

MASTER'S THESIS

Defining and measuring the success of nature compensation

A CASE STUDY OF THE KWETSHAGE – MEETKERKSE MOEREN PROJECT
(FLANDERS, BELGIUM)

Degrande, Sara

Award date:
2024

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Defining and measuring the success of nature compensation

A CASE STUDY OF THE KWETSHAGE – MEETKERKSE MOEREN
PROJECT (FLANDERS, BELGIUM)

SARA DEGRANDE

JUNE 2024

Thesis MSc Environmental Sciences
Faculty of Science
Department of Environmental Sciences
Open Universiteit
OU-begeleider: Dr. Jean Hugé
OU-assessor: Dr. Dennis Uit de Weerd



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English abstract

Nature compensation entails the creation of 'new nature' or the restoration of nature, to compensate for nature and biodiversity losses elsewhere. The expansion of the port of Zeebrugge, Belgium, led to the destruction of valuable and protected nature areas, which provided a range of ecosystem services. Ecosystem services are benefits for humans delivered by the natural environment. The area of Kwetshage - Meetkerkse Moeren was designated as a nature compensation area. However, how successful is this nature compensation? Is the so-called success interpreted as success by all stakeholders? This thesis assesses how effective this nature compensation initiative has been, by perception of different stakeholders. Interviews were executed with stakeholders, structured as in an Ecosystem Service Assessment using the ESRIA tool as a reference (Landsberg et al.). Both social and ecological effectiveness of the nature compensation project are taken into account. In order to execute the ESRIA structured interviews, multiple stakeholders of the case were involved and provided input through comprehensive questioning. Secondly, the ecological effectiveness ('success') of the nature compensation project was evaluated by identifying two indicator species (the Avocet and the Marsh Harrier) and gathering data on their abundance. This was executed mainly by processing secondary data (monitoring reports and waarnemingen.be). The results of the interviews showed that different stakeholders value different elements in this nature compensation project. The most commonly discussed part was the influence of the project on the agricultural sector. Other important ecosystem services were recreation possibilities, historical land use, water management, carbon sequestration and ecological value. For the second part of this thesis, the ecological effectiveness, it can be concluded that there is no increase in the abundance of Marsh Harrier and the Avocet. In general, more research is needed to make a final conclusion on the effectiveness of the nature compensation project. Additional and continuous monitoring over a longer period and for multiple species is recommended.

Dutch abstract

Natuurcompensatie houdt in dat er 'nieuwe natuur' wordt gecreëerd of natuur wordt hersteld, om natuur- en biodiversiteitsverliezen elders te compenseren. De uitbreiding van de haven van Zeebrugge, België, leidde tot de vernietiging van waardevolle en beschermde natuurgebieden, die een reeks ecosysteemdiensten leverden. Ecosysteemdiensten zijn voordelen voor mensen die worden geleverd door het natuurlijke milieu. Het gebied van Kwetshage - Meetkerkse Moeren werd aangewezen als natuurcompensatiegebied. Maar hoe succesvol is deze natuurcompensatie? Wordt het zogenaamde succes door alle belanghebbenden als succes geïnterpreteerd? Deze thesis beoordeelt hoe effectief dit natuurcompensatie-initiatief is geweest, volgens de perceptie van verschillende belanghebbenden. Er werden interviews afgenomen met belanghebbenden, gestructureerd als in een Ecosysteemdiensten Beoordeling (Ecosystem Service Assessment) met gebruik van het ESRIA-instrument als referentie (Landsberg et al.). Zowel de sociale als ecologische effectiviteit van het natuurcompensatieproject worden hierbij in acht genomen. Om de ESRIA-gestructureerde interviews uit te voeren werden meerdere belanghebbenden van het project betrokken. Zij leverden input door middel van uitgebreide interviews. Ten tweede werd de ecologische effectiviteit ('succes') van het natuurcompensatieproject geëvalueerd door twee indicatorsoorten (de Kluut en de Bruine Kiekendief) te identificeren en gegevens over hun voorkomen te verzamelen. Dit werd voornamelijk uitgevoerd door het verwerken van secundaire gegevens (monitoringsrapporten en waarnemingen.be). De resultaten van de interviews toonden aan dat verschillende belanghebbenden verschillende elementen in dit natuurcompensatieproject waarderen. Het meest besproken onderdeel was de invloed van het project op de landbouwsector. Andere belangrijke ecosysteemdiensten waren recreatiemogelijkheden, historisch landgebruik, waterbeheer, koolstofopslag en ecologische waarde. Voor het tweede deel van deze scriptie, de ecologische effectiviteit, kan worden geconcludeerd dat er geen toename is in het voorkomen van de Bruine Kiekendief en de Kluut. Over het algemeen is meer onderzoek nodig om een definitieve conclusie te trekken over de effectiviteit van het natuurcompensatieproject. Aanvullende en voortdurende monitoring over een langere periode en voor meerdere soorten wordt aanbevolen.

1. Problem definition

When comparing nature's baseline of global indicators of ecosystem extent and condition with the current situation, a 47% reduction is observed (IPBES, 2019). Up to 1 million species are threatened with extinction, and only 68% of global forest area remains compared to pre-industrial times. Summarized, nature is under a lot of pressure. Governments worldwide are taking action, and instances such as the European Union are enforcing legislations to protect nature and reverse degradation of ecosystems. Examples of this are the European Green Deal and Biodiversity strategy 2030 (EuropeanCommission, 2020). In Flanders, Belgium, article 90bis of the Forest Decree and the Decree of the Flemish Government of February 16th 2001, states that in the case of the removal of nature, in the context of construction works, port expansion, etc., the deforested area has to be compensated by creating new nature (ANB, n.d.). This activity is referred to as 'nature compensation', or 'biodiversity offsetting'. This is defined by Hannis & Sullivan, (2012) as: "...conservation activities designed to deliver biodiversity benefits in compensation for losses in a measurable way". Nature offsetting is supposed to lead to better conservation outcomes (Hannis & Sullivan, 2012).

In Flanders specifically, the magnitude of nature compensation for a certain area is based on the acreage of the area, the age of the nature that is removed, and characteristics of the vegetation that is removed (De Beck & Quataert, 2016). Depending on the type of nature that disappears, a compensation ratio is assigned. This compensation ratio can vary between 1:1 and 1:3 (for example: one ha is removed and compensated by three ha of 'new' nature). Nature compensation in Flanders can be executed in three different ways. A first approach can be that the initiator of the environmental permit performs the nature compensation. Secondly, it is possible to let a third party carry out the afforestation. A third option is a financial compensation (NatuurenBos, n.d.). The main aim of nature compensation is to establish 'no-nett-loss' of natural values after compensation (Broekmeyer, Bugter, & Van Teeffelen, 2012). The concept of 'no-nett-loss' is also used by the European Commission. The Biodiversity Strategy of 2020 set 6 targets and 20 actions that are placed in order to prevent the loss of biodiversity and ecosystem services. One of the actions is to ensure no nett loss (EuropeanCommission, n.d.). In order to determine whether nett losses are present after compensation, there has to be a quantification of the natural values. There exist three main principles that should be taken into account when determining the 'no-net-loss' in nature compensation. These principles, when being met, can improve sustainable conservation and biodiversity on ecosystem level (Broekmeyer et al., 2012). The principles are: the 1:1 principle, which is based upon the equality of the characteristics of the compensated nature, the proximity principle, which is based upon the equality of locations of nature and keeping the compensated nature in a certain area, and the timeliness principle, which is based upon keeping a constant nature value throughout time (Broekmeyer et al., 2012). Nevertheless, determining the presence of 'no-net-loss' is not as straightforward as it seems, and there are multiple bottlenecks when it comes to the practicalities surrounding nature compensation, described here below.

1.1 Nature compensation bottlenecks

In itself, nature compensation should guarantee 'no net loss' of nature. This includes no net loss in surface area, quality, and coherence of the compensation area (Broekmeyer et al., 2012). Not yet protected nature areas cannot be labelled as 'compensation areas'. This is because compensating destructed habitats by protecting already existing habitats is doomed to increase further biodiversity loss (Bekessy et al., 2010). New nature has to be created in a way that there is 'no net loss' of natural values compared to the original situation. However, when looking at real-life scenarios, issues are often observed before, during and after the implementation of nature compensation projects (Gaaff & Vader, 2005).

Below is a summary of the main nature compensation bottlenecks (Broekmeyer, Bugter, & Teeffelen, 2011):

- Complicated legislation and regulations
- Finding of a suitable location
- Insufficient knowledge of requirements
- Lack of registration and enforcement
- Timing of the compensation

Often, disappearing nature is compensated with equal nature, not equivalent nature (Broekmeyer et al., 2012). This means that nature compensation should not be a copy and paste of the original nature that was present, but it should be trying to match the value of the present nature. Along with the valuation of nature compensation, also the estimation of the 'success' of the nature compensation project should be better defined. In general, deciding what it means for nature compensation to be considered 'successful', and in practice measuring this success remains a significant uncertainty (Broekmeyer et al., 2011). What is considered a successful compensation for one stakeholder might not mean the same for another (Reed et al., 2009). Over time, the framing of nature conservation has already shifted from 'nature for itself', to 'nature despite people', to 'nature for people', to 'people and nature' (Mace, 2014). While still existing in parallel to this day, depending on the framing of individuals. These multiple frames have consequences to the approach used for nature conservation and in this case nature compensation. Now, there is a need for a well-structured, context-dependent definition of what successful nature compensation can mean for various stakeholders in a certain location at a certain time, building on the plurality of valuations of nature (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 2022). This needs to be combined with a defined approach of how the success of a nature compensation project can be measured.

1.2 Compensation of ecosystem services

Usually, the aim of nature compensation projects is matching the ecological value and biodiversity of the original area as well as possible. However, there is more to nature reserves than solely ecological value and biodiversity. Oftentimes nature reserves provide a lot more services to humans. These services are the ecosystem services (Daily, 1997). Daily, G.C. (1997) defines ecosystem services as: "... the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life." p. 3. Based on the four framings by Mace (2014), ecosystem services align with the framing 'nature for people'. This specific framing for conservation started in the late 1990s when pressure on habitats were high and conservations were failing. 'Nature for people' focusses on the potential benefits for humans to be gained from services delivered by ecosystems. This is when conservation started compromising ecosystem services and provision of sustainable benefits for people (Mace, 2014). It should however be noted that ecosystem service thinking is not perfect. It is presumed that with increasing wild species and thriving habitats, also the ecosystem services are maximised. This is not always the case. Often, to meet the increasing human population's needs, ecosystem services are compromising biodiversity. Examples are canalizing of rivers and draining of wetlands for clean water (Mace, 2014). A newer, more inclusive term has been introduced to complement the ecosystem services concept, namely the Nature's Contributions to People (NCP) (Díaz et al., 2018). The NCP's are both positive and negative contributions of living nature to people's quality of life (Maes, Burkhard, & Geneletti, 2018). It is a broader concept than the concept of Ecosystem Services, with the inclusion of cultural, indigenous, and local knowledge (J. Maes et al., 2018). Nevertheless, in this thesis the ecosystem services will still be used as a measuring tool, because it allows for nature to be mapped more easily. The use of ecosystem services is also supported by EU

regulators, industry and academia, and it integrates environmental policies, stressors, habitats, and scales (Maltby, van den Brink, Faber, & Marshall, 2018).

Ecosystem services can be categorized into four categories (Leemans & De Groot, 2003):

- Provisioning
- Regulating
- Cultural
- Supporting

Table 1 contains a list of ecosystem services and their category.

Table 1: Ecosystem services and their accompanying category (Leemans & De Groot, 2003)

Category	Ecosystem Service
Provisioning	Food & fiber
	Raw materials
	Subsistence fisheries
	Fresh water
	Investment
	Labour productivity
	Fuel wood availability
	Variability in livelihood
	Timber production
	Energy production
	Aquaculture production
	Water yield
	Crop yield
	Vegetation biomass
	Harvested wild and cultivated goods
Water provision	
Regulating	Climate and water regulation
	Erosion control
	Moderation of extreme events
	Carbon sequestration and storage
	Flood regulation
	Nutrient regulation
	Sediment regulation
	Water flow regulation
	Pollination
	Water quantity and quality
	Hazard mitigation
	Climate change adaptation and mitigation
	Water availability
	Coastal protection
	Marine water quality
Habitat risk assessment	

Cultural	Recreation
	Cultural diversity
	Open space proximity
	Aesthetic viewshed
	Scenic quality
	Nature-based recreation and tourism
	Aesthetic inspiration for culture
	Spiritual experience and identity
Supporting	Biodiversity
	Water purification
	Soil formation
	Water supply
	Total carbon
	Land management
	Landscape structure and composition
	Soil nutrient balance
	Soil organic matter
	Carbon stocks
	Climate
	Habitat quality
	Habitats for species

Nature compensation adds more value to an area than solely nature-based benefits. As a society, there is more to gain from successful ecosystems than thought off at first. Of course not all ecosystem services can be found in all nature reserves. This depends on location, magnitude, variety, and more characteristics of the nature compensation area.

When linking back to the previously made statement that there is a need for a context-dependent definition of what it means to have a successful nature compensation project and how this success can be measured, these ecosystem services need to be taken into account as well. So, when measuring the success of a nature compensation project, it is of great importance to bring not only ecological factors into the calculation, but attempt to evaluate the nature compensation project as comprehensive as possible by including all relevant ecosystem services and their presence, or absence of success in the nature compensation project (Fu, Xiong, & Zhang, 2021).

1.3 The harbor of Zeebrugge: Kwetshage and Meetkerkse Moeren

This thesis will focus on one specific case of nature compensation in Belgium. Harbors are often important ecological areas (Bebiano et al., 2015). It is not uncommon that projects are being set up in order to stimulate synergism regarding economic and ecological growth in these areas. That is why in April 2005, the Flemish Land Company (VLM) was given the assignment to realise 362 ha of nature compensation to compensate for the expansion of the port of Zeebrugge (VLM, 2020a). Two of the sub-areas that were chosen are the area of Kwetshage and the area Meetkerkse Moeren (VLM, 2022). These areas are situated North of Bruges' district Sint-Andries and South-West of Meetkerke (Figure 3, Figure 3, and Figure 3). Creation of reed swamp, salt marshes, but also general wetting of the area was planned in order to realise this project. In Kwetshage, 45.7 ha of reed swamp and 15 ha of polder grass land are realised. This new arrangement will restore 37 ha of historical grass land into reed swamp. Also in Kwetshage, 15 ha of cropland is converted into polder grass land with the aim for more species richness (VLM, 2022). In the Meetkerkse Moeren, 22 ha of cropland is converted into polder grass land by wetting. This nature compensation project started in 2005 under signature of the Flemish region, port company 'Maatschappij van de Brugse Zeehaven' (MBZ) and the Flemish Land Company (VLM). According to the Environmental Impact Report (EIR) that was drafted in 2005, the aim of the nature compensation project was (WES, 2005):

- Wetting and repair of moist environment
- Improving ecological functioning of the watercourses
- Strengthening of the landscape structure
- Improving biodiversity of the area

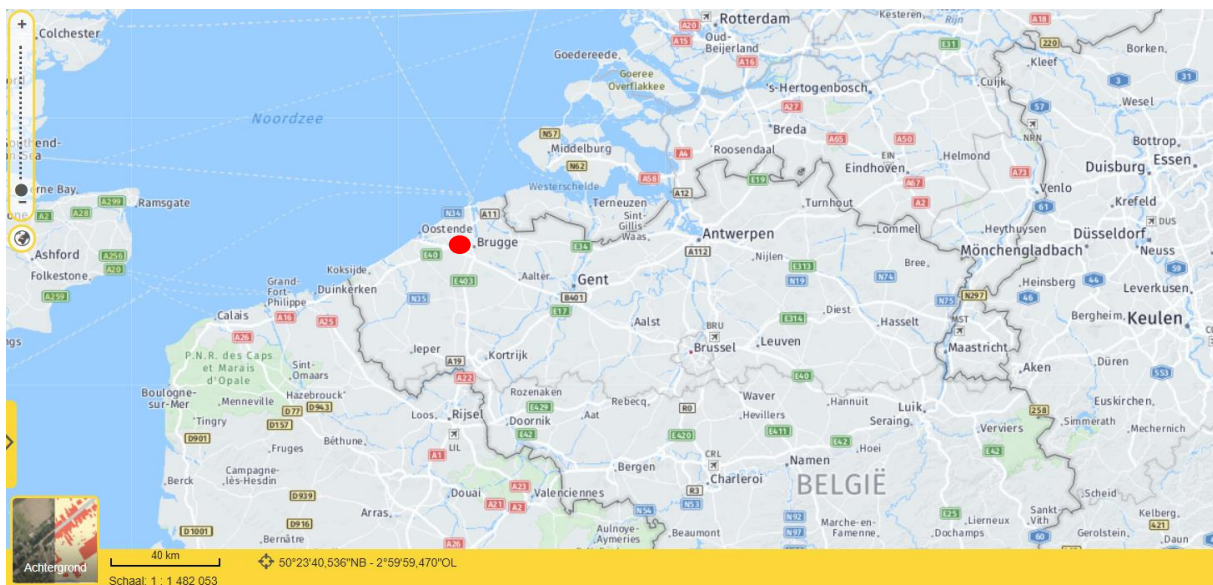


Figure 1: Map of Belgium with subject area in red (Geopunt, n.d.)



Figure 2: Map of North West Flanders. Nature compensation areas Kwetshage and Meetkerkse Moeren are coloured in red (VLM, 2017)

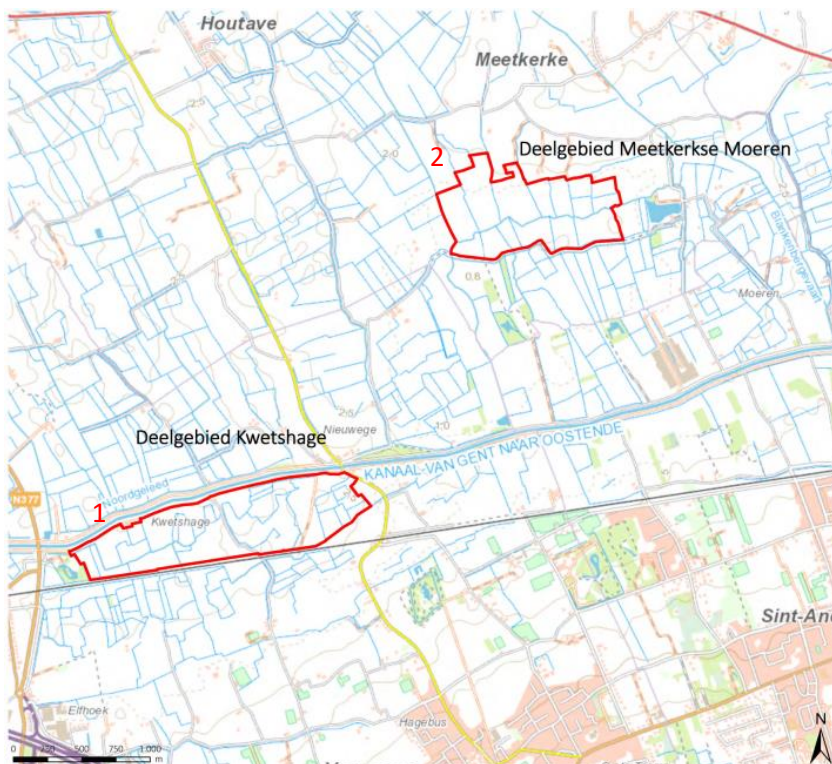


Figure 3: Map of sub-areas Kwetshage (1) and Meetkerkse Moeren (2) (VLM, 2017)

Almost all land surface destined for the nature compensation was originally cropland owned by farmers. The drastic land use changes caused by wetting and the development of reed swamps would not allow the farmers to use these areas for farming anymore. Because of this, the entire surface area had to be acquired by the Flemish government (VLM, 2020b). By 2020, 80% of this area had already been acquired. The project has to this day not been fully completed yet. The nature compensation works that are planned require additional acquirement of land that is now private property of farmers. Therefore, the government has to acquire other land outside the designated zone that can be used as exchange grounds to compensate farmers that are losing cropland due to nature compensation (VLM, 2017). Not all compensation works have been delayed. In this area, multiple initiatives of the Flemish Land Company (VLM) have been kicked-off already. For instance in the 'Lage Moer' in Meetkerke, between 2001 and 2009, hayfields, hay meadow, lanes, and the duck decoy were restored. Institute 'Natuur en Bos' reports this new nature already had its positive effects since multiple plants and animals thrive in the area (NatuurenBos, 2017). An abundance of vegetation such as the Early Marsh Orchid (*Dactylorhiza incarnata*), Silene (*Latifolia alba*), Marsh Ragwort (*Jacobaea aquatica*), and Sneezewort (*Achillea ptarmica*), butterflies such as the Brown Argus (*Aricia agestis*), Orange Tip (*Anthocharis cardamines*), and the Common Brimstone (*Gonepteryx rhamni*), but also birds such as the Great Cormorant (*Phalacrocorax carbo*), the Grey Heron (*Ardea cinerea*), Bluethroat (*Luscinia svecica*), Meadow Pipit (*Anthus pratensis*), Black-tailed Godwit (*Limosa limosa*), and more (NatuurenBos, 2017). The Institute for Nature and Forrest Research (INBO) monitored multiple birds species, vegetation, and hydrology from 2019-2020 in order to identify the natural values for the newly furnished plots for nature compensation (Verstraete et al., 2021).

However, these institutes monitor mostly the appearance and abundance of ecological success related to the nature compensation project. There is a knowledge gap when it comes to the wider frame of ecosystem services. There is a need for an evaluation of the success of the nature compensation related to the entirety of ecosystem services.

1.4 Summary of the problem definition

In practice it has been shown that nature compensation is often more complicated than expected at first, because of logistic reasons and regulations. Also, there is no agreement that states what it means for a nature compensation project to be successful. There is a need for a definition of 'success' and a method or benchmark that can be used in order to determine the success of a nature compensation project.

Using the case of the nature compensation project in Kwetshage – Meetkerkse Moeren, firstly this thesis investigates what it means for nature compensation to be successful by aiming on the plurality of what successful nature compensation means for different stakeholders, relating to the ecosystem services, and focussing on the social effectiveness of the nature compensation. This is done by including multiple stakeholders and interpreting nature compensation as comprehensively as possible. Secondly, this thesis aims to include measurable ecological data as well to evaluate whether the compensation project in Kwetshage-Meetkerkse Moeren is ecologically successful or not, so with that focussing on the ecological effectiveness of the nature compensation. This is done by defining indicator species with input from stakeholders and secondary data from institutes, and online databases such as waarnemingen.be.

2. Aim of the study

The aim of this thesis research is to define a way to analyse success in nature compensation. Firstly, a way of valuating the success of a nature compensation project is searched for. Secondly, a method or benchmark for the determination of success in nature compensation projects is investigated. This will both be applied to the case study of the nature compensation project in Kwetshage-Meetkerkse Moeren. The thesis research is performed in two phases.

- In the first phase, an emphasis is put on the question which criteria define the success of nature compensation areas for stakeholders. Stakeholders included are resident farmers, citizens, municipalities, research institutes (INBO, Natuur en Bos), NGOs (Natuurpunt), and the Flemish Government.
- After identification of the main criteria for success of nature compensation, in a second phase, the ecological effectiveness of this nature compensation project in these two specific areas are measured by examining indicator species.

3. Research questions

The main research question for this thesis is: "Is nature compensation in port areas in Belgium successful, based on the Kwetshage-Meetkerkse Moeren case?".

In order to answer this main question, the following sub questions are studied:

- 1) What defines the success of nature compensation areas according to stakeholders, based on the Kwetshage-Meetkerkse Moeren case?
- 2) Did the nature compensation project in Kwetshage-Meetkerkse Moeren cause an increase in the ecological value of the area?

From the questions above, a related sub-question arises:

- ➔ What is the link between the expectations regarding effective nature compensation and the reality in the Kwetshage-Meetkerkse Moeren area?

4. Research methods

As stated in the paragraph 2 'Aim of the study', there are two phases in this thesis research. In the first phase the focus is on 'defining the criteria of success of a nature compensation project according to relevant stakeholders', while answering research sub question 1. During the second phase, the focus is on 'determining the success of the nature compensation project in Kwetshage-Meetkerkse Moeren on an ecological level', while adding information needed for answering research sub question 2-3, and the main research question.

4.1 Defining the criteria for success of nature compensation

When defining the criteria for success of a nature compensation project it is first and foremost important to note that what one stakeholder considers to be 'successful' might differ a lot from another stakeholders' point of view (Mace, 2014). By involving a diverse group of stakeholders, the definition of what success can mean can be as comprehensive as possible. The ecosystem services framework was used for this research, as it allows for a multi-dimensional interpretation of what success means in the context of a nature compensation project (J. Maes et al., 2018).

The aim of the first phase is to define the ecosystem services that are valued by the stakeholders of the nature compensation project in Kwetshage-Meetkerkse Moeren. So if the ecosystem services that stakeholders consider important, are present in the nature compensation area, the stakeholders might consider the project as 'successful'. Therefore, Ecosystem Service Assessment (Pirasath et al.) will be used. ESA integrates ecology, economics, and geography as a broad range of ecosystem services which can be influenced by nature compensation (Bagstad, Semmens, Waage, & Winthrop, 2013). To perform an ESA, an ecosystem service assessment tool can be used. These tools can improve the assessment of ecosystem services by making the process more systematic, quantifiable, robust and credible (Hugé et al., 2020).

4.1.1 Selection of an ecosystem services assessment tool

Multiple types of ESA tools exist that contain different approaches in order to vary the focus (economic valuation, spatial, temporal, incorporation of biophysical models) (Bagstad et al., 2013). The specific Ecosystem Services Assessment tool that is used was selected based on the review article by (Hugé et al., 2020), which outlines a wide range of ecosystem services assessment tools. In order to be able to decide on the tool, context-specific elements of the case of the compensation nature in Kwetshage-Meetkerkse Moeren were decided earlier on such as the input, required skills, outputs, and ecosystem services addressed. The tool characteristics were selected from table 3 in Hugé et al., 2020 (p. 7-8).

- *Input*

The input data for the ESA will be a combination of stakeholder-based input in the form of interviews, and available data from secondary sources. Examples of these data sources are the 'biological valuation map', citizens data such as the website *waarnemingen.be*, and data obtained from the institute for nature and forest research (INBO).

- *Required skills*

To be able to successfully complete the ESA, the chosen tool had to be aligned with acquired skills. In the case of this research, skills that can be used are skills in the interpretation of field ecology data, and skills in stakeholder's involvement.

- *Output*

The desired outputs of this ESA are both qualitative and quantitative data. This allows the ESA to be more comprehensive.

- *Ecosystem services addressed*

The focus of the ESA will be on ecosystem services; regulating services (which means regulation of climate, water, disease, but also pollination), provisional services (which means provision of food, fresh water, fiber,...), and cultural services (which includes recreational benefits, and the aesthetic value of plants and species) (USDA, 2016). Additionally it is worth mentioning that ecosystem services can be added depending on input given by the stakeholders.

After deciding which input, skills, output and ecosystem services are dealt with in the ESA, the best-fitting tool was chosen. To choose the tool, figures from Hugé et al., 2020 were used:

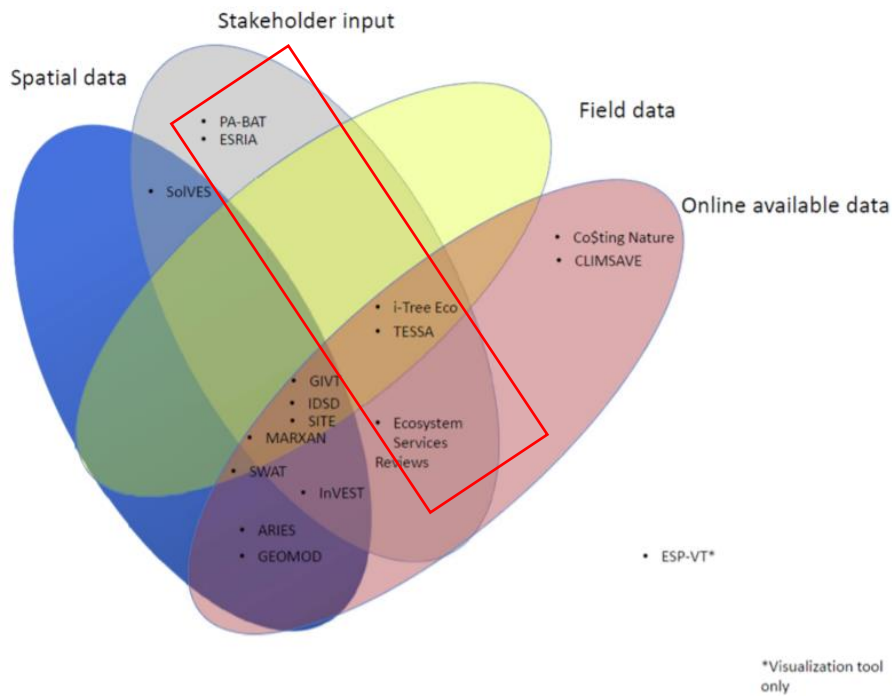


Figure 4: Overview of ecosystem assessment tools based on required input data (Hugé et al., 2020) p. 4

Using Figure 4 and the input data identified in 3.1.1, the tools in the red box are the contenders based solely on input data.

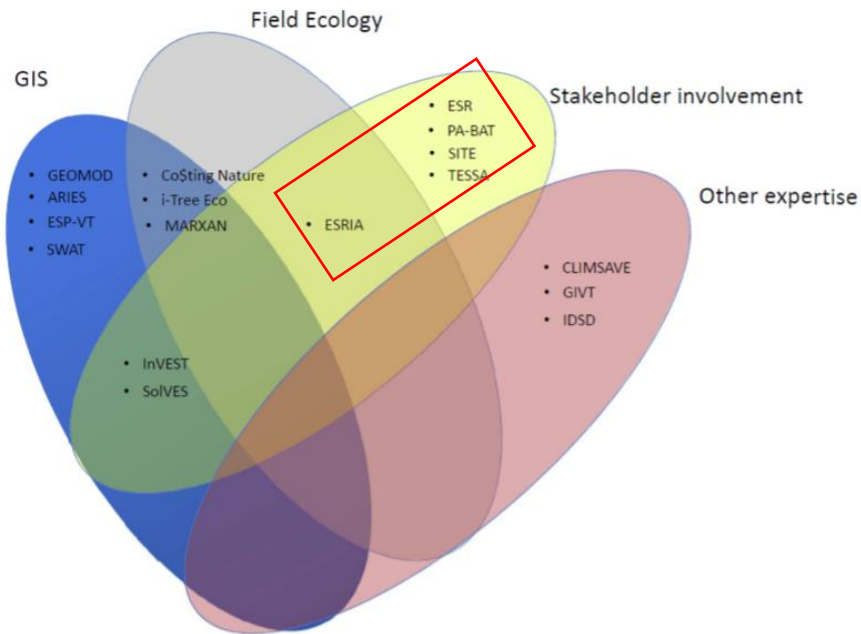


Figure 5: Overview of ecosystem service assessment tools based on required skills (Hugé et al., 2020) p. 5

Using Figure 5 and the required skills for this research identified in 3.1.2, the tools in the red box are the contenders based solely on required skills.

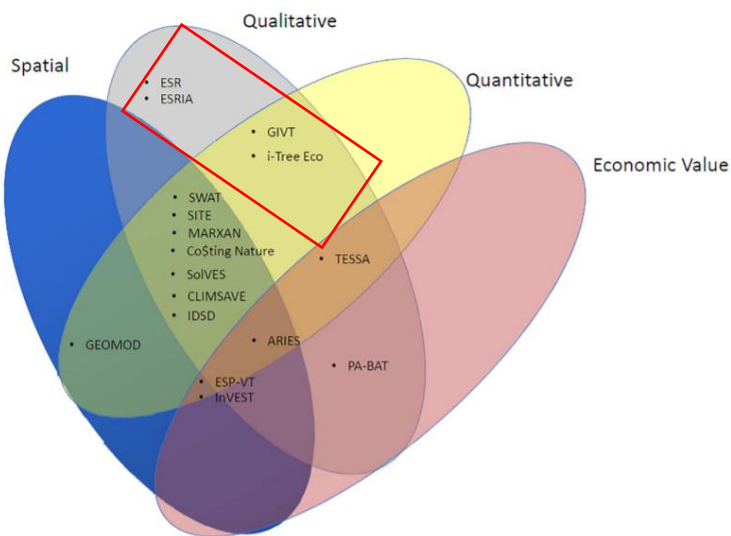


Figure 6: Overview of ecosystem services assessment tools based on generated output data (Hugé et al., 2020) p.5

Using Figure 6 and the output data preferred for this research identified in 3.1.3, the tools in the red box are the contenders based solely on output data.

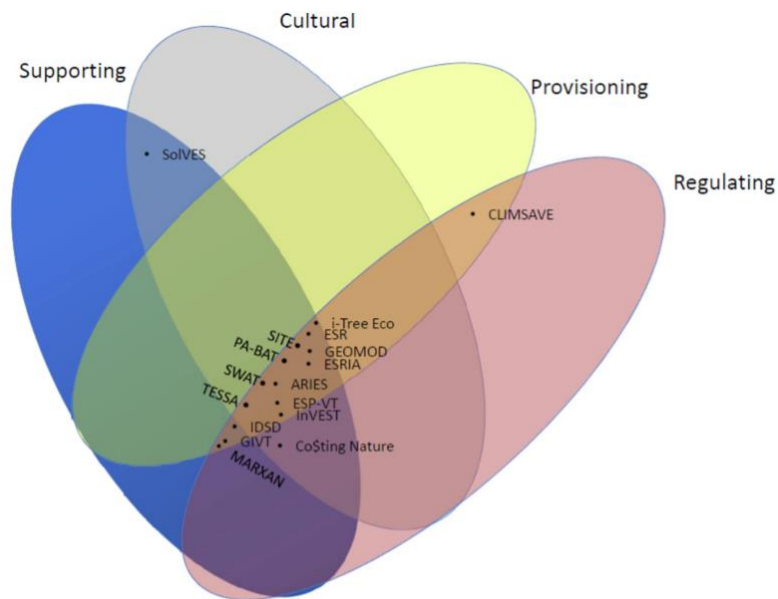


Figure 7: Overview of ecosystem services assessment tools based on ecosystem services (Hugé et al., 2020) p.6

Figure 7 shows the ecosystem services that are addressed in the different ESA tools. It is however difficult to clearly state which ecosystem services will be applicable. Therefore, this factor is subordinate compared to the others.

Based on the diagrams above, and the red boxes that meet the previously fixed input, required skills, and output-criteria, but also based on the general aim of this thesis research, the Ecosystem Services Review for Impact Assessment (ESRIA) tool was selected. ESRIA focusses on stakeholder-based input. It is used for impact assessment, comparison of options and identification of actions and strategies. The two main objectives of this tool are to “maintain the benefits people derive from ecosystems impacted” (Landsberg et al., 2011) , and “manage ecosystem-dependent operations to achieve planned performance” (Landsberg et al., 2011) . These objectives align with the aim of this phase of the research.

4.1.2 Ecosystem Service Assessment: ESRIA-structured interviews

The ESRIA is not performed as described by Landsberg et al., 2011. The ESRIA tool normally exists out of seven steps Steps 1-3 are scoping steps, steps 4-6 are impact analysis steps, and step 7 is the mitigation step. This thesis uses the outline of the ESRIA tool to structure interviews to obtain data from stakeholders.

The aim of the interviews is to obtain a thorough overview of the viewpoints, experiences and opinions of multiple stakeholders of the nature compensation project. Therefore, a questionnaire was drawn up. To formulate the different questions and to aim for the best coverage of the information hiatus, the ESRIA flowchart (Figure 8) was used as a guideline. The interview questions can be sorted into three groups: general questions, scoping questions, and impact analysis questions. The full list of questions can be found in Appendix 1.

After the questions were formulated, stakeholders were contacted to schedule the interviews. Participants were selected through online searches. The online searches used were the names of the stakeholder companies and institutes such as VLM, Natuurpunt, INBO, Agentschap voor Natuur en Bos. By browsing the websites and reading literature written by these companies and institutes, authors and project leaders were selected and contacted. For some stakeholders snowballing was used. This was most relevant for the habitants and farmers. Previously interviewed stakeholders would share their contact with farmers with whom they had contact with. Participants were sent a participation information letter containing the purpose of the research, background of the research, expectations, contact information, etc. together with an online informed consent. Both can be consulted in appendix 2 and 3. After consent, the interviews were held online through Microsoft Teams classic 1.6.00.27573 (64-bits). Recording of the interviews was done using the Dictaphone app in iOS 17.

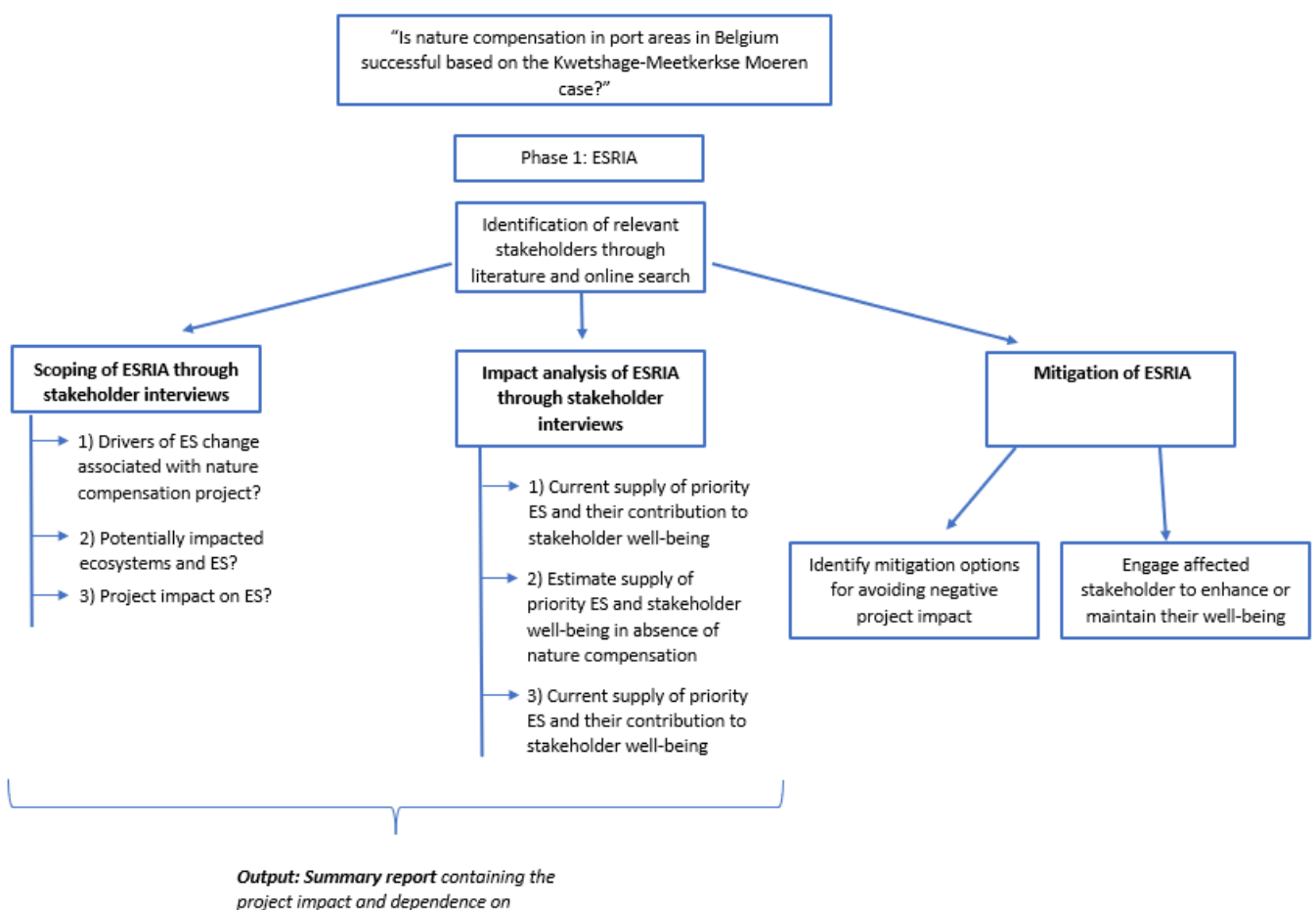


Figure 8: ESRIA flow diagram as applied in this study

4.1.3 Transcribing and coding interviews

After the interviews took place, the audio files were transcribed using an AI powered transcription tool 'Cockatoo'. This tool allows to upload audio files and uses AI technology to turn these into text (docx files). Afterwards, the text was manually read through to check the accuracy and corrected where needed, compared with the original audio files.

To organize the data and structure the interviews, coding was applied using the software Atlas.ti 24. Coding is "the analytical process of organizing raw data into themes that assist in interpreting the data." (Baralt, 2011). The codes itself were derived from the list of interview questions (see Appendix 4) so the answers to different questions throughout multiple interviews could be organized. The main distinction was made between 'value addition' and 'value subtraction', in both the 'original ecosystem', and the 'current ecosystem'.

4.2 Ecological effectiveness of the nature compensation project

In the second part of this thesis research, the ecological effectiveness ('success' or the lack of it) of the nature compensation in the case study area was determined, based on the presence of a selection of species. The aim was to consider some indicator species that can be used to value the biodiversity relevant for the research area. Then, using citizen science data or/and secondary data, the abundance of these indicator species were assessed to determine the success of the nature compensation. An overview of the approach is presented in Figure 9.

4.2.1 Choosing indicator species

In order to choose the most appropriate indicator species, an extensive literature search was performed for the research area, focussing on indicator species of the habitat types of the compensation area (polder grassland, reed swamp, pasture). Input from an expert stakeholder was collected, This was during the ESRIA structured stakeholder interviews.

4.2.2 Determining influence of the nature compensation project on biodiversity

To be able to determine whether the nature compensation project had a positive influence on fauna and flora, two indicator species were chosen. The abundance of these species in the area over time was retrieved from secondary data such as the citizen science database waarnemingen.be and the monitoring reports of INBO (Verstraete et al., 2021). Based on the results, a reflection was made whether there is net loss or gain regarding biodiversity.

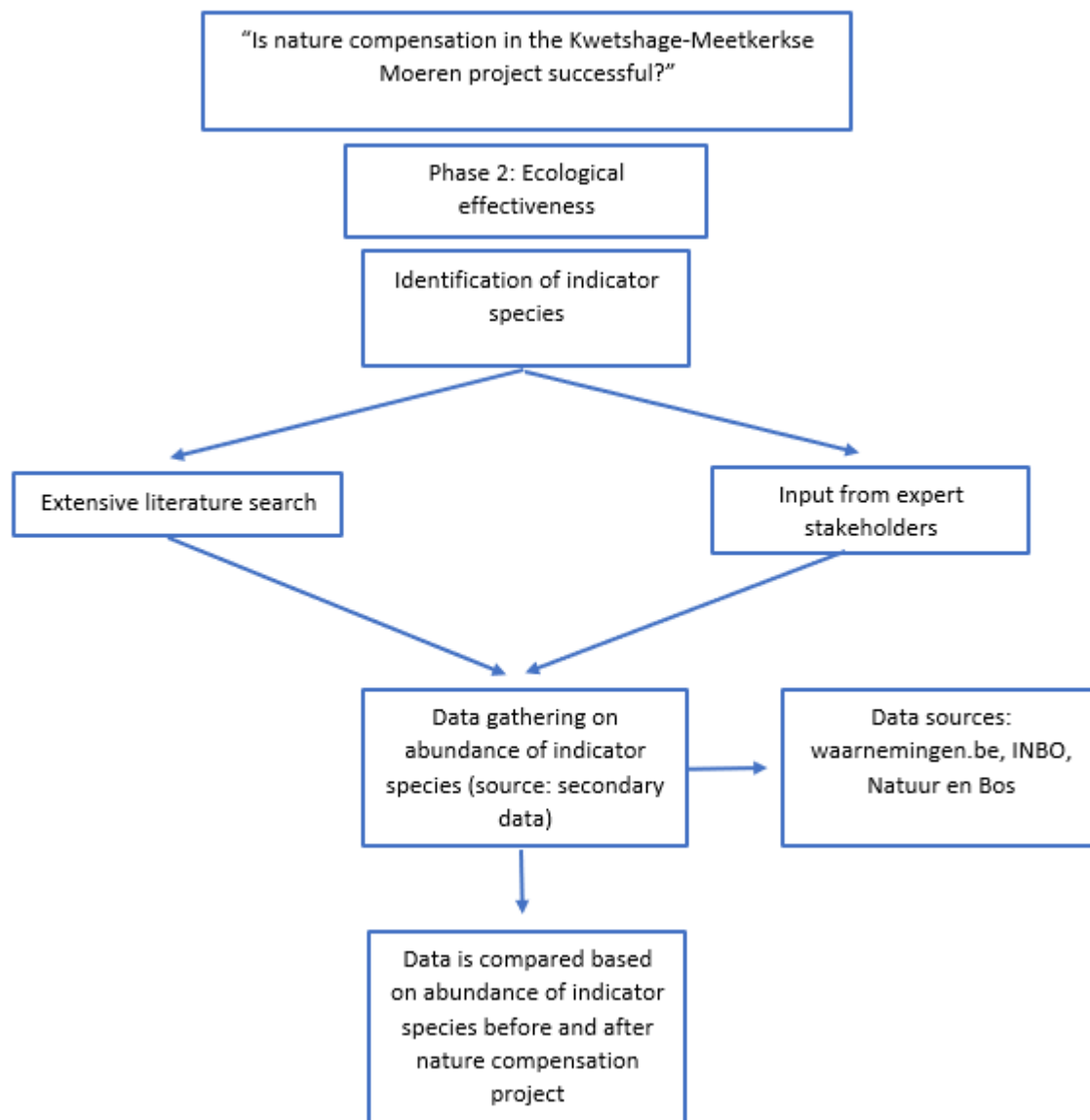


Figure 9: Flowchart ecological effectiveness of the nature compensation project

5. Results

5.1 Ecosystem Service Assessment: ESRIA-structured interviews

Table 2 presents information on all the executed and declined interviews. Per line a stakeholder of the nature compensation project is described with their correlating organisation and involvement. The status of their interview is displayed. This can either be conducted, declined, or no response was given.

For the source, there is sample frame, referred of substitute. This relates to the categories the interviewees were divided into. In this case, categories were made based on type of involvement and profession to guarantee a diverse sample of stakeholders.

The format of all interviews is semi-structured. All interviews are based on the list of questions described in paragraph 4.1.2. , but additional questions were posed to be able to go more in-depth onto certain topics. This was dependent on the specialty or experiences of the interviewee.

All interviews, but one (chairman of management committee) were audio recorded. The only reason this particular interview was not recorded is that there were technical issues with the Dictaphone-app and the online meeting software. Extensive notes were taken during this interview as a solution to these problems.

Since the research concerns a small sample of stakeholders and some of the participants can easily be recognized, all interviews are confidential and the reporting is anonymous.

Table 2: Overview of selected stakeholders for the interviews

Stakeholders	Organisation	Involvement	Status	Source	Format	Length	Recording	Transcript
Leading official	Government	Executor	Conducted through online meeting on 08/02/2024	Substitute in sample frame	Semi-structured	0:33:24	Audio recording	Confidentiality required
Projectleader 1	Government	Executor	No response	Sample frame	NA	NA	NA	NA
Projectleader 2	Government	Executor	No response	Sample frame	NA	NA	NA	NA
Alderman 1	Government	Compensation Area	Conducted through online meeting on 24/01/2024	Sample frame	Semi-structured	0:24:24	Audio recording	Confidentiality required
Alderman 2	Government	Compensation Area	Conducted through online meeting on 13/10/2023	Sample frame	Semi-structured	0:27:50	Audio recording	Confidentiality required
Farmer 1	Industry	involuntarily involved	Conducted through online meeting on 16/02/2024	Referred by member NGO	Semi-structured	0:22:14	Audio recording	Confidentiality required
Farmer 2	Industry	involuntarily involved	No response	Referred by member NGO	NA	NA	NA	NA
Representative farmer's association	Industry	involuntary involved	Conducted through online meeting on 13/02/2024	Referred by Alderman 1	Semi-structured	1:05:37	Audio recording	Confidentiality required
Chairman of management committee	Research	Monitoring	Conducted through online meeting on 11/09/2023	Sample frame	Semi-structured	0:40:13	Notes	Confidentiality required
Projectleader 3	Research	Monitoring	Conducted through online meeting on 13/09/2023	Sample frame	Semi-structured	1:22:28	Audio recording	Confidentiality required
Scientific employee monitoring	Research	Monitoring	Conducted through online meeting on 5/02/2024	Sample frame	Semi-structured	0:45:49	Audio recording	Confidentiality required
Member NGO + inhabitant	NGO	Reporting, conservation	Conducted through online meeting on 17/01/2024	Sample frame	Semi-structured	0:41:03	Audio recording	Confidentiality required
Advisor	Port	Fincancier	Declined	Sample frame	NA	NA	NA	NA

A summarized overview of the results and main findings of all the interviews is presented in the tables below (Table 3). The results have been grouped along the main codes that have been used when processing this data.

Table 3: summarized results of the ESRIA structured interviews

Stakeholders	Leading official	Alderman 1	Alderman 2	Farmer 1
Role and involvement	Works in project design as hydrologist and leading official	Alderman of Zuienkerke	Alderman of Jabbeke, but also inhabitant of the area	Farmer in the compensated area
Which stakeholders are impacted?	- farmers - government - research companies	- farmers - municipalities - research companies	- farmers - municipalities - research companies	- farmers - municipalities - government
Identified ecosystem services	- food and fiber - water management - biodiversity - recreation	- food and fiber - water management	- water management - food and fiber	- food and fiber - recreation
Is there pressure on the area?	NA	NA	NA	NA
Which additions of value were present before NC?	NA	More agricultural activities, supply of food	More agricultural activities, supply of food	More agricultural activities, supply of food
Which subtractions of value were present before NC?	- inferior agricultural plots	NA	- less biodiversity	- inferior agricultural plots
Which additions of value have happened after NC?	- excellent pumping station regulating the water levels of agriculture - hydrological isolation of agriculture and nature reserve	NA	- a lot of birds find their way towards the area - enrichment for the municipality - water buffer - contiguous nature	- plots that were chosen are logical - qualitative agricultural plots as exchange grounds
Which subtractions of value have happened after NC?	- inhabitants can not enter the area to enjoy nature	- compensation for farmers was insufficient - quantitatively speaking the water management should have been monitored better as to not hinder agricultural activities - increased competition for agricultural plots with farmers outside of the search area, caused by the exchange plots	- resistance from affected farmers - farmers having to move their activities further away from home - loss of money when land is exchanged - inhabitants can not enter the area to enjoy nature	- insufficient communication about the execution of the constructions - farmers having to move their activities further away from home - no more use of herbicide and fertilizer, causing loss of efficiency in farming - incomprehension of the excavation works when farmers are not allowed to dig smaller holes - inhabitants can not enter the area to enjoy nature
Policy measures	- government decides which habitats and how many hectares of nature need to be compensated. VLM is the executor of these constructions.	- permits are not renewed for neighbouring farmers	- instalment of 'land bank' for exchange with farmers	NA
Do you consider the project as successful?	Yes, a lot of positive feedback coming from nature lover, but some negative feelings coming from the agricultural sector	No, changes in waterlevels have lasting consequences for the agricultural sector. These have not been compensated for in a sufficient manner.	Yes, considering nature a big step forward has been made. There was sufficient communication between VLM and the municipality.	No, this project does not feel like an addition in value because it was very expensive, farmers lost a lot of land and people can not go and enjoy the area

Stakeholders	Representative farmers' association	Chairman mgmt committee	Projectleader 3	Scientific employee monitoring	member NGO + inhabitant
Role and involvement	Representative of the affected farmers of the project during managing committee	responsible heritage management for the flemish government and chairman of the management committee of the NC project	Projectleader polders for the flemish government	Executor of years of monitoring works in the area	Board member of an NGO involved in the area, but also inhabitant
Which stakeholders are impacted?	- farmers - government - research institutes	- farmers - inhabitants - research institutes	- harbour - farmers - inhabitants - government - research institutes	- farmers - research institutes	- farmers - inhabitants - NGO
Identified ecosystem services	- food and fiber	- carbon sequestration and storage - biodiversity - water management	- landscape structure and composition - biodiversity - soil formation - habitat quality	- water management - biodiversity	- carbon sequestration and storage - recreation - biodiversity
Is there pressure on the area?	Compensation has been performed within the harbor area. This creates tension, because what if more compensation will be needed in the future when these plots are needed for harbor expansion?	- economic pressure: the harbor needs to complete the nature compensation to be able to start the expansion they want	- pressure on landownership from farmers, private individuals, and NGO's	- predators such as foxes put extra pressure on the bird species nesting - farmers using herbicide and fertilizers	- over salinization of the area in cases of draught
Which additions of value were present before NC?	More agricultural activities, supply of food	NA	- valuable historical land markings	NA	NA
Which subtractions of value were present before NC?	- these farmers had already been affected by expropriations in previous projects	- smaller flood buffering	NA	NA	- infertile plots for agricultural activities
Which additions of value have happened after NC?	NA	- Solution to water shortage because of swampy areas - storage of more CO2 in swampy areas - recreation and tourism - eliminating fragmentation	- removal of unused bridge and construction of nature - removal of hunting forests in MM to stimulate meadow birds	- more reed birds are observed	- climate robust rewetting - biodiversity - a lot more birdwatchers
Which subtractions of value have happened after NC?	- insufficient exchange plots available - insufficient nature potency in acquired plots - anxiety amongst farmers for more expropriations - farmers having to move their activities further away from home	- disappearing of agriculture - resistance of agricultural sector - emission of methane caused by swampy areas - draught can cause salinization, making agriculture in the area impossible - doubt on the success of the meadow birds in MM - unsuccessful establishment of insects due to phosphor and nitrogen in the soil	- illogical setting of the objectives regarding birds - digging and chopping of valuable historical landscape for the sake of nature compensation instead of nature restoration	- after vegetation monitoring, objectives for vegetation were not achieved - vegetation is not of the same quality as the original nature - objectives for abiotic conditions, birds and vegetations are not met - plots closer to canals would have been better for vegetation - very opposing habitat types needed to be constructed which causes unideal conditions for both - some farmers are still using fertilizers and herbicide	- no possibility of visiting the area - only one-time compensations for affected farmers
Policy measures	- chainreaction of compensation projects and expropriations of the same pool of farmers	- aim for max return - accentuating the area instead of drastic changing	- arbitrary setting of objectives	- compensation of species, this is translated into habitats - ill defined objectives for the birds	- prohibition of pumping surface water - instalment of 'land bank' for exchange with farmers
Do you consider the project as successful?	No, insufficient consideration towards farmers was taken. The objective of the government to execute this project in this area was not successful.	Yes and no. In KH, the reed swamp is succesful. The briny grassland in MM shows a more problematic nature compensation	yes and no, valuable nature has been created, but in the wrong place	Yes, there is an addition of excellent nature in Flanders	Yes, it's the cherry on top of the pie since the NGO has been striving for this area to become more nature oriented since the 90s

5.2 Ecosystem services defining the success of nature compensation according to the stakeholders of the Kwetshage-Meetkerkse Moeren project

The results of the interviews are represented below, based on the different ecosystem services that were identified by the stakeholders during the interviews.

5.2.1 Agriculture: food and fiber

Multiple stakeholders, namely farmers, aldermen, project leaders,... have mentioned that this project has mainly affected the agriculture activities in the area. There were multiple consequences for agriculture in the area caused by the nature compensation project.

5.2.1.1 Reasoned land use

Before the nature compensation project, the area of Kwetshage and the Meetkerkse Moeren was mainly farmland (VLM, 2020a). Interviewees are unanimous about this. Additional information about the original land use is that these farmlands were not of the highest quality according to multiple stakeholders. Other statements from stakeholders of various profiles also mention the fact that the soil was not very fertile, therefore these were not used as cropland, but as meadows and hayfield. Important is, that this farmland was already fragmented with some protected nature reserves of the Habitats Directive area, adding to the biodiversity of the area. A representative of the farmer's association notes here that NGO 'Natuurpunt' already acquired some plots in the area in the context of nature development. This means that overall, in the search area of this nature compensation project there was already some prior tension on land ownership.

Even though in general, the agricultural sector in the area was not in favour of the project, multiple stakeholders, such as farmer 1, alderman 1 and 2, the representative of the farmers' association, indicated that the sector did have understanding of why this project was carried out in this specific area. Additionally it was stated by the leading official that "...the agricultural sector understood that if something had to happen somewhere, it would be better there than in a zone that has more agricultural value.". This was confirmed by farmer 1 saying that it was the ideal area since it was inferior agricultural land.

5.2.1.2 Acquisition of the target area

In its entirety, the nature compensation project included 500 ha. The executor of the compensation works thus needed to acquire a large plot of land. Naturally, this meant farmers would have to leave this area to allow the project to carry out. The majority of the farmers who had to stop their activities saw their lands exchanged by different lands outside the search zone. In this process, the executor company fixed the land prices of the search area and the exchange areas. Farmers then got an equal plot of land outside of the search zones in order to be able to continue their activities. Alderman 2 here notes that this was for some individual farmers a set-back if they happened to have purchased their original plot for a higher price. A minority of the farmers was bought off. According to alderman 2, this could be more negative compared to land exchange since it is more expensive to again independently acquire a plot of land since these farmers had to pay the registration fees and notary costs. Expropriations were not of the order in this project.

There are other consequences linked to the process of exchanging agricultural land outside of the area of interest. Alderman 1 stresses that by exchanging agricultural plots within the search zone for plots outside of this zone, the executor company became a direct competitor of the agricultural companies located in this area. This increased competition for agricultural land increased the prices of the land. This domino effect negatively impacted farmers outside and inside the search zones since this limited their chances of business growth and making it more expensive overall.

5.2.1.3 Farming under the current policy

Some farmers had plots of land that bordered the search zone for nature compensation. These farmers could continue their activities, but because of the implementation of a nature reserve in their nearby area, additional policies were introduced and associated consequences for farming ensued. Farmers were for example no longer allowed to use herbicides and fertilizers. Also, the water levels from the areas next to them were raised. This potentially could influence the water levels of their own land.

First and foremost, one-time financial compensations were installed according to multiple stakeholders. This compensation was granted because agriculture in the nearby area of the nature compensation would drastically change. The magnitude of the financial compensation would be determined based on a formula that was developed, taking into account the losses that would be applicable to the agricultural plots involved. Since one of the pillars of this nature compensation project entails rewetting and increase of the groundwater levels, this could potentially change the abiotic conditions of the meadows and hayfields surrounding the area. Here, the opinions and statements of stakeholders are contradictory. From the agricultural point of view these changes in the hydrology of the soil caused negative effects for the surrounding agricultural fields. Higher water levels would mean that for instance cattle could only be put on the meadows later in the year, and needed to be put in the stable earlier than before. This means a loss to the agricultural establishment. The quantification of this loss became a cause for discussion. From the executor's point of view the groundwater level changes are very well regulated, so this should not pose any issues to farmers. During the construction of the nature compensation area, a pumping station was installed that regulates the groundwater level for agricultural use. The nature reserve was hereby isolated and put on a higher groundwater level. Because of a surrounding ring canal, the runoff water from the nature reserve would not interfere the agricultural areas. These contradictory statements could be evidence of a discrepancy between theory and the reality, but further research would be needed to conclude this.

Secondly, also the permits of the nearby farmers would get influenced. Stakeholders from different backgrounds stated that the use of herbicides would become prohibited in the surrounding area of the constructed nature compensation as to not disturb the natural growth of vegetation of the nature reserve. As testified by farmer 1, this would decrease the overall efficiency of the affected plots because herbs such as thistle could not be exterminated by spraying herbicide, only by mowing. This causes the thistles to return more abundant every year, reducing the amount of cattle that can graze in these meadows. Stakeholders involved in the monitoring of the nature compensation project do report periodic use of some herbicides by certain farmers despite the policy. Not only herbicides, but also fertilizer can not be used anymore on these plots, only manure. This reduces the yield of hayfields.

It is debated from a farmer's point of view, but also from political view, that the one-time financial compensation does not cover the actual losses of the affected farmers.

5.2.2 Recreation

Inhabitants of the nearby towns and villages have expressed to multiple stakeholders the disappointment of not being able to enjoy this new piece of nature constructed so close to them. From an ecological perspective it is disadvantageous to let people enter the reserve, because the presence of humans could interfere with tendency of multiple bird species to nest. This has been stated by the stakeholder group mostly involved with the ecological side of the story. The executor of the works is aware of this demand for more recreative possibilities. It is especially difficult to understand for the public the fact that there used to be a loop around the premisses of the Kwetshage area. This has been removed since the construction of the nature reserve. Stakeholders do mention that more people find their way to nearby towpaths to go birdwatching. This strengthens the urge for inhabitants to enter the reserve. The leading official states that options are being reviewed to reinstall a loop around the reserve so people can enjoy the nature reserve without disturbing it.

5.2.3 Landscape structure and composition

During the interview with 'project leader 3' a specific take was shared. As a critique, this stakeholder regrets the works in Kwetshage specifically since the newly constructed nature reserve does not at all add to the restoration of historical land use. To this person's opinion, a completely different plan needed to be made for this area. Historically, the polders contain precious natural landscape with checkerboard pattern. However, the budget for the construction of the nature compensation had been made available with the aim of attaining certain goals. These goals were communicated to the executor of the works and were not taking into account the historical natural landscape. In order to attain to the goals, extensive excavation works were needed to install different habitat types such as reed swamp, salt marshes, and brackish puddle. These habitats would on their turn then attract the right species of insects and birds, reaching the nature compensation goals.

The excavation works would remove about 0.5m of the soil and with it removing the soil structure of the area. In the context of nature compensation this was necessary according to stakeholders (leading official and scientific employee monitoring). Only by removing the upper soil layers there would be the options to obtain salt marshes and to be able to manipulate the groundwater levels. Farmer 1 also had a take on this matter, since they witnessed the construction of the nature reserve they were perplexed on the scope of the excavation works. When they previously owned these plots, they were prohibited by law to do any digging, even small scale with shovels as to not disturb the historical soil layers. Therefore this person felt incomprehension for the approach of the works.

The leading official makes during his interview an opposing statement. This person states that actually, Kwetshage used to be a swamp area, and over the course of history it has been made dry to allow for better agriculture activities. Of course, this rewetting and the excavation works did not take place in the context of nature restoration, but rather nature compensation, so in a way it can be said that these stakeholders would have had a different approach on this matter. Also opposing to project leader 3, the chairman of the managing committee shared that the area of Kwetshage was always supposed to become more nature focused and this trend had been observed over the past years thanks to instances such as Natuurpunt, only the rewetting which was now a big part of the nature compensation project would not have been able to be completed without the financial input in context of nature compensation. So from this point of view the excavation works can be seen as an advantage to the natural landscape and valuable instead of an abomination to the historical landscape.

5.2.4 Ecological effectiveness according to stakeholders

One of the bigger concerns with the construction of the correct habitats were the salt marshes. This habitat type was constructed by excavation works, trying to mimic the abiotic conditions in which there is salty seepage, necessary for the flourishing of salt marshes. After the construction, there was a lot of debate amongst several stakeholders present in the management committee on how to define, evaluate, and report the acreage of the salt marshes. How would one hectare of salt marshes be defined? It was decided upon that one hectare of salt marshes would be equal to 1 hectare of the objective when 7% of the acreage contained these salty elements.

However, the reporting and evaluation would not appear to be straightforward. Over time, the saltiness of the soil would increase and decrease due to natural processes. This was explained by the scientific employee monitoring during the interview. At the beginning of the construction works, the salty seepage of the soil is higher because of the excavations, but in the end the conditions are not ideal to maintain the salt marshes, so over time the saltiness decreases again. This ensures that at the beginning of the monitoring the objective of the salt marshes acreage was obtained, but over time, without maintenance excavation, the process reverses. In its turn, the target breeding birds might not be present if the correct habitat is not maintained. Monitoring of vegetation and hydrology of the area has stopped in the meantime, leaving the matter unresolved. This does raise the question in some stakeholders such as the representative of the farmers' association, whether these plots of land were the right location for the creation of these types of habitats. This was confirmed by the scientific employee monitoring. Locations closer to a canal or the sea have better abiotic circumstances such as the salty seepage, allowing more qualitative habitats and therefore more successful compensation project. However, this was not possible because this approach would have been more expensive and would require for a lot of expropriations of the inhabitants.

During the interviews with the stakeholders, some expressed their opinion and findings on the ecological success of the nature compensation project. Multiple stakeholders, such as alderman 2, member NGO, and the chairman of the managing committee, state that the area is already a roaring success for breeding birds, but it still needs some extra time to completely blossom. A lot of rewetting and the implementation of reed bedding causes the attraction of multiple birds species. There are however some opposing opinions too.

A representative of the farmers' association claims that the area that was used to perform the nature compensation was not the best location to do so. This would cause lacking effectiveness of the compensation, because these plots did not have the best potential for nature aptitude. This stakeholder has some considerations on the original objective of the project by the Flemish government because this objective had a very detailed description of the types of habitat that needed to be created, without considering if the search zones for the project had the right potential for a successful compensation. This concern is partially shared with the scientific employee monitoring. This person is mostly concerned about the inherently different types of habitats that were supposed to be compensated. Some of these habitats are in need for very different abiotic circumstances. For these reasons, the stakeholder states that preservation of the original natural value should be the ultimate goal, and nature compensation can be seen as taking a step back.

5.2.5 Water management and carbon storage

Even before the nature compensation constructions were implemented, the area often flooded and even deliberately was used as a flood buffer to prevent the flooding of nearby cities and towns according to the leading official. These plots of land were already low-lying, but the additional excavations works and rewetting changed the flood management of the area. During the works, flooding buffers were constructed to prevent the flooding of nearby towns and villages. This is described by the chairman of the management committee and the leading official as necessary because a permanent wetting of the area decreases the overall buffer capacity in case of flooding.

Additionally, another part of the hydrology of this nature compensation and the rewetting of the area is that these wet conditions improve the CO₂ intake and draining of higher situated farmlands in the spring. The downside there is that swampy areas do have an increase methane emission. This process has been strengthened by the nature compensation.

5.3 Ecological effectiveness of nature compensation based on monitoring data

The ecological effectiveness was in this part determined by the abundance of two bird species in the compensation areas.

5.3.1 Choosing the indicator species

For Kwetshage, 45.7 ha of reed swamp, and 15 ha of polder grassland were constructed. For the Meetkerkse Moeren, 22 ha of grass land were constructed. The INBO monitoring included counting of breeding birds (Verstraete et al., 2021). Two indicator species were chosen to evaluate for this thesis research: the Avocet (*Recurvirostra avosetta*), and the Marsh Harrier (*Circus aeruginosus*). An expert in monitoring was consulted. The expert recommended these were two species for which the target habitats were translated into new compensation nature. The Avocet is also indicated as an indicator species for biodiversity in Dutch Marine waters, therefore it is also thought to be relevant in this research (H.W.G. Meesters et al., n.d.). The Marsh Harrier also prefers marshland and reed beds to hunt and nest, plus it is also considered an umbrella species (Alves, Ferreira, Torres, Fonseca, & Matos, 2014). So the abundance of the Marsh Harrier can be seen as a proxy for the biodiversity of the area. The objective of the compensation project in general thus included the attraction of, amongst other, these two species to the compensation project. Therefore it was decided for this thesis to also use these species as tentative indicators for ecological effectiveness. Choosing to evaluate biodiversity based on indicator species has its limitations (Lindenmayer & Likens, 2011). For example, a non-ideal species may be chosen, there can be a lack of transferability between ecosystems, environmental circumstances, etc. Nevertheless, this approach remains valuable in research since it allows for a more efficient evaluation and easier communication with the public (Lindenmayer & Likens, 2011).

5.3.2 Results of the species monitoring

Two sources of data were used: waarnemingen.be and the monitoring report of INBO (Verstraete et al., 2021). INBO uses an extensive territory mapping method as described in (Hustings, Kwak, Opdam, & Reijnen, 1985) and adjusted to the method of (Vergeer, Van Dijk, Boele, Van Bruggen, & Hustings, 2016). This method is a standardized species-specific method to census the territories of breeding birds (Verstraete et al., 2021). Monitoring of territories allows for an insight on the distribution of the species and on which preferences of habitats exist (Verstraete et al., 2021). The results are presented below in tables and graphs.

5.3.2.1 The abundance of the Avocet in the study area over time

First, the results from waarnemingen.be are presented in Figure 10. This includes a graph that shows the number of sightings divided by the amount of observers of that year. This correction is made because otherwise, there could be false trends spotted caused by a fluctuating amount of observers (Figure 10). There is no data before 2009.

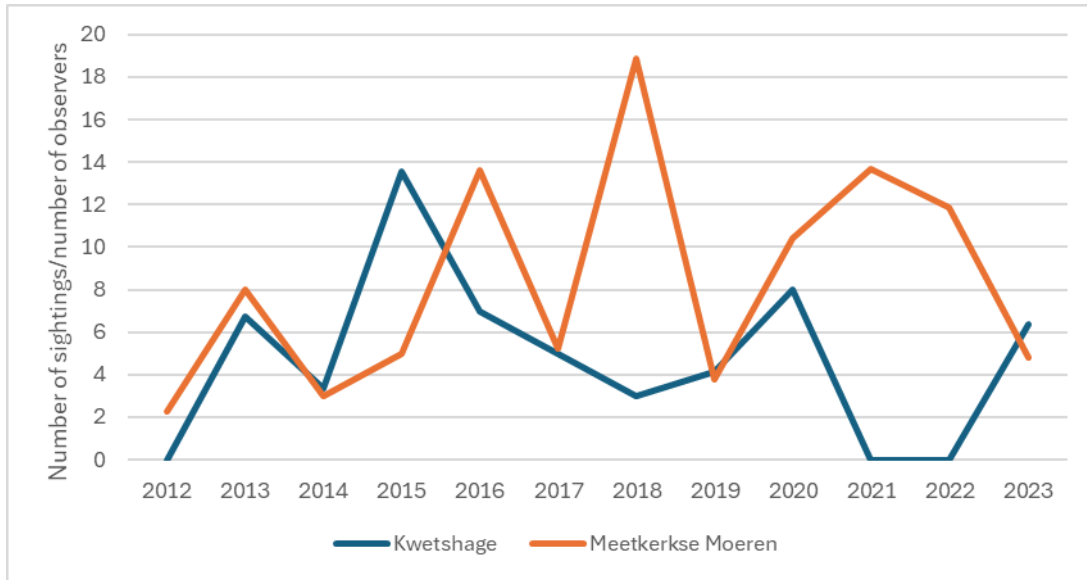


Figure 10: The number of Avocet sightings divided by the number of observers per year. Source: waarnemingen.be

Secondly also the data from the INBO monitoring report is shown in Figure 11. There is no data before 2006, or after 2020 from this source. INBO reports territories observed instead of sightings. This is a more valuable way of reporting since it also indicates nesting of the animals (Hinde, 1956).

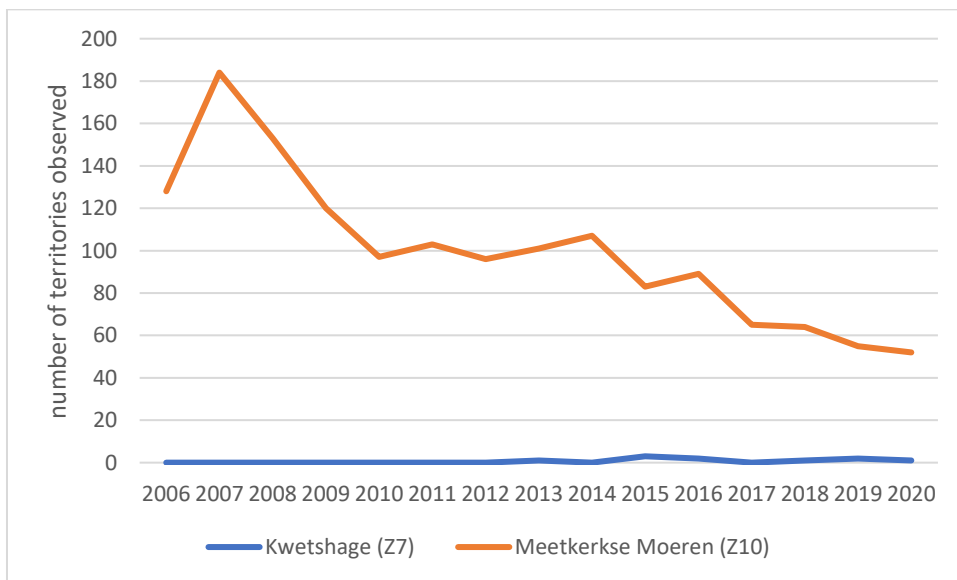


Figure 11: The number of Avocet territories observed by INBO (Verstraete et al., 2021)

5.3.2.2 The abundance of the Marsh Harrier in the study area over time

First, the results from waarnemingen.be are presented (Figure 12). This includes a graph that shows the number of sightings divided by the amount of observers of that year. This correction is made because otherwise, there could be false trends spotted caused by a fluctuating amount of observers. There is no data before 2009.

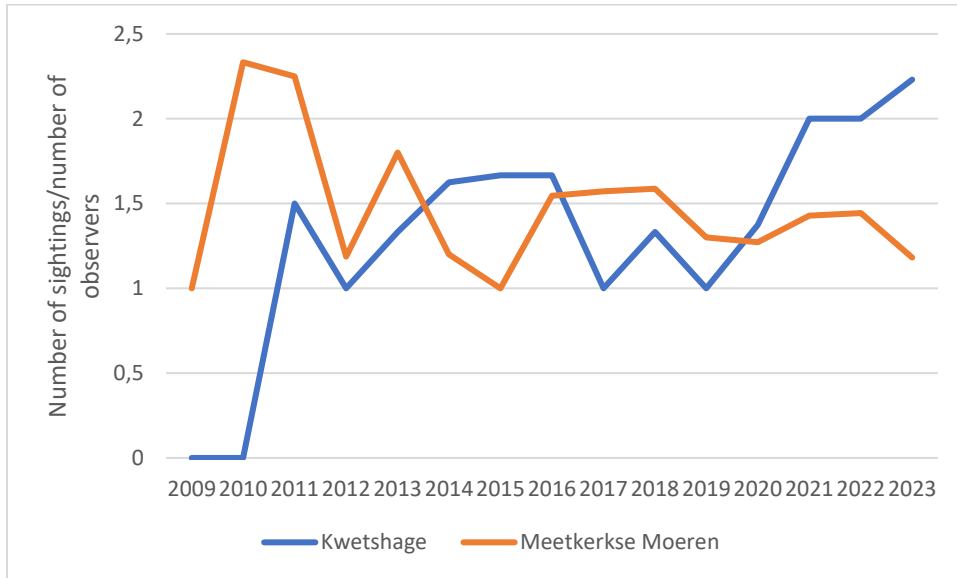


Figure 12: The number of Marsh Harrier sightings divided by the number of observers per year. Source: waarnemingen.be

Secondly also the data from the INBO monitoring report is shown in Figure 13. There is no data before 2006, or after 2020 from this source. INBO reports territories observed instead of sightings.

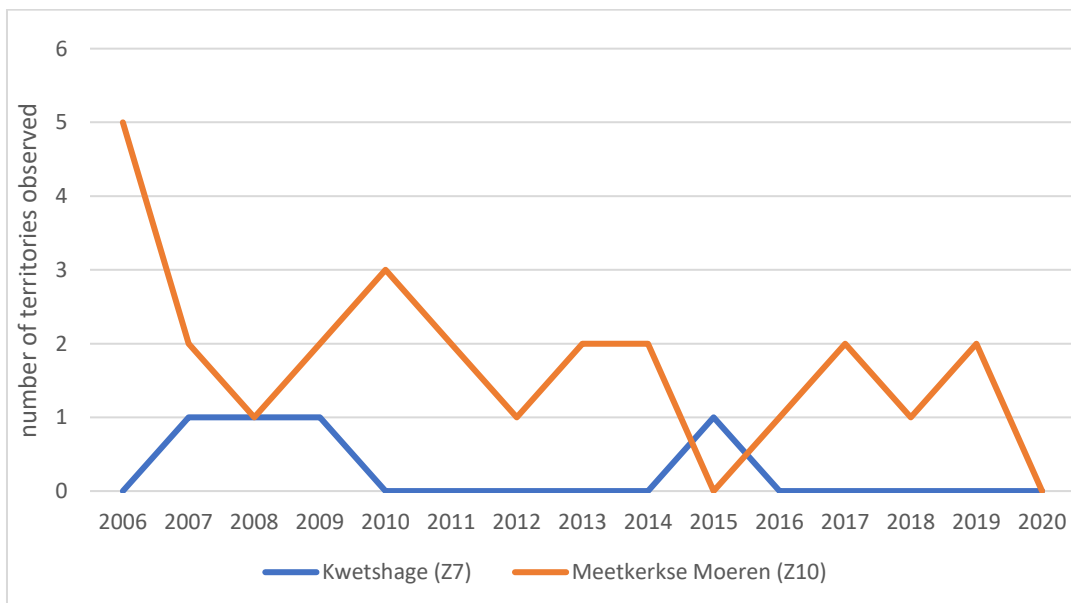


Figure 13: The number of Marsh Harrier territories observed by INBO (Verstraete et al., 2021)

6. Discussion

6.1 What defines the effectiveness of nature compensation areas according to stakeholders?

From chapter 5.2 it is clear which ecosystem services were important to stakeholders of the nature compensation project in Kwetshage and the Meetkerkse Moeren. However, how does this correlate to the literature on the subject? In this chapter, the ecosystem services mentioned are discussed and compared to previous research on nature compensation.

6.1.1 The agricultural perspective

The main setback for the nature compensation project in Kwetshage and the Meetkerkse Moeren was the initial resistance and aversion of the agricultural sector. This was described in chapter 5.2. Multiple reasons were identified such as insufficient compensation, loss of business opportunities, and additional policy regulations related to the introduction of the nature reserves.

There are two strategies often used to incorporate agriculture and nature conservation: 'land sharing' and 'land sparing' (Shackelford, Steward, German, Sait, & Benton, 2015). These can be seen as two solutions to the same problem (Baudron & Giller, 2014). In 'land sharing', there is extensive agriculture which is wildlife friendly. In 'land sparing', there is less extensive agriculture which is also less wildlife friendly (Shackelford et al., 2015). Considering the nature compensation project of Kwetshage and the Meetkerkse Moeren, farmers had to close down agricultural activities in the area, and were moved outside the target zone. This means the 'land sparing' strategy was used. The 'land sparing' approach has also been proven to have a more effective influence on biodiversity (Phalan, Onial, Balmford, & Green, 2011). This is however drastically less supportive towards the agricultural sector. 'Land sharing' on the other hand allows the co-existence of farming and biodiversity conservation. The willingness of farmers to accommodate to nature conservation projects, such as nature compensation, has been described before (Sponagel, Angenendt, Piepho, & Bahrs, 2021). The study by Sponagel et al. (2021) conducted a choice analysis of 209 farmers in Germany. The main conclusion was that "farmers are willing to implement compensation measures voluntarily on arable land." Sponagel et al. (2021). This relates to the 'land sharing' strategy. This study mostly shows willingness in participation of production-integrated compensation (PIC) and recommends implementation of large-scale planning of compensation measures to avoid land-use conflicts between the agricultural sector and nature conservation. For the project in Kwetshage and the Meetkerkse Moeren, this PIC method would have been hard to implement since the objective required consecutive nature plots for the creation of sufficient habitat for target species such as the Avocet and the Marsh Harrier. This required farmers to move away from the area and stop their activities. Hence the opposition related to this project. An alternative suggestion could be a hybrid between 'land sharing' and 'land sparing'. Creation of a 'centre reserve' in which no agriculture is present (land sparing) with surrounding agriculture with applied PIC strategy (land sharing) could stimulate the synergism between agriculture and nature conservation and limit the number of affected farmers. The stakeholders sharing this opinion (farmers, alderman 1 and 2, inhabitants, representatives of the farmers' association) are more leaning towards a belief in which decisions should be made from an economic perspective, while recognizing that these areas are shared between humans and nature (Broussard, Dahdouh-Guebas, & Hugé, 2023).

Additionally, farmers and stakeholders concerned with the farmers of the project in Kwetshage and the Meetkerkse Moeren stated that compensations paid may not cover the actual losses of the farmers. This increased feelings of dissatisfaction related to the nature compensation project. Financial payment is less desired if it is based on financial cost instead of the opportunity cost (Hodge, 1989). Literature states that “The appropriate measure of compensation is the sum of money which would leave the farmer at the same level of welfare once restrictions have been placed over the land use, as he or she would have been on had the restrictions not been introduced.” Hodge et al., (1989) p.1031. Although in general, willingness to set aside arable land when offered financial compensation does increase (Boon, Broch, & Meilby, 2010). Based on the results of the interviews, stakeholders are divided on whether or not the financial compensation offered for the nature compensation project was sufficient.

Agricultural activities are subject to increasing regulation. For instance, farmers surrounding the nature reserve are no longer allowed to use fertilizers or herbicides. This is because the fertilizers may add an excess nutrients to the soil, reducing species richness (Tallowin, Mountford, Kirkham, Smith, & Lakhani, 1994). Herbicide drift could damage the vegetation in the nature reserve and consequently influence animal species (Marrs, Frost, & Plant, 1991). However, farmers are negatively influenced by these consequences since weeds are more abundant in meadow field, reducing the yield of farming (Kudsk & Streibig, 2003). Sufficient financial compensation for the farmers is therefore desired by the sector. On the other side, increasing regulations may be seen as a downside to financial aid, because agriculture is also heavily subsidized from both the Flemish government and the European Union (Vlaanderen, n.d.). Additionally, decreased use of pesticides and herbicides may improve the health of the farmers since they become less exposed to these substances (Kudsk & Streibig, 2003).

Overall, it was made clear by multiple stakeholders involved with the agricultural sector that there was general understanding for the decisions made. These stakeholders agreed that compensation should ideally be performed in areas where there is the highest net benefit (Hodge, 1989). And therefore the chosen zone was favourable. This aids the understanding of the agricultural sector for their losses, hence the initial resistance was at least partly overcome.

6.1.2 Co-existence of recreation and nature conservation

Based on the results of the stakeholder interviews, a big downside of the current situation of the nature compensation area in Kwetshage and the Meetkerkse Moeren is that inhabitants and nature lovers are not able to enjoy the premises of the nature compensation. Access is desired. Often, recreation and nature conservation are difficult to co-exist, because recreational use may degrade the area in a way that it is no longer enjoyable in the sense of recreation or has sufficient environmental value (Cole, 1993). Visitors may be trampling on vegetation, degradation of water quality may be observed, and influence on wildlife is one of the biggest concerns (Marion, Leung, Eagleston, & Burroughs, 2016). Of the utmost importance for this nature compensation project is the nesting of target bird species. Disturbance of recreationists coming too close to the animals can reduce the habitats size and quality (Cole, 1993). This can cause decreased time of nest attendance and nest displacement (Martínez-Abraín, Oro, Jiménez, Stewart, & Pullin, 2010). Therefore reducing the ecological success of the reserve.

Mostly for humans, there are some positive elements linked to outdoor recreation such as increased positive mental health and physical health outcomes (Wolsko, Lindberg, & Reese, 2019). There might be some hope to introduce outdoor recreation in nature reserves, because studies have shown that recreation in nature may be linked to enhancements of nature protection (Stenseke, 2012). Local communities may be encouraged by education and business opportunities. In this scenario, inhabitants of the nature compensation area in Kwetshage and the Meetkerkse Moeren might reframe their

perspective of the nature reserve and grow more fond of it. To obtain this situation some extra strategies can enable the co-existing of recreation and nature conservation. Introduction of sufficient facilities such as trailways, visitors centres, displays on nesting birds or even closing certain areas where and when birds are nesting could help introduce recreation. This could generate understanding and cultivate knowledge amongst the public (Cole, 1993).

6.1.3 Land-use legacy and ecology

One stakeholder (project leader 3) had a strong opinion on the nature compensation project regarding the contrast between the historical land-use and the current situation after nature compensation. This stakeholder suggested the value of nature restoration instead of nature compensation. Past land-use leaves an imprint in the soil (Foster et al., 2003). These imprints affect the dynamics and presence of ecosystems but can be altered by agriculture. Studies have also shown that soil networks present in historical soil have an enhanced efficiency of carbon uptake (Morriën et al., 2017). This adds motivation to the retention of the historical soil networks. The area of Kwetshage and the Meetkerkse Moeren was dedicated as historical permanent grassland (ANB, 2024). This means the upper layer of soil remained intact over the years despite the presence of agriculture, because the agricultural sector could not do any delving in these plots. However during the excavation works for the nature compensation project, the imprint of historical land-use in the soil could be removed. Excavation works were necessary to attain the desired water level. Hereby losing all advantages of the historical land-use imprints.

Nevertheless, the practice of nature reconstruction is not single-sided. Guided by ecological consideration and historical references, when restorationists agree on the period to reconstruct, there could still be discussions on what this should look like and whether this is an attainable goal (Swart, Van Der Windt, & Keulartz, 2001). There is no singular approach to nature restoration. Different stakeholders may have a different perspective on the matter. For one stakeholder, species composition may be of greater importance, for another the hydrology, ... This might be the case for the nature compensation project in Kwetshage and the Meetkerkse Moeren too.

Overall, this topic of nature restoration versus nature conservation is a complex one. Additional research on the influence of the excavation works on the soil network would be needed to form a final conclusion on the best approach for this area.

6.1.4 Evolution of nature: inland salt marshes

During the construction and the monitoring of the vegetation in the area of the nature compensation project, there were some concerns on the establishment of salt marshes' vegetational elements and the correlating hydrology of this habitat type. Inland salt marshes usually arises with the reclamation of the sea. To thrive, this habitat type needs salty seepage (often caused by the presence of a canal) (Van de Meutter, Gyselings, & Van den Bergh, 2016). Multiple factors can influence the potential success when constructing saltmarshes such as the elevation of the land, the size of the site and the soil salinity (Wolters, Garbutt, & Bakker, 2005). For the area of Kwetshage and the Meetkerkse Moeren, additional research, measurements and monitoring would be required to confirm whether these parameters were advantageous for the creation of salt marshes. It can be presumed that a location closer to a canal would have improved the creation of the salt marshes since more salty seepage would be present. Additionally, the most successful method of salt marsh construction is the translocation of sod compared to translocation of seeds and clippings (Van de Meutter et al., 2016).

Secondly, monitoring showed that over time, the salt marshes in the nature compensation project have degraded in quality (Verstraete et al., 2021). Effective maintenance may help prevent this. Suggested is the implementation of grazing or mowing to attain a more heterogenic soil and vegetation

profile (Wolters et al., 2005). Salt marshes' vegetation can not compete with vegetation that is usually present in agriculture, such as pasture species (Laegdsgaard, Kelleway, Williams, & Harty, 2009). That is why maintenance could be beneficial.

6.1.5 Water management and carbon sequestration

Rewetting of the area in Kwetshage and the Meetkerkse Moeren also influenced the water management strategy of the area. Wetlands can have multiple purposes such as flood protection, water quality enhancement, food chain support and carbon sequestration (Verhoeven & Setter, 2010). The area of Kwetshage and the Meetkerkse Moeren was constructed into wetland with mostly reed beds and salt marshes. Wetlands may act as a sponge in the environment in which it absorbs more water during floods, and releases water during dry periods (Acreman & Holden, 2013).

Additionally, the wetlands may improve the water quality (Verhoeven & Setter, 2010). Especially the reed beds are very effective in the removal of human and animal wastewater (Shutes, 2001). This ecosystem service is however less relevant to the nature compensation project in Kwetshage and the Meetkerkse Moeren as it is not mentioned in the objectives, nor will wastewater be disposed in the constructed wetlands. Wetlands are also capable of removing nutrients from water (Verhoeven, Arheimer, Yin, & Hefting, 2006). This could be potentially improving the quality of the groundwater in the Kwetshage and Meetkerkse Moeren area since this was previously agricultural soil. Because of the agricultural activities, manure could have enriched the soil with nutrients, which are now gradually being removed by the wetlands. Additional research is needed to examine this hypothesis.

Lastly, wetlands play an important role in sequestration (Adhikari, Bajracharaya, & Sitaula, 2009). When managed properly, wetlands can create a sink for atmospheric carbon. If not, and the water levels are lowered, the wetlands may release carbon (Adhikari et al., 2009). This stresses the importance of sufficient water level management. Wetlands also emit methane, hereby adding to the concentration of greenhouse gasses in the atmosphere (Kao-Kniffin, Freyre, & Balsler, 2010). Hydrology monitoring results are not available for the area after construction works have been executing. To make any claims on the water management and carbon sequestration functionalities of this area, further research is required.

6.2 Did the nature compensation project lead to an increase in the ecological value of the area?

To answer this research question, the figures and tables of chapter 5.2 are discussed. Previously, the Avocet and Marsh Harrier were chosen as indicator species for the ecological success of the nature compensation project. These species will be discussed separately.

6.2.1 Abundance of the Avocet

Based on Figure 11 (data from INBO), for the area of Kwetshage, there is a very small increase in the number of territories of Avocets. Starting from zero territories between 2006 and 2012, increasing to one to three territories between 2013 and 2020. The increase in Kwetshage is very low based on these numbers. The data from waarnemingen.be (Figure 10) shows strong fluctuations from 2012-2023. This is citizen's data, meaning that there are some pitfalls in the use of this data (D. Maes et al., 2018). Some examples of these pitfalls are the lack of detailed location, data might not be valid, etc.

For the area of the Meetkerkse Moeren, from 2006 until 2014 over 100 to 180 territories were observed. This amount decreased after 2014 and became stagnant from 2015-2020 around 55 territories. This seems counterproductive to the objective of the nature compensation project, but can be explained by the loss of the pioneering situation this species had before 2014. Pioneering in birds is when one singular male, or a breeding couple are present in an appropriate area (Johnson, 1994). The loss of the pioneering can be explained by the redistribution of the species after the nature compensation construction created more suitable habitats in the broader context of the nature compensation project of the port of Zeebrugge (Verstraete et al., 2021). This redistribution is driven by the fact that the Avocet is a colonial nesting species. This has proven to increase nesting success withing the species (Lengyel, 2006). Another reason for the redistribution of the Avocet may be that this peak in territories was part of their trial-and-error approach to nesting, and the colony moved on to find a more suitable nesting place (Lengyel, 2006). Leaving a less dense colony which may decrease the chances of nest abandonment (Hötker, 2000).

Overall, even when the data is double sided, when looking at the bigger picture, the nature compensation did help this species thrive in the broader context of the nature compensation project. Monitoring of the entire project shows that the avocets territory is increasing yearly (Verstraete et al., 2021). Further development of the area over time and continuous monitoring is needed to make a better statement of the in- or decreasing amount of territories of the avocet.

6.2.2. Abundance of the Marsh Harrier

Based on Figure 13, the INBO reports decreases of the Marsh Harrier in Kwetshage. At the start of the monitoring, around one territory was observed, after 2015 this has not been observed anymore. Figure 12 with citizen's data reports a slight increase in sightings of Marsh Harrier per observer. In both figures changes are very small and inconclusive. More data gathering and monitoring is desired.

For the Meetkerkse Moeren, there is a decrease in the number of territories observed (Figure 13). Starting from five territories in 2006 until around one to two in 2020.

In both areas, the number of territories of the Marsh Harrier is now stable. The Marsh Harrier prefers the presence of sufficient reed beds to breed and hunt, but is disturbed by human presence such as agricultural activities (Alves et al., 2014). The stagnant number of Marsh Harrier in Kwetshage and the Meetkerkse Moeren can thus be explained by the fact that the nature compensation project has not been evolving for long enough and the reed beds need more time to evolve into an ideal habitat for this species to thrive since the construction works in Kwetshage were only finished in 2023 and those of the Meetkerkse Moeren in 2022 (VLM, 2022). Additionally, the excavations and constructions that happened for the nature compensation project may have disturbed the presence of the marsh harrier in the area.

Further development of the area over time and continuous monitoring is needed to make a better statement of the abundance of the Marsh Harrier.

On the longer term, there are doubts on the ecological success of nature compensation in this area, because worldwide, water bird species are declining (Wang et al., 2022) (IUCN, 2020). Thus, in monitoring, a problematic compensation could be seen, without the international context of a declining population of water birds.

6.2.3 General ecological effectiveness

There are other elements that represent the ecological success of this nature compensation project. Some of them were mentioned by the stakeholders during the ESRIA-structured interviews such as the effectiveness of salt marshes' construction, general bird monitoring, and hydrology. These are all monitored by INBO and results are presented in a monitoring report (Verstraete et al., 2021). The results of this report show that for the salt marshes there was an initial increase in salty element, but these have decreased again. This opens the discussion to whether the location of the nature compensation project was ideal. For instance, reed bedding and salt marshes are in need of very different hydrological environment (Fogli, Marchesini, & Gerdol, 2002). Trying to create these adjacent to each other could become impossible. Therefore, if the habitat vegetation is not thriving, the bird population may be lacking too.

For a more in depth discussion on the overall bird monitoring of the nature compensation project, referral is made to the monitoring report of Verstraete et al. (2021).

6.3 What is the link between the expectations regarding effective nature compensation and the reality?

The biggest concern with nature compensation projects in general is obtaining the 'no-nett-loss' goal (Gastineau, Mossay, & Taugourdeau, 2021). However, studies have shown that ecological compensation has had positive effects on the environment on a larger scale (Chen, Dou, & Xu, 2021). Ideally this would be the case for the project of Kwetshage and the Meetkerkse Moeren.

As described in the note written by the Flemish Land Company (VLM, 2017), the aim of the nature compensation project in Kwetshage and the Meetkerkse Moeren was mostly re-wetting and strengthening of the landscape structures by constructing polder grassland, reed bedding etc. Reporting by VLM states that this is also what has been performed (VLM, 2022). The aim formulated by VLM for Kwetshage and the Meetkerkse Moeren is the re-installment of territories for the Marsh Harrier, the Avocet and other species. However, as reported in chapter 6.2.2, the monitoring data shows a slight decrease in Avocet territories and no significant change in the abundance of the Marsh Harrier. Over time, monitoring might show a different picture when the habitats have more evolved.

Considering the constructed habitats, all of the works for these two areas in this project have been completed. The expectation of attaining a certain compensation area and the reality of the compensation works are aligned. However, the nesting of the targeted bird species is still to be waited on. Overall, some valuable plots of nature have been created in this project, whether these are equal to the original nature will have to be investigated and monitored over time.

7. Conclusion

Linking back to the first research question: 'What defines the success of nature compensation areas according to stakeholders, based on the Kwetshage-Meetkerkse Moeren case?', it is difficult to give a singular answer. The results of the ESRIA structured interviews showed that different stakeholders value different elements in this nature compensation project. The most commonly discussed part was the influence of the project on the agricultural sector. Stakeholders in this project are very understanding towards both the project and the targeted farmers. Other important ecosystem services were recreation possibilities, historical land use, water management, carbon sequestration and ecological value. During the discussion of the results, it was frequently reflected that additional research is necessary. This shows the limitations of the ESRIA-structured interviews, since more in-depth analysis is often desired to make comprehensive conclusions.

Regarding the second research question: 'Did the nature compensation project in Kwetshage-Meetkerkse Moeren cause an increase in the ecological value of the area?'. Based on the limited data available for this thesis research, it can be concluded that there is no increase in the abundance of Marsh Harrier and the Avocet. However, more monitoring is required for a longer period and of more species in the area of Kwetshage and the Meetkerkse Moeren to be able to make a final conclusion on this topic. Monitoring of proxies is also not sufficient to make a solid conclusion on a complex ecosystem.

For (sub-)research question three: 'What is the link between the expectations regarding effective nature compensation and the reality in the Kwetshage-Meetkerkse Moeren area?', it can be said that some good value plots of nature have been constructed, but whether these are equal to the original situation will need to be evaluated over time.

In general, this thesis research shows that nature compensation is a very complex issue and multiple stakeholders of different backgrounds, with different views are brought together to reach a specific goal. The case study teaches that communication and sufficient weighing of decisions may help with the implementation of nature compensation and gain understanding with stakeholders. Scientifically speaking, more upfront testing, evaluating and discussing of the correct search zones for compensation may improve the perception with stakeholders, but also the overall ecological effectiveness of the project.

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Appendix I: Questionnaire

The questionnaire will start with some general questions in order to get an overall view on the stakeholder and their position and involvement in the case

Question 1: Can you give a small introduction about yourself and your professional role?
Kunt u een kleine introductie geven over uzelf en uw professionele rol?

Question 2: In which way were you involved with the nature compensation project in the sub-areas of Kwetshage/Meetkerkse Moeren (KH/MM)?
Op welke manier werd u betrokken bij het natuurcompensatieproject in deelgebieden Kwetshage/Meetkerkse Moeren?

Question 3: Since when and for how long were you involved with the nature compensation project in KH/MM?
Sinds wanneer en voor hoe lang werd u betrokken in het natuurcompensatie project in KH/MM?

Question 4: How would you describe, in general, your experience working with/being involved with the nature compensation project in KH/MM?
Hoe zou u, in het algemeen, uw ervaring beschrijven betreffende het werken met/beïnvloedt worden door het natuurcompensatieproject in KH/MM?

Steps 1-3 of the ESRIA are focused on scoping

Steps 1 and 2 center around identification and prioritizing of the relevant ecosystem services

1) Identifying of relevant drivers of ecosystem change associated with the nature compensation project (DPSIR)

Question 1.1 : Do you think the area KH/MM is rich in nature? If yes, can you imply in which way you suspect this or know this? (indicator species?)

Denkt u dat het gebied KH/MM rijk is aan natuur? Indien ja, kunt u speciëren waaraan u dit vermoedt of van waar deze kennis komt?

Question 1.2 : Does the nature in the area supply any services to you or others? If yes, can you identify some of these services delivered by the area KH/MM?

Levert de natuur in KH/MM ook diensten? Indien ja, kunt u een aantal van deze diensten identificeren?

Question 1.3 : Are there external drivers present in the area of KH/MM causing pressure on the nature of the area? Which ones?

Zijn er externe drijfveren aanwezig in het gebied KH/MM die druk uitoefenen op de aanwezige natuur? Dewelke?

Question 1.4 : Is nature pressurized in the area KH/MM?

Staat de natuur onder druk in het gebied KH/MM?

Question 1.5 : What is the state of nature in the area KH/MM?

Wat is de staat van de natuur in het gebied KH/MM?

2) Identifying potentially impacted ecosystems, ecosystem services and stakeholders (DPSIR)

Question 2.1 : Are there ecosystem services you can identify been impacted in the area KH/MM?

Worden ecosysteemdiensten beïnvloedt in het gebied KH/MM?

Question 2.2 : Is stakeholder impact linked to ecosystem/ecosystem service impact?

Worden stakeholders beïnvloedt door impact op het gebied KH/MM?

Question 2.3 : Were you as a stakeholder either positively or negatively influenced by the impact on the area KH/MM?

Heeft u als stakeholder invloed ondervonden van eventuele impact op het gebied KH/MM? Waren deze invloeden positief of negatief voor u?

3) Assessing dependence of the nature compensation project on ecosystem services

Question 3.1 : Do you feel as a stakeholder you had the opportunity to influence or contribute to the nature compensation project?

Heeft u het gevoel als stakeholder te kunnen bijdragen tot het natuurcompensatieproject?

Question 3.2 : Are there certain ecosystem services which were present before the nature compensation project that were beneficiary to you?

Zijn er enige ecosysteemdiensten die aanwezig waren voor het natuurcompensatie project die u voordelig beïnvloedden?

Question 3.3 : If yes, to question 3.2, is this ecosystem service still present in the current state of the area KH/MM?

Indien ja op vraag 3.2, is deze ecosysteemdienst nog steeds aanwezig in de huidige situatie?

Question 3.4 : Were certain ecosystem services influencing the trajectory of the nature compensation project?

Hadden sommige ecosysteem diensten een invloed op het verloop van het natuurcompensatieproject?

Question 3.5 : In reverse, did the nature compensation project influence certain ecosystem services?

Omgekeerd, heeft het natuurcompensatieproject een invloed gehad op eerder aanwezige ecosysteem diensten?

Question 3.6 : Was your input requested when planning for the naturecompensation project was made? Were stakeholder preferences taken into account?

Werd uw input gevraagd toen de plannen voor het natuurcompensatie project werden opgemaakt? Werden de voorkeuren van stakeholders in rekening gehouden?

Question 3.7 : In your opinion, do you feel the nature compensation project contributed natural value to the area of KH/MM?

Naar uw mening, heeft het natuurcompensatie project natuurlijke waarde toegebracht in het gebied in KH/MM?

Steps 4 - 6 of the ESRIA are focused on impact analysis

1) Assessing ecosystems and their supply and contributions to stakeholders before the nature compensation project

Question 1.1 : Were you as a stakeholder of the naturecompensation area influenced positively or negatively by the present ecosystem services before the nature compensation project? If yes, which ecosystem services and in which way would this unfold?

Werd u als stakeholder van het natuurcompensatie project positief of negatief beïnvloedt door de aanwezige ecosysteemdiensten voor uitvoering van het natuurcompensatieproject? Indien ja, dewelke en op welke manier?

Question 1.2 : Can you identify the main contributions of the ecosystem services in the area KH/MM before the nature compensation project?

Kunt u de hoofdzakelijke bijdragen van de ecosysteemdiensten identificeren van het gebied KH/MM in de periode voor de uitvoering van het natuurcompensatieproject?

Question 1.3 : If you could have had a say, which supply or contribution would you have liked to have received for ecosystemservices from the area KH/MM?

Mocht u zelf kunnen kiezen, welke levering of bijdrage zou u gewild hebben afkomstig van ecosysteemdiensten van het gebied KH/MM?

2) Estimating of foreseeable ecosystem services and their contribution to stakeholder well-being in absence of the nature compensation project

The expansion of the Zee Brugge harbor caused the need for nature compensation.

Question 2.1 : If nature compensation did not occur, how do you believe would the ecosystems of the area KH/MM might have changed?

Mocht natuurcompensatie niet zijn doorgevoerd, op welke manier denkt u dat ecosystemen in het gebied KH/MM zouden veranderd zijn?

Question 2.2 : If nature compensation did not occur, do you believe certain ecosystem services would have been influenced? Which ones?

Mocht natuurcompensatie niet zijn doorgevoerd, denkt u dat ecosysteemdiensten die geleverd werden door het gebied zouden beïnvloedt worden? Indien ja, dewelke?

Question 2.3 : If nature compensation did not occur, do you believe you as a stakeholder would have been influenced? In what way?

Mocht natuurcompensatie niet zijn doorgevoerd, denkt u dat u als stakeholder hierdoor beïnvloedt zou geraakt zijn?

3) Assessing the impact of the nature compensation project on supply of priority ecosystem services regarding the well-being of stakeholders

Question 3.1 : Right now, with nature compensation already taken place, do you as a stakeholder feel an improvement or deterioration of ecosystem service supply?

Sinds de doorvoering van het natuurcompensatieproject, ondervindt u als stakeholder een verbetering of verslechtering van de levering van ecosysteem diensten?

Question 3.2 : Are you as a stakeholder more impacted by ecosystem services since the nature compensation project was implemented?

Bent u als stakeholder meer beïnvloedt door ecosysteemdiensten sinds het natuurcompensatieproject werd doorgevoerd?

Question 3.3 : Do you believe the performance of the nature compensation project depends on the ecosystem services that are now installed?

Denkt u dat de prestatie van het natuurcompensatieproject afhankelijk is van de momenteel aanwezige ecosysteemdiensten?

Question 3.4 : Do you generally consider this nature compensation project successful? If no, what would you like to see changed in order for you to perceive the project as successful?

Beschouwt u over het algemeen het natuurcompensatieproject als succesvol? Indien nee, wat zou u graag veranderd zien opdat u het project als succesvol kunt beschouwen?

Appendix II: participant information letter

Participant information letter

Dear Sir / Madam,

We ask you to participate in a scientific study '*Defining and measuring the success of nature compensation: a case study of the Kwetshage – Meetkerkse Moeren project*'. Participation is voluntary. In order to let you join, we do need your online permission.

Before you decide whether you want to participate in this research, you will be informed about what the research entails. Read this information carefully and ask the researcher to explain if you have questions. *You can also ask the principal investigator, who is mentioned at the end of this letter, for additional information.*

1. Purpose of the research

The purpose of this thesis research is to define a way to express success in nature compensation. Firstly, a way of defining the success of a nature compensation project is searched for. Secondly, a method or benchmark for the determination of success in nature compensation projects is investigated. This will both be applied to the case study of the nature compensation project in Kwetshage-Meetkerkse Moeren. The thesis research is performed in two phases.

- In the first phase, an emphasis is put on the question which criteria define the success of nature compensation areas for stakeholders. Stakeholders who will be included are resident farmers, citizens, municipalities, research institutes (INBO, Natuur en Bos), NGOs (Natuurpunt), the port company (MBZ), and the Flemish Government.
- After identification of the main criteria for success of nature compensation, in a second phase, the criteria that were identified will be measured/evaluated for the chosen areas. Based on these measurements and evaluation, the success of the nature compensation project in Kwetshage-Meetkerkse Moeren can be determined.

2. Background of the research

The expansion of the port of Zeebrugge, Belgium, led to the destruction of valuable and protected nature areas, which provided a range of ecosystem services. The area of Kwetshage - Meetkerkse Moeren was designated as a nature compensation area. In total, 362 ha of nature compensation was executed to compensate for the expansion of the port of Zeebrugge. Two of the sub-areas that were chosen are the area of Kwetshage and the area Meetkerkse Moeren. In practice it has been shown that nature compensation is often more complicated than expected at first, because of logistic reasons and regulations. Also, there is no agreement that states what it means for a nature compensation project to be successful. There is a need for a definition of 'success' and a method or benchmark that can be used in order to determine the success of a nature compensation project.

3. What participation means and what is expected of you

Participants of this research are stakeholders of the nature compensation project. Participation entails an interview that will take between 30 to 90 minutes. During this interview, questions about the participant's knowledge of and experience with the project will be asked. The interview is semi-structured and can be recorded if this is approved by the participant.

4. Possible advantages and disadvantages

Not specified.

5. If you do not want to participate or want to stop the research

You decide whether you will participate in the research. Participation is voluntary. If you do not want to participate, this does not have any negative consequences for you. If you do participate, you can always change your mind and quit, even during the research, by verbally expressing this. You do not have to explain why you quit. The data collected up to that moment may be used for the research.

6. End of participation

Your participation in the research ends when the interview has been finished. The entire research is finished when all participants are ready.

After processing all data, the researcher will inform you about the most important results of the research. The research will be reported in the form of a MSc Thesis. This happens approximately in June 2024, after your participation.

7. Use and storage of your data

For this research, no demographic/personal data/contact information is collected, used and stored. The collection, use and storage of your data is necessary to answer the questions posed in this study. The results of the research will be shared with Dr. Jean Hugé. The data cannot be traced back to you in reports and publications about the research.

Data can also be shared with other researchers to conduct further research. The data that will be shared does not contain any information that can be traced back to you. Further research does not hold any consequences and will be fully anonymous.

Confidentiality of your data

The collected contact information will be deleted once they are no longer needed.

Access to your data for control

In order to be able to assess whether the investigation has been carried out in a reliable manner, members of a visitation committee can inspect the *[locked]* information.

Duration of data storage

Your data must be kept for 10 years by the Open University.

More information about your rights when processing data

For general information about your rights when processing personal data, you can consult the website of the Dutch Data Protection Authority. The privacy disclaimer of the Open University can be found at www.ou.nl/privacy.

9. Do you have questions?

If you have any questions, please contact Sara Degrande on natuurcompensatie@ou.nl

10. Signing the consent form

If you have had sufficient time for reflection, you will be asked to decide on participation in this study. By your written consent you indicate that you have understood the information and agree to participate in the research. Both yourself and the researcher receive a signed version of this consent statement.

Appendix A: contact details

Researcher: *Sara Degrande*

natuurcompensatie@ou.nl

Principal investigator: Jean Hugé

Jean.hugé@ou.nl

Complaints: *1-loket Klachten en geschillen*

Data Protection officer of the institution: ***ms. S.E.M. (Saskia) van der Westen LLB***, e-mail: FG@ou.nl,
telephone: 045- 5762431

For more information about your rights: www.ou.nl/privacy

Appendix III: Online informed consent

Online informed consent

I give permission for the data that is collected during this study to be used for this scientific research.

I have read / received the information brief related to this study and I have had the opportunity to ask questions to the researcher if certain points were not clear.

I understand that all the information that I supply in relation to this study will be collected in a safe manner, will be published anonymously (if applicable) and therefore will not lead back to me.

I understand that I can pull out of the study at any time and I do not have to provide a reason for doing so.

the data is stored for a period of 10 years, in accordance with the VSNU guidelines

If you have read the above points and agree to participate in the study please digitally sign this consent form below by inserting today's date

Appendix IV: List of codes

Characteristics area
contribution to nature compensation
Current ecosystem
Demographics
direct impact
duration
indirect impact
involvement
nature compensation intent
original ecosystem
policy measures
valuation success
value addition
value subtraction