in coastal areas increases the pressure on land, because of the development of airports, boulevards, infrastructure, resorts and golf courses as can be seen in the example of Benidorm (figure 30). In the surroundings of coastal settlements nature reserves and other day-trips can be found. This nature can be many things. Dunes in the Netherlands, France and the Ukrainia (VLIZ, 2008). Norway has its fjords and Swedish and Finnish coasts exist mainly of forests. Wetlands can be found in Ireland, United Kingdom, the Low Countries, Western France and the Italian Po Valley.

The Po Valley is also a good example of nutrient rich valley, with suitable conditions for more intensive agriculture. Also in Spanish huertas and French riverbanks Mediterranean polycultural agriculture represses other functions (Jordan, 1973, p. 54). Riverbanks in Northern Europe are also suitable for profitable agriculture, but especially in north west of Europe industries have developed along the bigger rivers. These rivers provide good transport possibilities connecting the big port cities of Antwerp, Rotterdam, Bremen and Hamburg with their hinterlands. As a result of industrial waste water discharges and agricultural and urban run-off pollution occurs (EEA, 2007, p. 100). Mostly in the Baltic sea and the North sea this pollution has had negative effects for
the fish populations and fisheries (Hinrichsen, 2011). Most European fishing takes place in Denmark, Iceland, Norway, Russia and Spain, in some places to extensively (Grote Bosatlas, 2006, p. 231). Regulation by management of fishing might improve the circumstances, but it does not solve the problem of overfishing, because fishing villages and families do not have proper alternatives for gaining income (EEA, 2006, p. 49). Exploitation of coastal resources demands a more sustainable approach.

Recently climate change has developed to one of the biggest threats to coastal landscapes. In the coastal area an increasing risk for floods as a result of an increasing amount of storms and sea level rise occurs on top of that (EEA, 2007, p. 210). As a result of sea level rise, but strengthened by increasing pressure on land by human use coastal erosion might occur. This enlarges the risk for flooding in the coastal areas. Climate change among others caused a transition towards increasing sustainable landscape development in the coastal area (EEA, 2006, p. 48).

4.4 – Sustainable landscape dynamics in Europe’s coastal landscapes

Concluding from the last two paragraphs the following research question can be answered:

What sustainable landscape dynamics can be detected in Europe’s coastal landscapes?

Having sketched the physical characteristics of Europe’s coastal landscapes, the cultural analysis provides an extended number of landscape dynamics which influence the landscape. These landscape dynamics are listed in figure 31, already categorized into the main themes of sustainability where possible. Also the sustainable approach of these landscape dynamics are formulated. These sustainable landscape dynamics are the dynamics that are taken into account in analysing the three case studies in chapter 5. To make these practical observations easier, the expected effects on the landscape characteristics of Europe’s coastal area are listed in the third column of the table. Analysing Europe’s coastal landscapes on a general level has given a good starting point to test the STiL-framework in practice. This makes it possible to analyse the effects of sustainable landscape dynamics on Europe’s coastal landscape.
<table>
<thead>
<tr>
<th>Landscape dynamics of Europe’s coastal landscapes</th>
<th>Sustainable landscape dynamics</th>
<th>Effects on landscape characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population growth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban expansion</td>
<td>Internal growth</td>
<td>No expansion, agricultural and natural land is conserved</td>
</tr>
<tr>
<td>Increasing tourism</td>
<td>Sustainable tourism</td>
<td>Increasing tourism facilities Pressure on cultural and natural heritage</td>
</tr>
<tr>
<td>Exploitation of resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensification of agriculture</td>
<td>Ecological focus area’s in CAP Landscape conservation</td>
<td>Balanced ecosystems Natural enclaves Conservation of traditional landscapes</td>
</tr>
<tr>
<td>Excavation of raw materials</td>
<td>Use of renewable materials</td>
<td>Less mining</td>
</tr>
<tr>
<td>Production of energy</td>
<td>Production of renewable energy</td>
<td>Wind turbines, solar panels etc. (figure 24)</td>
</tr>
<tr>
<td>Overfishing</td>
<td>Restrictions on fishing</td>
<td>Balanced ecosystems (fishes, birds plants ect.) Fisherman villages and their boats remain</td>
</tr>
<tr>
<td>Pollution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deterioration of air quality</td>
<td>Emission regulations</td>
<td>Higher chimneys Smaller polluters adapt Balanced ecosystems</td>
</tr>
<tr>
<td>Deterioration of water quality</td>
<td>Pollution regulations</td>
<td>Balanced ecosystems Less droughts</td>
</tr>
<tr>
<td>Pollution of the soil</td>
<td>Pollution regulations</td>
<td>Balanced ecosystems Less droughts and erosion</td>
</tr>
<tr>
<td>Waste collection</td>
<td>Reuse of waste materials</td>
<td>Multiple various garbage bins Less garbage dumps and landfills Burning plants</td>
</tr>
<tr>
<td></td>
<td>Separation of waste</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduce garbage landfills</td>
<td></td>
</tr>
<tr>
<td>Climate change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dealing with sea level rise</td>
<td>Flooding preventions</td>
<td>Building of dikes, dams, floodgates Flooding meadows</td>
</tr>
<tr>
<td></td>
<td>Emission regulations</td>
<td></td>
</tr>
<tr>
<td>Dealing with coastal erosion</td>
<td>Expropriation of potential victims</td>
<td>Land loss</td>
</tr>
<tr>
<td>Dealing with habitat shifting</td>
<td>Connecting nature reserves</td>
<td>Various species compensation Reduced biodiversity loss</td>
</tr>
<tr>
<td>Conservation of natural and cultural heritage</td>
<td>Connecting nature reserves</td>
<td>Ecoducts, hedges, natural riverbanks Visitor centre, pathways, parking places, road signs</td>
</tr>
<tr>
<td></td>
<td>Combining tourism and heritage conservation</td>
<td></td>
</tr>
<tr>
<td>Landscape dynamics not derived from the sustainability discourse, therefore not included in the STIL-framework</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growing trade</td>
<td>Growth of ports</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increasing infrastructure</td>
<td></td>
</tr>
<tr>
<td>Abandonment of defence works</td>
<td>Remains of bunkers abandoned</td>
<td></td>
</tr>
</tbody>
</table>

Figure 31: Table with landscapes dynamics of Europe’s cultural landscapes compared to sustainable dynamics and their effects on the landscape characteristics.
5.1 – Selecting the case studies

After designing and operationalizing the STiL-framework the final part of this research aims to test the framework in practice. In the same time the research question for the second part of this thesis will be answered for Europe’s coastal landscapes:

What sustainable landscape dynamics can be detected in Europe’s coastal landscapes and how have these been influencing the characteristics of these landscapes that commenced in the 1960s?

It is important to test the STiL-framework in practice, because practical experience can expose the strengths and weaknesses of the framework. The next three paragraphs describe three case studies in which the STiL-framework is tested: Zuid-Holland (The Netherlands), Samsø (Denmark) and Seine-Maritime (France) (figure 32).

The selected case studies are diverse, in order to be a first versatile test for the analytical framework. When the framework is improved these case studies can become an example for various regions along Europe’s coast, to which the framework can be copied. The study areas are selected by several criteria divided into two categories: physical-geographic and landscape dynamics. The physical-geographic criteria are derived from the various geographical characteristics of the European coastal landscapes explained in chapter 4. This includes the division between cliff coasts and coastal plains, the division between the dominant substrate and the tidal influence. Seine-Maritime is a cliff coast while Samsø and Zuid-Holland are coastal plains, of which Samsø is an island and Zuid-Holland is situated in a delta. The sandy dunes of The Hague differ geographically from the mud flats of Samsø and the hard rock cliffs of Seine-Maritime. Seine-Maritime is exposed to big tidal influence of the Atlantic Ocean, while Zuid-Holland has moderate tidal influence and Samsø is influenced by micro-tides (figure 27).

The other criteria are the big scope of landscape dynamics as discussed in chapter 2. The case studies are selected to be subject to several dynamics from the STiL-framework. Urban growth for example is a main issue in Zuid-Holland, whereas increasing tourism is subject of a struggle in all case studies (Interview A.M. van de Lindeloof, 2014). The Danish island of Samsø is already self-sufficient in energy production, while Seine-Maritime is only commencing its transition from nuclear energy to wind-energy (Interview M. Kristensen, 2014; Interview F. Sénécal, 2014). The industrial department of Seine-Maritime also has more problems regarding pollution, while the island of Samsø has good air quality due to its sea winds. Seine-Maritime and Samsø have to deal with coastal erosion, while the Dutch focus on problems that occur as a result of sea level rise (Interview M. Kristensen, 2014; Interview F. Sénécal, 2014). The various landscape dynamics are studied in three various areas to gain information about all different processes that form the landscape.

Besides these criteria Zuid-Holland and Samsø are chosen because they are known for their sustainable landscape development (Zandmotor.nl, 2014 ;Visit Samsø, 2014b, p. 32). The third case study should therefore not be known for sustainable development to show a gradation in sustainable development. For that reason the industrialized area of Seine-Maritime is chosen as the third case study (vivre-en-normandie.com, 2009). All three case studies are studied with the STiL-framework. This framework shows how sustainable approaches affect the landscape structure and the landscape’s function in the study areas. All case studies are introduced and various landscape types are described. In the end the sustainable approaches and their effects on the landscape characteristics are elaborated on, discussed following the five themes of sustainability as described in chapter 2. In the final paragraph the case studies are compared in order to conclude some of the findings. Most of the important landscape dynamics, the most remarkable effects on landscape characteristics and the timeframe of the implementation of sustainable approaches can be derived from the STiL-framework.
Sustainable landscape development in practice

1 Urban area

Densely populated urban area’s characterized by pressures on recreational space and difficulties with water drainage.

Internal growth in cities and design with natural green elements, good for recreation and water drainage.

2 Glasshouses

State of the art food production and horticulture on the gradient between former peatlands and riverbanks, small scale maze of dikes filled with glasshouses.

Strict rules on pollution and use of new techniques in thermal energy.

3 Dunes and coastal zone

Sandy dunes and beaches and protected nature area under pressure by tourism and urban growth. The dunes also function as primary sea defence.

Combining tourism and nature protection. Soft strengthening of the dunes if possible.

4 Riverbanks

Rivers and their banks, as well inside as outside the dikes suitable for fruit production and agriculture.

Extensive cattle breeding in the riverbanks and more room for rivers when they flood.

5 Former peatland-meadows

Open grasslands and meadows, too wet for agriculture and affected by subsidence of the soil.

Subsidized open grasslands to remain green space in the urban region.

6 Dryings [in Dutch: Droogmakerijen]

Former lakes pumped dry in order to cultivate. Now open low lying agricultural farmland, rationally designed within dikes.

Profitable open agricultural lands protected by dikes.

Figure 33: Types of the coastal landscape in Zuid-Holland (photos: private collection)
5.2 – Building with nature: natural coastal defence in urbanizing Zuid-Holland

One of the most urbanized and densely populated areas of Europe is situated along Rhine-Meuse delta in the Dutch province of Zuid-Holland (figure 33). This delta has been the centre of trade and the gate to the European hinterlands since the Dutch Golden Age of the late 16th and 17th century (Abrahamse & Rutte, 2011, p. 116). Remarkable for this area is that the delta is situated below sea level and kept arable and liveable land by innovative artificial coastal defence systems and the natural sandy dunes. Due to the pressure on the land by the sea these dunes are shrinking every year, placing the inlands of Zuid-Holland in an even bigger flooding risk (Provincie Zuid-Holland, 2010a, p. 17). Most important business sectors in this region are the Rotterdam harbour, which is the biggest harbour in Europe. The Dutch national governmental functions as well as the international juridical functions are both located in the coastal city of The Hague.

Landscape types and their threats

The sandy dunes along the Dutch Rhine-Meuse delta coast are characterized by their natural appearance. Houses are rare and the dunes contain many threatened animal and plant species, because of the unique nature. Right behind the coastline is an urban ring called ‘De Randstad’ (figure 33). In the middle of the urban ring the landscape is characterized by open grassland for grass production and cattle grazing (Planbureau voor de Leefomgeving, 2013). These former peat land meadows are located several metres beneath sea level and are too wet and swampy for proper food production. The more clayey soils along the rivers are more productive for the production of fruit and vegetables. Former drained lakes in the area contain fertile maritime clay soils which provide excellent agricultural and horticultural land. This includes areas that are completely filled with glasshouses, in which the agricultural production is optimized. In those areas no trees can be found for they would make a shadow on the valuable land. These dryings [in Dutch: droogmakerijen] are one of the landscape types of Zuid-Holland along the formerly mentioned sandy dunes, cities, open grassland and riverbanks.

The biggest threat for the Zuid-Holland landscape is flooding, a threat which is increasing by climate change and its sea level rise. Although the dunes protect a big part of the lower hinterlands (former peat land meadows), there are some weak links which need a sustainable solution (Provincie Zuid-Holland, 2010a, p. 7, p. 10). The main threat comes from the rivers. Warmer summers lead to more melting glaciers in the Alps and more melting water flowing down along the Rhine and the Meuse rivers. The rivers need more space for flooding and riverbanks are threatened by flooding (Ministry of Transport, Public Works and Water Management, 2006, p. 7). Another threat for the area is the increasing urban growth. Cities expand more and more, putting pressure on inner green areas and the natural sandy dunes, with major consequences for the nature in the area. Also increasing tourism puts a growing pressure on these natural areas (Provincie Zuid-Holland, 2010b, p. 10). Finally the former peat lands are heavily threatened by soil subsidence as a result of water withdrawal to dry the lands. Near the coast subsidence can also lead to salinization of the arable lands.

Landscape dynamics with a sustainable approach in Zuid-Holland

The landscape dynamics influencing Zuid-Holland’s landscape have been developing into a sustainable approach since the 1960s. From an interview with local experts followed that urban expansion is growing, but is not replacing natural and agricultural lands. An internal growth policy has been implemented lately encouraged by the national and provincial government’s contour-policy (Interview A.M. van de Lindeloof, 2014). From the 1990s onwards urban growth was only permitted within designated areas. This changed the landscape structure in urban areas considerably, but the impact on rural areas has been limited (Provincie Zuid-Holland, 2010b, p. 5). Tourism growth in the coastal zone has been reduced by the economic crisis of the last few years, limiting the pressure on land caused by tourism.

Looking from the sustainability theme ‘exploitation of resources’ the intensification of agriculture is the most remarkable of the landscape dynamics in Zuid-Holland. Glasshouse farming and bulb cultivation now use less pesticides and more organic and innovative methods for efficient agricultural production. For example in using thermal energy from the greenhouses for the heating of water. This affects the landscape’s function, but hardly shows any changes in the landscape structure (Stukje & De Werk, 2009, p. 5). Also other methods to (re-)use...
renewable energy sources are increasing. On individual initiative wind-turbines, solar panels and biomass power plants have been developed and entered the landscape characteristics as can be seen in the STiL-framework (figure 35).

In Zuid-Holland pollution has been a bigger problem in the past, but regulations in the 1960s and 1970s have been eye opening to the population who was becoming the victim of their own pollutions. After the 1970s, pollution decreased, although the dense population still causes much emission of particulate matter (Interview A.M. van de Lindeloof, 2014). Soil pollution can be found in the dunes, because according to local experts the dunes were formerly used as landfills. The waste materials that are released from that now leak into the soil and the ground water. According to groundwater experts the measures to reduce these effects are too expensive and therefore not executed.

The most problematic landscape dynamics are caused by climate change, and more specifically by sea level rise. Since most of the land is situated below sea level, this area has high flooding risk. After a flooding disaster in 1953 many measures have been taken to improve dikes and flood defences, for example the Maeslantkering in 1997. In 1993 a Basic coastline is drawn to be sustained. Which means that if erosion takes place national government has to supplement new sand. From the 2000s the coastline is sustained with so called ‘hard’ interventions if necessary (dams and dikes, with clear effects on the landscape) and ‘soft’ if possible interventions (sand suppletion, hardly any effects on the landscape’s structure) (Provincie Zuid-Holland, 2010a, p. 11; Interview A.M. van de Lindeloof, 2014). The weakest links in the dunes have been strengthened with the help of sand suppletion on the beaches. On current day a pilot project aims to spray an enormous volume of sand on the beach of Monster (see figure 34) within several months, enough for twenty years. This pilot project is to spread sand naturally along the whole coastline and blown into the dunes to strengthen them. This so-called ‘building-with-nature’-project causes a natural strengthening of the coast (Zandmotor.nl, 2014). The project provides chances for natural development, but it also provides recreational functions. Although the landscape function changes, the landscape structure still looks like a sandy beach.

Other effects on the landscape are the decrease of natural area in the province. This despite the attempt of the Netherlands to create an extensive network of nature, Ecological Main Structure (EHS), based on Natura 2000 policies. This structure has stimulated the development of nature corridors to decrease fragmentation of nature and link the dunes to the riverbanks. Also some ecoducts have been built allowing animals to cross a barrier from one nature area to another (Provincie Zuid-Holland, 2010b, p. 7; p. 11). This concept also contributes to dealing with habitat shifting, because it allows animals to migrate to new habitats instead of becoming extinct in their original habitats (Phillips, 2003, p. 19).

The most striking change in the landscape characteristics is the urban growth in this area. Urban growth is not driven by the sustainability discourse, but it is limited by it. Also much effort has been put into flood prevention of the hinterland. Since the 1950s ‘hard’ dikes appeared in the landscape, but since the implementation of the basic coastline also ‘soft’ interventions are executed Thus the dunes can continue protecting the land. Recently the small province has decided to integrate sustainable approaches and from now on innovative and coherent sustainable development can be expected in Zuid-Holland (Interview A.M. van de Lindeloof, 2014).
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<td>Ecological Main Structure</td>
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*Figure 35: STIL-framework for Zuid-Holland*
Hilly grasslands
Hilly grass production lands with small villages spread out over the area. Straw production for local heating cycles, and small agricultural lands, around the water reservoir use of chemicals is forbidden.

Agricultural production lands
Productive almost flat production lands. Produced organically without chemicals and protected as special preserved location combined with the hills.

Forest and heatland
Planted forests used for forestry and wet heatland on the place the North and South island are now connected. Forests produce biomass for heating the island and provided a recreational area.

Tidal flat
Rich natural area which changes by the tides, great breeding place for birds and therefore not accessible whole year long for tourists. Natural development combined with recreational opportunities.

Micro relief hills
Natural hilly area which is very animal rich and intensively used by islands tourists. Special preserved natural area accessible for tourists and farming is done organic.
5.3 – Samsø: an energy self-sufficient island in Denmark

The Danish island of Samsø, South-East of Århus in Kattegat - has become a precursor on sustainable development. After being appointed as a renewable energy island in 1997 the small island has become completely self-sufficient in electricity and for 70% in heating (Interview with B. Garbers, 2014). Eleven on-land wind-turbines, owned by the local inhabitants produce enough energy for the 4000 island residents. This pilot function in sustainable development has also led to the founding of the Energy Academy on Samsø in 2007 in which knowledge and education is shared on the implementation of renewable energy (Visit Samsø, 2014b). Over the years the flat and grassy island has been noticed by its sustainable developments, and has become part of Samsø’s identity and landscape.

Landscape types and their threats

The main business sectors on Samsø are agriculture and tourism, which can be seen in the landscape (PlanEnergi, 2007). Tourism has been growing over the decades and mainly focusses on cycling, hiking and sailing. Nowadays 10% of the 100.000 yearly tourist come to inform about the energy transition on the island (Visit Samsø, 2014b). Over the years the flat and grassy island has been noticed by its sustainable developments, and has become part of Samsø’s identity and landscape.

Because Samsø is an island, it has some different threats and opportunities than mainland coastal landscapes. There are few educational institutes, and also the number of labour opportunities is limited. That means that the population of the island consists mainly of elderly people and more people dying every year than there are born on the island. So the main threat for the island is population decline (Interview with M. Kristensen, 2014; Planenergi, 2007, p. 8). Besides these demographic problems, the climate change is another threat for Samsø. Heavier and more frequent storms cause some coastal erosion and an increasing risk of flooding (Interview with M. Kristensen, 2014). A third threat for Samsø farmers is the high cost of exporting products to the mainland, which makes it more difficult to remain profitable. These problems contribute to the islanders attitude feeling need to depend on each other in order to survive together (Interview with B. Garbers, 2014).

Landscape dynamics with a sustainable approach in Samsø

Although Samsø's population does not grow, urban growth is still a challenge. It is beneficial for inhabitants to rebuild their houses in a more sustainable way (better isolated and energy efficient), which keeps the building sector alive. This example creates jobs and contributes to better living circumstances on the island (Interview with M. Kristensen, 2014). Tourism on Samsø is growing and especially for cycling and hiking in the small scale hills a good infrastructure can be found. Tourism is not growing to large proportions, but a bigger and more sustainable ferry is ordered, which runs on gas (Energiakademiet, 2014).

From the landscape dynamics concerning exploitation of resources the sustainable production of energy is striking. Due the sustainability discourse Samsø’s inhabitants have decided to become self-sufficient in energy-use in 1997, and they are even aiming to be completely fossil fuel free in 2030, twenty years earlier than the EU aims for. The wind turbines are paid by the local inhabitants and for that reason they are not considered as disrupting the landscape (figure 37). Actually the windmills have become the symbol of the sustainable transition. Combined with a solar field and four biomass power plants which produce heating, all energy used on the island is also produced on the island (figure 38). Biomass is the grass from the hilly grasslands and woodchips from the forest. Overproduction is transported to the main land (Planenergi, 2007, pp.46-47). According to a local municipality worker fish rate is very low in the Baltic sea due to overfishing and pollution. Luckily the protected waters around the off-shore wind-farms provide new breeding grounds for fish species to rebuild their
Farmers on the island have high transportation costs. Therefore, they cannot compete with farmers on the mainland. That's why the farmers choose for quality instead of quantity. For that reason ‘Organic Samsø’ is founded recently, an action group in favour of organic farming. Near the drinking water basins on the island it was already forbidden to use pesticides and chemicals for years, in order to prevent pollution (Planenergi, 2007, p. 52). Reducing the use of pesticides also contributes in reducing soil pollution. The air and water quality on the island is already good because of the hard oceanic winds that refresh the air constantly (Interview with M. Kristensen, 2014).

A potential effect of climate change is that it can lead to harder winds, resulting in higher income from the wind turbines. Climate change caused a risk for the island and therefore a sustainable approach on the landscape dynamics is chosen. More storms increase the risk of flooding and coastal erosion. On Samsø erosion is not prevented, but it is solved by expropriating potential victims. Flooding is prevented by flooding some of the lower meadows along the coast when necessary (Interview with M. Kristensen, 2014).

Over the last five decades the landscape characteristics have not changed much. According to the STIL-framework most changes can be seen in the landscape function and not in the tangible landscape structures (figure 39). When in 1997 the island inhabitants decided to become more sustainable, this changed. Firstly, several wind turbines were built and soon followed the biomass power plants and their heating networks over the island. These iconic examples of sustainable landscape characteristics are partly owned by the inhabitants, who also share in the profits (Planenergi, 2007, p. 12, p. 22, p. 42). The biomass which is burned is also grown on the island. Formerly farmers would burn their fields of straw, but now it gives them energy, and the ashes of burning are used again as fertilizer (Interview with B. Garbers, 2014). The key point of Samsø's success story is that the people of Samsø are included in the project. They invested in the projects themselves, for economic purposes. The projects had to remain simple to let everybody have a proper insight in how it works. It thereby had the effect that there are no complains of disturbance in the landscape by wind turbines, because these are the inhabitants own turbines.
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<td><em>Flooding preventions</em></td>
<td>Expropriate potential victims of coastal erosion</td>
<td>Flooding meadows</td>
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<tr>
<td><em>Connecting nature reserves</em></td>
<td>Expropriation of potential victims Abandonment of houses and land</td>
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*Figure 39: STiL-framework for Samsø*
Sustainable landscape development in practice

1 Coastal cliffs
Along the coast calcareous cliffs arise more than 100 metres above sea level, which are affected by erosion continuously. Lands and houses risk being eroded, but they can be subsidized to move away. The moving peddles are being returned manually in order to protected the valleys.

2 Densely populated valleys
Valleys contain several villages which have grown massively lately. These lower areas are protected against flooding by walls. In more rural valleys bocage landscapes can be found. Hard protection measures keeps the valleys from flooding from both seaside and drainage water from the plateau.

3 Polycultural Pays de Bray
Various land uses characterise the plateau in South Eastern Seine-Maritime. Cultivated production lands, bocage landscapes in more humid areas and forests. Preserving the diversity in the varied landscape and produce a big variety of products.

4 Industrial Seine valley
The banks of the Seine river are heavily industrialized, but also contain steep and natural slopes. Protected nature in the Parc Naturel Régional des Boucles de la Seine Normande and strict regulations on pollution provide a more sustainable environment.

5 Agrifood plateau with clos-masure (Pays de Caux)
The rainy and windy plateau is characterised by clos-masure settlements, farms with a curtain of trees to protect the cattle and goods. Rainwater is drained by traditional ponds and the clos-masure farms are protected as cultural heritage as are the big number of local products.

Seine-Maritime
Country: France
Area: 6.278 km²
Inhabitants: 1.243.834
Density: 198 inh./km²
Coastline: 130 km (evi.com, 2014)

Figure 40: Landscape types of Seine-Maritime coastal landscapes (photo’s: private collection and Atlas paysage Haute-Normandie, 2011)
5.4 – Threat of erosion on the cliff coast of Seine-Maritime

The French coast of Seine-Maritime is mostly known for its industries and cliff coasts (figure 40). Where the Seine estuary meets the Atlantic ocean, limestone cliffs arise over hundred meters above sea level. Alike the other side of the Channel in England the limestone plateau is alternated with valleys formed by drainage water. The French department of Seine-Maritime is the fourth most densely populated area of France and has two important harbours (Le Havre and Rouen) to supply Paris stream upwards on the industrialized Seine (figure 41) (Regio Haute-Normandie, 2003, p. 6). The important trade position has made the department flourish, as well as the textile industry during the industrialisation of the 19th century (Regio Haute-Normandie, 2003, p. 7). The area continued to develop itself and now produces over 10% of France’s electricity. Most of its nuclear electricity is from power plants along the coast. The area is also developing a pilot in off shore wind-farming (Interview with F. Sénécal, 2014). Other important industries, the petrochemical industry and the automobile industry, are both located along the Seine, one of the most industrialized rivers in Europe. Higher on the plateau of Pays de Caux the agri-food sector flourishes. Along the coastal cliffs tourism is still growing, and has been increasing ever since the railroads were established during the 19th century. Bathing places like Dieppe and Étretat in the coastal valleys have become very popular among Parisians, but also to international tourists. This has given an economic impulse in the small coastal villages that formerly earned most of their livelihood in fishing (Interview with I. Juilliard, 2014).

Landscape types and their threats

Most of Seine-Maritime’s villages are located in the valleys open to the sea (Agence Follea-Gautier, 2011, p. 22). Early inhabitants lived in the valley, but because of increasing population the villages expanded on the slopes of the valley over the former farmlands of the village. The higher ramps of the valley have always been excellent spots for holiday homes of the rich Parisians (Interview with F. Sénécal, 2014). The land on the plateau have always been good productive soils for agriculture, providing the area with a big range of local products like apples and Neufchâtel cheese (Regio Haute-Normandie, 2003, p. 14). The famous clos-masure settlement (figure 42) goes back for centuries, and prevent local products and livestock from the maritime winds (AREHN, 2010, p. 13). These clos-masures have been threatened since the rural population moved to the cities in the 1970s crisis. The expanding villages and new landowners did not integrate the traditional landscape and initiated much upscaling in the area (AREHN, 2010, p. 9). The Seine valley is mostly known as an industrialized area, although according to the regional government the industries are reducing nowadays (Interview with F. Sénécal, 2014). The valley also contains several protected nature reserves, including the ‘Parc Naturel de Boucles de la Seine Normande’ (Agence Follea-Gautier, 2011, p. 39).

One of the most important threats for the landscape of Seine-Maritime is the loss of identity (Interview with I. Juilliard, 2014). The landscape is the most important product of the area and part of the unique identity of the region, which gives the landscape an economic value as argument for entrepreneurs and industries to settle in the area (AREHN, 2010, p. 22). Landscape conservation is a
rapidly upcoming landscape dynamic in Seine-Maritime. Also the agricultural sector contributes to conservation of the cultural landscape as a result of new CAP. In the traditional cultural landscape hedges and trees had a function to protect against the wind, which are also useful in contemporary landscapes of Seine-Maritime (AREHN, 2010, p. 23). Losing the landscape's identity is mostly caused by the landscape dynamics urban expansion and intensification of agriculture. A more important threat for Seine-Maritime is pollution. The present industry in the Seine valley and agriculture on the plateau pollute the soil, water and air, causing bad quality of water and contributing to the global emission problems. Because the area is known for its rainfall the risk of flooding in populated valleys along the drainage water courses is also a threat for Seine-Maritime. The sea level rise causes flooding risks to the populated valleys. But its effects of increasing storms and extreme weather conditions might be the cause of increasing coastal erosion on the characteristic cliff coasts. Commonly around fifteen centimetres of the cliff coast is eroded every year leading to loss of agricultural lands and even buildings (Costa, 2004, p. 9)

Landscape dynamics with a sustainable approach in Seine-Maritime

The aforementioned threats demand a sustainable approach in Seine-Maritime. Since population growth is not as big in Seine-Maritime as it is in other regions the landscape dynamics in urban expansion have an approach which are not specifically sustainable. Internal expansion of residential areas is now sufficient to prevent loss of rural landscape (Interview with F. Sénécal, 2014). The rural areas on the plateau and in Pays du Bray are not subject to urban growth because the accessibility is not appropriate. This is causing an unattractive settling climate. The increasing tourism in the coastal valleys is good for economic purposes and not a threat to the landscape. Because the hinterland can be used for tourism, tourists are spread out over the whole region. Rebuilding touristic facilities is done with respect to the coastal nature according to regional policymakers (Interview with F. Sénécal, 2014).

The intensification of agriculture has multiple effects on the landscape in this area as can be seen in the STiL-framework (figure 43). The intensification is mostly the result of mechanization, but it might have led to increasing use of chemicals and pollution of the soil and groundwater (AREHN, 2010, p. 23). In Pays du Bray support is necessary for modernization of agriculture. The innovations will be implemented with respect to the cultural bocage landscape (Atlas paysage Haute Normandie, 2011). Because Seine-Maritime has been one of France's most important energy producers the nuclear power plants had to be supplemented by new power sources, which are visible in the landscape characteristics of Seine-Maritime. Normandy aims to become a pilot region in off shore wind-farming. The first on-land wind-farms are realized and knowledge develops quickly because of the heavy rainfall. For that reason people on the plateau have built ponds for over centuries, to disburden the (natural) drainage system.

European and national regulations also aim to reduce pollution, but in the heavily industrialized Seine valley it is a challenge to suffice European standards. There has been a discussion about a reduction of the use chemicals in industry and agriculture for twenty years now and since twelve years the department has been actively diminishing the use of chemicals (Interview with F. Sénécal, 2014). Emissions are reduced in order to prevent climate change, but due the French temperate climate, the effects of climate change are not visible for the public yet. This is not corresponding with widely accepted opinions of scientists and other European governments.

Because the cliff coast is over 100 metres high the sea level rise is no big risk in the area. The densely populated valleys are mostly protected by walls, dikes and other 'hard' defence works for many years now. The main problem here lies in the flooding of the valley’s water courses because of the heavy rainfall. The reconstruction of these ponds is now supported by subsidies, another example of landscape conservation (Interview with I. Juilliard, 2014). According to the Euroision case study coastal erosion on the cliffs has been accelerated lately, but it cannot be said that this is caused
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<tr>
<td><strong>Reduce garbage landfills</strong></td>
<td><strong>Flooded prevention constructions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dikes, dams and floodgates</strong></td>
<td><strong>Restoring heritage ponds</strong></td>
<td></td>
<td>Extensively managed riverbanks</td>
</tr>
<tr>
<td><strong>Water drainage</strong></td>
<td><strong>Abandonment of houses and land Supplention of pebbles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flooding preventions</strong></td>
<td><strong>Nature networks</strong></td>
<td>Core areas, buffer zones and corridors</td>
<td>Network of nature</td>
</tr>
<tr>
<td><strong>Expropriate potential victims of coastal erosion</strong></td>
<td><strong>Expropriation of potential victims</strong></td>
<td>Abandonment of houses and land Supplention of pebbles</td>
<td></td>
</tr>
<tr>
<td><strong>Pebbles Supplention</strong></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Connecting nature reserves</strong></td>
<td></td>
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</tbody>
</table>

Figure 43: STIL-framework for Seine-Maritime
by climate change, however extreme weather as a result of climate change can have terrible effects on eroded coasts (Salman et al., 2004, p. 2). There is no sustainable approach to reduce erosion in France, because it is not cost effective. Expropriating the houses and lands on endangered cliffs is cheaper than preventing coastal erosion. The authorities are taking care of erosion of pebbles as an extra protection for the valleys. The other landscape dynamic in the theme of climate change is habitat shifting. Seine-Maritime protects several species on European and on national level. One of the solutions is connecting nature reserves with each other to make it more easy for animals and plants to migrate along with their habitat (Interview with F. Sénécal, 2014).

In Seine-Maritime multiple examples of conservation of heritage can be seen, because losing traditional landscapes is losing local identity (Interview with I. Juilliard, 2014). Examples of conservation of bocage, clos-masure and ponds are already mentioned in the other themes. This implies that Seine-Maritime manages to combine several landscape dynamics in order to conserve the regional landscape.

All in all the effects of Seine-Maritime's sustainable approaches are not that visible in the physical landscape. Internal growth of cities and regulations for pollution cause the main impact in landscapes. Also the reducing of energy consumption can only be seen by promotion campaigns. The most effecting landscape dynamic is the transition from petrol gas to nuclear power plants and wind-farms in the region. Besides the introduction of wind-farms the main direction of Seine-Maritimes policies involve respect for the existing natural and cultural heritage and conserving the traditional landscape, therefore reducing change in the area.

5.5 Conclusions from the case studies

By analysing this first three case studies with the STIL-framework some remarkable conclusions can be formulated in order to answer the research question.

What sustainable landscape dynamics can be detected in Europe's coastal landscapes and how have these been influencing the characteristics of these landscapes that commenced in the 1960s?

The landscape dynamics that have been recognized in most areas have been changed by a sustainable approach. Urban growth has been approached sustainably by internal expansion reducing the pressure on surrounding lands. New methods of producing energy have entered the landscape in all case studies. Mostly wind-farming has been introduced, both on land and off-shore. One of the most recognized threats is sea level rise and sustainable approaches contain the construction of dikes and dams, but also flooding meadows and riverbanks. Recently supplention of sand and pebbles entered the landscape, although this has limited effect on the landscape characteristics (figure 44). A returning issue in coastal areas is coastal erosion. Partly solved by the supplention, but generally by expropriating endangered lands.

Besides these main sustainable landscape dynamics in Europe’s coastal landscapes another remarkable influence can be seen. Many of the sustainable landscape dynamics do affect the landscape characteristics but only limited. Often a conservative dynamic aims to conserve the traditional landscapes. Urban growth does not expel agricultural and natural lands. Tourism develops with respect to natural and cultural heritage. Farmers are subsidized to conserve the landscape and nature reserves are connected to remain balanced and un-fragmented ecosystems. The only impact on the landscape characteristics are new technologies in energy production. Also measures against flooding can be seen in the landscape, although even those slowly use more conservative ‘soft’ measures.

It is also remarkable that the sustainability discourse has been developing since the 1960s, but most of the policies date from the 1990s and later. Only regulations on pollution date back to the 1970s and 1980s. In The Netherlands measures against flooding have started...
earlier, while France has been a world leader in its transition to nuclear energy. Which now has led to a disadvantaged position in the development of renewable energy production technologies. But this can change instantly as can be seen on Denmark’s Samsø. The have started to act sustainable since they had won a contest in 1997. It will be interesting how this will develop in the future since the Netherlands will keep trying to stay world leading in flooding prevention, Samsø in sustainable energy and the France Seine-Maritime seems to be ahead in landscape conservation.

The STiL-framework has given interesting insights in the sustainable landscape dynamics working on these coastal areas. Their effects have been analysed and policy makers will know the results of their policies over the last five decades. These results can be the starting point for new policies and justify new sustainable developments. The STiL-framework is an clear method to analyse landscape change as a result of the sustainability discourse. Still, its strengths and weaknesses are discussed in the next chapter.
6.1 - A CRITIQUE ON QUALITATIVE ACADEMIC RESEARCH

In academic research it is essential to be critical to the sources, methods and theories that have been applied. In this chapter a critique on this research is given. In this research the large quantity of books and articles on both sustainability and landscape made it impossible to use these to the whole extent. Therefore, several summarizing and overviewing works were used, for example De Steiguer (2006) and Barlow Rogers (2001). These books describe a broad spectrum of relevant issues, but contain only limited in depth information. Besides these superficial sources objectivity is another point of attention. It should be pointed out that in the case studies used plans and policies might present only one perspective on issues, sometimes even from a political point of view. This means that the use of these sources might present only one perspective on issues, sometimes even from a political point of view. This also counts for the frequently used reports of the EEA (2006; 2007), which provides broad analysis, but whether political preferences are taken into account remains questioned. Practically the same comments can be made for tourist guides which present the area often in a positive way. Despite of trying to write as objectively as possible, some subjects and issues might have been interpreted more positively than they actually are, lacking thorough in depth research. On top of that, all these sources are interpreted by the author and therefore not objective, since he has his own background knowledge and perspective on the issue. Another thing to keep in mind is that most of the interviews have been executed in English, which is not the mother tongue of both the interviewer and the interviewed expert. This may lead to interpretive interview results.

In an attempt to use less subjective methods to answer the research question some map analysis and comparisons have been done between landscapes in the 1960s and now (figure 35). Unfortunately the driving forces working on the landscape do not only lead to sustainable solutions and sustainable landscape development. Other solutions can be technical, economic or social, which also affects the landscapes (Scott Cato, 2009, pp. 36-37). These other possible solutions make it impossible to do map analyses to answer the research question (figure 45). Thus the research question is formulated in such a manner that only a qualitative research framework could answer the research question. Future research on these other solutions could be interesting and be complimentary to this research.

The definitions used in this report are heavily debated and should therefore be studied carefully. Although they are based on literature the used definition in this research might be somewhat different. In chapter 1 the used definitions are clearly described. Several parts of the research seem an enumeration of literature and other sources. This was necessary in order to set especially the sustainability discourse in its rightful context. This does not mean that there have not been any new analyses, but several of these analyses are supported by the mentioned sources.

6.2 - STRENGTHS AND WEAKNESSES OF THE STIL-FRAMEWORK

Next to the critique on academic qualitative research a critical evaluation of the STIL-framework is necessary since it is a newly developed framework. Therefore, this paragraph critically accesses the strengths and weaknesses of the STIL-framework as it is used in the research.

The first critical remark is the large scale the research aims to study. Europe's coastal landscapes contain an extended and various scope of landscapes, all with distinct local circumstances and varying national policies. The STIL-framework is actually made to overcome these differences. However, the STIL-framework is developed to study similar landscape dynamics in various locations and circumstances around Europe. The framework makes it possible to identify the various situations and makes the similarities and differences between the study areas visible. For example it could be recognized that population growth is a much more important theme of sustainability in Europe's coastal landscapes than it is in the mountainous area. Also various sustainable approaches become visible. These outcomes are useful for policymakers on local, national and European level, although projecting the results to a higher scale should be done very carefully because of the many physical and cultural differences within larger areas.

Secondly, in the case of sustainable landscape development it is important to get expert information from both policymakers and (sustainability) activist organizations. Also other neutral research is useful to gather information. In the executed case studies, it would have been convenient to have spoken to someone from a sustainability organization in Seine-Maritime and to speak to landscape observers in Zuid-Holland, but both
were not willing to contribute to this research. This might cause an unbalanced view on the situation. On the small island of Samsø both parties are intertwined, which can be good for information exchange. But it also limits the number of different perspectives and lacks a critical review on ideas and policies.

The third critical remark is that the STiL-framework provides only qualitative results. Although it is clearly summarized in a table, the relations between the table and the elaborative texts are summarily. Because there are no quantitative indicators it is impossible to measure differences in a quantitative way according to this framework. However, as mentioned before, qualitative research is good to explore the scientific field and the occurring processes in a landscape, but it is sensitive for subjective interpretations of the researcher. Therefore, quantitative research would be the next step in order study the effects on landscape characteristics more exact.

One of the strengths of the STiL framework is its big scope of subjects it examines. In science often detailed and narrowed down research is executed. But, to use this scientific research in practice it is important that the context is taken into account and a broad scope of related processes is studied as well. The STiL-framework discusses a broad scope of themes in sustainability and a great number of landscape dynamics, which makes it a thorough and complete study to provide new insights to policymakers all over Europe’s coastal landscapes. On top of that the framework is easily adaptable to various driving forces and the landscape dynamics can be filtered for all kind of landscapes.

All together there are some weaknesses to this research and to the STiL-framework, but since it is one of the first attempts to monitor sustainable landscape development, there is room for improvement.

Figure 45: A example map comparision shows the big changes in landscapes since 1947, not all of them as a result of the sustainable discourse (AREHN, 2010, p. 17)
7.

After a thematic introduction on sustainable developments and a geographical introduction to Europe’s coastal landscape, three case studies were performed in order to make it possible to compare the theoretical parts with the results of the STiL-framework analysis. Making this comparisons provides enough information to be able to answer the central research question:

What changes in landscape characteristics of Europe’s coastal landscapes are caused by landscape dynamics as a result of the sustainability discourse that commenced in the 1960s?

7.1 – Part I: Landscape dynamics as a result of the sustainability discourse

In the introductory chapter the research is split up into two parts, each answering their own sub-questions. The first sub-question was:

What landscape dynamics are a result of the sustainability discourse that commenced in the 1960s and how can their effects be analysed?

In order to identify the landscape dynamics that occur as a result of the sustainability discourse, the sustainability discourse is divided in five themes: 1) population growth, 2) exploitation of resources, 3) pollution, 4) climate change, and 5) conservation of natural and cultural heritage. Per theme landscape dynamics were selected if they were initiated from the sustainability discourse and they affect landscape characteristics. The selected landscape dynamics can be found on the illustrated timeline of sustainability (figure 46). In this timeline the landscape dynamics are placed at the time when an international awareness of the issue was created and a sustainable approach was developed to place them in their temporal context. The sustainable approaches are the new landscape dynamics, in this research called sustainable landscape dynamics.

Part of the definition of landscape dynamics is that they affect landscape characteristics. To identify the effects landscape dynamics have on landscape characteristics the STiL-framework is developed. This framework can be used as a guideline in order to be able to compare various analysis. In the STiL-framework the effects on landscape characteristics can be filled in, based on field observations and expert knowledge on the case its recent policies. In this research the sustainable approach has been filtered from policies in order to see how these sustainable approach effects the landscape characteristics. Both aspects of landscape characteristics, landscape structure and landscape function, are taken into account during this research.

7.2 – Part II: Sustainable landscape dynamics effect Europe’s coastal landscape characteristics

Europe’s coastal landscapes are similar and different in many ways. Geographically the meeting place of oceanic waters, land and winds can be cliffs or tidal flats. Culturally the coast is a place of cultural developments and many landscape dynamics working on Europe’s coastal landscape characteristics for centuries. In order to analyse the effects on Europe’s coastal landscape characteristics the following sub-question had to be answered.

What sustainable landscape dynamics can be detected in Europe’s coastal landscapes and how have these been influencing the characteristics of these landscapes that commenced in the 1960s?

When analysing Europe’s coastal landscape, both its physical-geographic and its cultural-socioeconomic landscape characteristics were identified. After selecting landscape dynamics that are presently active on the landscape characteristics of Europe’s coastal landscapes, these landscape dynamics were compared to the sustainable landscape dynamics. The ones that overlap were used in the case studies to test the STiL-framework (figure 31).

From these case studies it can be concluded that landscape dynamics as a result of sustainability affect landscape characteristics mostly in the themes of exploitation of resources and climate change. The landscape dynamics intensification of agriculture affects the size of lands, and the use of mechanization. Production of (renewable) energy introduces new windmills and solar panels in the landscape, adding a new layer of landscape characteristics. Also the effects of climate change initiate sustainable approaches to deal with the effects of this landscape dynamics. A sustainable landscape dynamic to preserve flooding and habitat shifting add dikes, dams and ecological corridors to the landscape characteristics. The effects on landscape
Figure 46: Timeline of sustainability, key events in the development of the sustainability discourse (Appendix II elaborates on how this timeline is developed)
characteristics by the landscape dynamics of other themes in sustainability have only limited effects and often follow a more conservative policy.

7.3 – The effects of the sustainability discourse on landscapes

To see how the sustainability discourse influences the landscape characteristics in various regions the central question has to be answered:

What changes in the landscape characteristics have been caused by sustainable landscape dynamics that commenced in the 1960s and how have these dynamics influenced Europe’s coastal landscapes?

Now we know which landscape dynamics follow from the sustainability discourse and how they have influenced Europe’s coastal landscape. Although landscapes are different in every region, some general conclusions can be drawn. It then becomes possible to identify the changes in landscape that have occurred as a result of the sustainability discourse commenced the 1960s.

At first it becomes clear that the sustainability discourse has been debated long before it became part of policies. With some exceptions on pollution sustainable policy did not occur until the late 1980s and early 1990s. Only from that point onwards sustainability was included in policies and it slowly entered the landscape. This was mainly in agriculture, but also in the production of energy (figure 47). In agriculture conservative measure contributed to the conservation of landscape. While in energy production new technologies like wind turbines have been entering the landscape. The effects of climate change also demand a sustainable approach on landscape dynamics. Flood prevention by dikes and dams have been present in the landscape for centuries already, but since the 1990s a more sustainable approach was taken. The ‘hard’ preventions slowly got supplemented by ‘soft’ measures to prevent flooding. Also a more conservative approach with respect to the existing lands. In the themes of population growth, pollution and conservation of heritage a more and more conservative approach can also be recognized.

From these findings it can be concluded that the sustainable landscape dynamics have influenced landscape characteristics since the 1990s, but in a more and more conservative approach. Conserving the landscape, restoring traditional rural landscapes and natural states contributes to a more sustainable world. Leaving more space for natural developments.

In this research a framework is developed to study changes in landscape. Using these methods it can now be stated that the effects of the sustainability discourse on the landscape dates from the last two decades and includes mainly conservative embodiments.

7.4 - Relevance for future research and policymakers

Many new questions appear, since the conclusion does not provide obvious results. If conserving landscapes is sustainable, were humans more sustainable in the past? And if the sustainability discourse is limited to its influence on landscape, how will these past decades be remembered in the future? Are we influencing the history book called landscape by conserving landscapes of past worldviews?

It is clear that this research generated new questions and therefore future research possibilities. Another important issue is the relevance of the research for current practices. Concluding that not much is changing in the landscape might explain why the elements with much impact are heavily debated, for example the off-shore wind-farms (Haarlems Dagblad, 2013). Maybe a design for windmills is needed in this period of limited landscape changes, one that is more coherent with its surrounding landscape. For other policymakers and researchers this report might suggest that landscapes of the past can function as an
example for a more sustainable world, at least the natural aspects, however more research on this suggestion is recommended.

In addition to the outcomes of this research also the methodology is operationalized in a way they it can be used in future research all around Europe. The analytical framework of the STiL-framework can be used to identify the effects of sustainable policy and it monitors changes in the landscape characteristics over the last five decades.

It can be recommended that the outcomes of this research are used as starting point for a quantitative research in order to search for measurable indicators. In that way research on how sustainable developments have influenced and are still influencing Europe’s coastal landscape can be continued. All in all this report provides a broad and integral overview on where we stand in developing our landscapes in a sustainable way, and how these developments have influenced our landscape so far.

### Landscape dynamics of sustainability

<table>
<thead>
<tr>
<th>Population growth</th>
<th>Internal growth</th>
<th>Sustainable tourism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploitation of resources</td>
<td>Ecological focus area’s in CAP</td>
<td>Landscape conservation</td>
</tr>
<tr>
<td>Use of renewable materials</td>
<td>Production of renewable energy</td>
<td>Restrictions on fishing</td>
</tr>
<tr>
<td>Pollution</td>
<td>Emission regulations</td>
<td>Water pollution regulations</td>
</tr>
<tr>
<td>Soil pollution regulations</td>
<td>Reuse of waste materials</td>
<td>Separation of waste</td>
</tr>
<tr>
<td>Reduce garbage landfills</td>
<td>Climate change</td>
<td>Flooding preventions</td>
</tr>
<tr>
<td>Emission regulations</td>
<td>Expropriation of potential victims</td>
<td>Connecting nature reserves</td>
</tr>
<tr>
<td>Connecting nature reserves</td>
<td>Conservation of natural and cultural heritage</td>
<td>Combining tourism and heritage conservation</td>
</tr>
</tbody>
</table>

Figure 48: Table of sustainable landscape dynamics effecting Europe’s coastal landscapes
Acknowledgement:
Pictures and maps without references are custom made by the author; if the map is based on sources these are acknowledged in the caption and the list of references


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Consulted persons:

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Interview with Irene Juilliard (Landscape and coastal developments du Département) on the 3rd of June 2014 in Rouen.

Interview with Michael Kristensen (Energy Academy and Municipality Technical Developer) on the 6th of June 2014 in Samsø.

Interview with Bernd Garbers (Technical advisor at Energy Academy) on the 6th of June 2014 in Samsø.

Lecture by Kongjian Yu (Landscape architect), Ecological solutions to urban water issues in China, Lecture in the series China Talks at Copenhagen University, attended on 11th of June 2014.

Interview with Arjan van de Lindeloof (Landscape architect of provincie Zuid-Holland) on the 28th of May 2014 in Den Haag.

Lecture by Auke van der Woud (Profesor in architectural history), Landscapes in transition in the 18th and 19th century, Lecture in a series on European Cultural Landscapes at Knowledge Centre for Landscape at Groningen, attended on 14th of March 2014.
APENDICES

APENDIX I:
Interview questions - III -

APENDIX II:
Critique on timeline of sustainability - V -
**Interview**

**Name:**
Can I use your name for references?

**Function:**
Why is the coast of Zuid-Holland/Samsø/Seine-Maritime (Z-H/S/S-M) an unique European coastal landscape?
What has changed in the landscape of Z-H/S/S-M over the past five decades?
For how long has Z-H/S/S-M included sustainability in environmental policies?
Why has Z-H/S/S-M included sustainability in policies? What are threats for the landscape?

**Population growth:**
What is your sustainable approach on urban growth?
What is your sustainable approach on increasing tourism?

**Exploitation of resources:**
What is your sustainable approach on intensification of agriculture?
What is your sustainable approach on exhausting raw-materials?
What is your sustainable approach on overfishing?

**Pollution:**
What is your sustainable approach on water quality? (drinking water and bathing water)
What is your sustainable approach on air pollution?
What is your sustainable approach on soil condensation?

**Climate change:**
What is your sustainable approach on raising sea level?
What is your sustainable approach on coastal erosion? (reduction/adaptation)
What is your sustainable approach on habitat shifting?
What is your sustainable approach on pressure on natural and cultural heritage?
How can sustainable initiatives be seen in the landscape of Z-H/S/S-M?

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**Appendix I:**

Interview questions
The timeline of sustainability (figure 46) is an author’s interpretation on the developments in the field of sustainability in relation to the landscape. The timeline has been set up after much reading done for this thesis and is based on educated guesses from the author. Taking into account the most important publications, policies, conferences and events which are not debated as being part of the development of sustainability. Since this figure could cause an argument, a more extended critique on the figure can be found in this appendix.

- The publications, policies, conferences and events are chosen because they were referred to in several sources, but of course depends on which sources you use. For example American authors pay more attention to the Sierra Club, the Wilderness Act and the Clean Air Act than European authors do.
- It is open for discussion in which main theme of sustainability and driving force the various publications, policies, conferences and events are categorized by the author. The author aimed to choose the main theme, but much themes in sustainability intertwine and many publications, policies, conferences and events cover several main themes.
- In this figure the relation with landscape is limited, because the most important works in sustainability often discuss several topics, not definitely including landscape.

In order to improve this timeline the importance of themes can be made quantitative if the number of scientific publications and newspaper articles on the various themes could be measured. This will show the relevance of each theme over time. The most important publications, policies, conferences and events can already be measured by citations.

All together this figure gives an interesting illustration on the development of the sustainability discourse, but to use it in further research it should first be improved.