

Executive summaries

Regional Integration Project

Global Sustainability Science

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General introduction

In the 1st year course 'Regional Integration Project' students from the bachelor 'Global Sustainability Science' studied a wide range of topics regarding sustainability issues on Texel. The four overarching themes were (1) Nature management and recreation, (2) Water and Salinity, (3) Imagining futures for Texel and mobility, and (4) Renewable Energy. The students applied mixed-methods and studied ecological aspects and social aspects underlying these issues. In this document, you can find executive summaries of the obtained results.

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1: Nature management and recreation

1A: Tourism and nature management

1A: Balancing Tourism and Agriculture for Nature Preservation on Texel: Insights from Local Stakeholders

This research project on Texel examines the interplay between tourism and agriculture and its impact on nature preservation. Texel is known for its biodiversity and as a crucial stopover for migrating birds. It attracts about one million tourists annually, significantly impacting the local economy and environment. The impacts from both tourism and agriculture present challenges and opportunities for sustainable development.

Using qualitative methods, including interviews with farmers, government officials, and nature managers, this study aimed to uncover stakeholders' perspectives on the interlinkages between tourism, agriculture, and nature conservation. Tourism serves as a major economic driver, providing significant revenue and seasonal jobs, while also benefiting farmers by creating a market for local products. However, agriculture, which covers around half the island, faces challenges such as soil salinity, limited expansion opportunities, competition, and interest from outside actors.

The environmental impact of tourism and agriculture was also highlighted. Tourism increases traffic and habitat disturbance, particularly affecting bird species. While agriculture supports soil health through livestock grazing, conversely intensive farming practices degrade the ecosystem. Stakeholders proposed solutions to mitigate these impacts, including the development of multi-functional farms that integrate tourism with agriculture. These farms could include farm shops, camping sites, and educational tours, thereby diversifying income while promoting nature conservation. As well as financial compensation for farmers engaged in nature preservation, controlling tourist access to sensitive areas, and implementing a tourist tax to fund sustainable initiatives were suggested.

Collaboration emerged as a crucial theme. Effective collaboration between farmers, tourism operators, and conservationists is essential, with agritourism highlighted as a potential strategy to support local farmers and educate visitors. Involving the local community in decision-making processes ensures their interests are considered, and importantly that they are taken into account as well. The future requires fostering a sustainable balance between economic drives and environmental preservation.

To address the challenges and opportunities of tourism and agriculture on Texel, several policy recommendations are proposed. Establishing financial incentives for farmers engaged in nature management such as grazing protected areas, is essential. Compensation could support sustainable farming and nature preservation efforts.

Enhancing infrastructure to manage tourist traffic can mitigate adverse effects on natural habitats and agriculture. Promoting agritourism will boost the local economy and educate visitors on sustainable practices, while developing multi-functional farms can enhance agricultural sustainability.

1B: Views on nature

1B alpha: How do the inhabitants and tourists of Texel perceive nature?

This research report investigates the extent to which Texel inhabitants and tourists consider intentionally human-modified nature on the island to be still a natural environment. Considering that Texel is famous for its nature, which is the main draw for tourists and crucial for the island's economy, it is relevant to examine how much humans can modify natural environments before they are no longer considered natural, and what values are to these. The findings and given policy recommendations can aid policymakers, urban planners, and civil engineers, among others, with understanding which areas are considered natural and how much these areas can be altered without causing dissatisfaction.

Previous literature has shown that there is not one definition of nature, however, according to most definitions found, humans are considered separate from nature (Cambridge Dictionary, n.d; Corner et al., 2013). This research uses the term "intentionally human-modified nature" to refer to environments altered by human activities for purposes such as ecosystem services or conservation: examples on Texel include farms, bird breeding areas, and human-made dunes. Vining et al. (2008) found that while people often see themselves as part of nature, they generally do not consider human-modified environments as natural. Castree and Braun (2002) identified three definitions of nature: external (separate from society), intrinsic (valued for itself), and universal (including humans). These help understand whether people view modifications as natural or unnatural.

A survey, with both open-ended and closed questions, was conducted on Texel to gain insights into the perceptions of human-modified nature. This study specifically examines how demographics such as age, employment, origin, and living conditions influence the perception of "human-modified nature"; what is the value attributed to it compared to "natural" environments; and whether humans are considered an integral part of nature.

Findings reveal that both Texel residents and visitors value nature for its beauty and biodiversity, rather than for practical uses. This suggests that they hold an intrinsic view on nature and consider intentionally human-modified areas on the island to be natural, as long as these modifications do not visibly serve human purposes and maintain a natural appearance. This leads to the following policy implications:

1. Human modifications on nature, for ecosystem services or conservation, should consider the perceptions of inhabitants and tourists, and therefore, maintain the aesthetic and biodiversity values of natural environments.
2. Tourism strategies should focus on showcasing the natural beauty of Texel's landscapes while carefully managing nature where necessary.

By aligning conservation policies with the intrinsic values, Texel can ensure the sustainable enjoyment and preservation of its natural environments.

1B beta: Views on Nature of Texel residents and tourists

This study is done on the views on nature of both residents and tourists on Texel. For this study the following research question was set up: 'What factors correlate and differ with the view on nature of the Texel residents and tourists?'. The study was conducted by surveying residents and tourists in Texel. This survey contained demographic questions about status, age, gender,

religion, and occupation and questions where people were asked to rate specific pictures on their naturalness. Before this survey was conducted, a literature review was done. The main findings of this literature review were that previous research had found that gender and age could have an effect on the view of nature, while factors like religion, status, and occupation either had no pre-existing research or the research found no correlation. The survey was conducted in three locations on Texel, where both residents and tourists were asked to fill in the survey, which led to 97 completed surveys to analyze. The main findings of the survey showed a difference between age groups, as the participants from age 55 and up rated nature higher than the participants from lower age groups. Other results showed that there is a difference in views on nature between religion; specifically between the non-religious and catholic groups. No difference was found between gender groups, however, this was not in line with previous researched literature. This was the same for the results of the occupation and the status demographics, yet for these demographics, there was no previous research to compare. These results lead to the conclusion that contradictory to our hypothesis the demographics of age, occupation, and status do not affect how people view nature. At the same time, the hypothesis that gender and religion affect the view of nature could be accepted.

From the collected information some policy recommendations were set up, these policy recommendations were created to help the municipality of Texel improve their policies and help the connectedness with the residents and tourists. With these improvements in mind, the following policy recommendations were set up:

- I. We recommend increasing the involvement of individuals from various age groups in decisions surrounding nature management.
- II. Increase the involvement of the tourists in the decision-making process of nature management.

1C: Views on birds paradises on texel

1C alpha: Bird paradises, utopia or dystopia? A study on the perception of Texel's residents and tourists on bird breeding conservation areas

This research report investigates the perception of Texel's residents and tourists regarding the bird breeding conservation areas, in terms of their effectiveness in attracting tourism and their significant trade-offs in land use. In more detail, the study will help to highlight whether the ecological and socio-economic benefits of the artificial breeding sites outweigh drawbacks in the context of land management conflicts.

The data was obtained through a survey created on Qualtrics Survey and was made available in an online and paper version in Dutch, English, and German. The survey included closed and open questions to obtain quantitative and qualitative data. The data collection targeted both residents and tourists through a direct, personal approach. The collection was conducted over the span of three days in May 2024 at various locations on Texel. The data analysis was performed using JASP and Microsoft Excel. The quantitative data was represented through charts and tables, while the qualitative data was translated, coded, and categorized. The data that was obtained through the survey showed insights into the perception of residents and tourists. A total of 93 respondents participated in the survey, of which the majority were residents. The residents showed a higher level of familiarity with the areas compared to tourists. Interestingly enough, the data showed that most respondents, regardless of their affiliation, viewed the conservation areas as important to extremely important. Furthermore, both residents and tourists have similar perceptions on the

social and ecological aspects of the conservation areas. However, there was a divergence in opinions regarding the economic benefits of the areas. Both residents and tourists showed a strong preference for maintaining the current bird conservation areas over other types of land uses. The majority agreed that the benefits of the bird breeding conservation areas outweighs the trade-offs that it has for other types of land use. The qualitative data revealed diverse opinions on the optimal situation for the conservation areas, as some respondents viewed the current situation as ideal, others advocated for increased protection and conservation efforts, and some suggested alternative management strategies.

This research report can provide useful suggestions for stakeholders involved in the decision-making process targeting the management of bird breeding conservation areas, stating the importance of reaching a balance between local communities, tourism, nature conservation organization and government figures. It could serve as a starting point for future research that should focus more deeply on ways to implement strategies that take into consideration the diverse interests of different stakeholders at play, focusing not only on the desired ecological benefits, but also ensuring socio-economic benefits for the communities living on Texel.

1C beta: Views on bird paradise Utopia on Texel

Birds are very important for ecosystems; they spread seeds by their feces, help keep the mouse and rat populations under control, and are used to study the impact of toxic substances (Ifaw, 2023). On the island of Texel, there can be found over 300 types of birds from which about 80 species are breeding there (Birding brakes, n.d.). A very important factor for this richness in birds on Texel is the migration route of birds. Most bird species tend to migrate along the coastline where they pass Texel (Binsbergen, 2004). One significant bird breeding site on Texel is Utopia. This is a protected area shielded by a dike, offering safe breeding grounds for birds, especially during high tides and storm surges (Natuurmonumenten, n.d.). The increasing threat of sea-level rise due to climate change emphasizes the importance of such protected sites.

However, public opinions on the Utopia breeding site vary. Some view it as a valuable addition to the island's natural heritage, while others believe the area could be used more effectively. To explore these differing perspectives, we came up with the main research question: How do socio-economic factors correlate to people's views on the artificial breeding site Utopia in Texel? Supporting the main research question, our group has formulated several sub-questions; How does profession influence the view on the artificial breeding site Utopia in Texel? How does age correlate to the view on the artificial breeding site Utopia in Texel? How does income correlate to the view on the artificial breeding site Utopia in Texel? How does gender correlate to the view on the artificial breeding site Utopia in Texel? This research aims to analyze the community's attitudes towards the Utopia breeding site and understand the socio-economic factors that shape these views. By doing so, we hope to inform future policy decisions and conservation strategies that balance ecological preservation with community interests.

For this research, we sampled individuals from Texel's population by utilizing an online survey method. The survey included questions related to socio-economic factors such as age, income, profession, gender and residence. Moreover, it also contains questions about participants' views on the Utopia birds breeding site. We distributed the survey over three days at several locations in Texel. Quantitative analysis was employed to measure variables, with statistical tests including the Chi-Square test to assess correlation and difference between socio-economic factors and views on Utopia.

Our findings yielded a significant correlation between differences between occupation sectors and views on Utopia. Office workers showed the highest preference for the breeding site, supporting our hypothesis that socio-economic factors influence views on Utopia. However, no significant differences were found between gender, age, income, residency on Texel, and views on Utopia. This could be caused by limitations such as language barriers, sample size inaccuracies, and potential sample bias. Future research should address these challenges and consider a more comprehensive method. In conclusion, our research identified a clear correlation between the occupation sector and views on the Utopia breeding site. Office workers exhibited the strongest preference for Utopia, suggesting the need for conservation efforts and policy initiatives. Further research is needed to address limitations and improve our understanding.

1D: Herbivores and biodiversity

1D alpha: Grazing management strategies and plant diversity in the Slufter

Salt marshes are dynamic ecosystems influenced by tides. Therefore, these ecosystems have both marine and terrestrial features. The Slufter's management strategies aim to preserve its unique biodiversity, currently employing natural management approaches involving cows and horses. However, horse grazing has proven to be less effective, decreasing biodiversity by trampling. This highlights the importance of adopting appropriate management strategies. This research examines the advantages and disadvantages of various management strategies on plant species diversity. The research question addressed is: How do different grazing management strategies affect the vegetation diversity of the Slufter's ecosystem on Texel?

The fieldwork was managed through a quantitative comparative research method, examining herbivore grazing versus non-grazing management across 45 plots, in the northern and southern parts of the Slufter. At each sampling point data on vegetation species richness, abundance, height and vegetation cover was collected using a quadrat sampling tool [Figure 5]. Additionally, elevation differences were mapped in QGIS, and biodiversity rates were calculated using the Shannon Diversity Index [Figure 6]. Data analysis was conducted using JASP to explore relationships between variables.

During the research indicators of cows, horses, geese and rabbits were observed. Grazed plots had more species per plot and higher mean differences in vegetation cover compared to ungrazed plots. Statistical tests showed no significant differences in Shannon-Wiener diversity and vegetation height between grazed and ungrazed areas, but significant differences in species number and vegetation cover. Different grazing types have a significant impact on the number of species and the vegetation cover. Similarly, salt marsh zones also showed significant differences in species number and vegetation cover.

Limitations of this research include the lack of success in contacting Staatsbosbeheer to obtain information about large herbivore habitats. Additionally, the assessment of vegetation cover and species varied due to interpersonal variation. Identifying which herbivores graze the plots presented another challenge. Furthermore, the results were not tested for confounding factors, like sea and soil conditions. Lastly, the study was not experimental, so causal relationships could not be identified.

In conclusion, herbivory in the Slufter's ecosystem does not affect species diversity or height, but it does influence vegetation cover. Overall, grazed plots had a higher average vegetation cover,

but horse grazing is associated with lower vegetation cover compared to other herbivores. Similarly, the number of species varies between grazing management and non-grazing management. Moreover, significant differences in vegetation cover and species numbers were noted across different salt marsh zones, like dunes and middle/high marshes. These findings provide stakeholders with valuable insights to make well-considered decisions on grazing management strategies, land use, conservation strategies, and recreational activities.

1D beta: Herbivores and their influence on vegetation on Texel

This study was conducted on the island of Texel, located in the Wadden Sea. Texel has a great variety of landscapes, but this research report focuses on coastal dune areas and their vegetation. The report looks to answer the question: 'What effect do different herbivorous species have on the vegetation of dunes in Texel?'. Existing research has focused on general grazer impacts in the Wadden Sea and North Sea but lacks specific insights on different species' effects. This study seeks to fill that gap.

Two different areas that are being grazed on by herbivores and one test site without grazers were used for this research. De Geul had cows and sheep, De Bollekamer had cows and horses and Bleekersvallei served as a control location. Our main subjects of interest were plants species richness, ground coverage, and vegetation height. The area with cow and sheep activity had the highest plant species richness and the highest vegetation height. The area with cows and horse activity had the second highest species richness, while the control area had the lowest. For ground cover, all three locations had an average ground cover higher than 80%. It must be considered that only the results for species richness were found to be statistically significant.

The research showed that a combination of sheep and cows leads to the highest plant species richness, making it more effective than using a combination of cows and horses. A lack of herbivores led to low species richness and is thus the least effective. No statement can be made about the vegetation height and ground cover since the tests were determined insignificant.

The research aims to come up with effective management strategies for coastal areas that can be implemented on Texel but might also be effective for different coastal dune areas outside of Texel and possibly outside the Netherlands. These management strategies are becoming more important as a result of rising sea levels and increased occurrence of coastal erosion. Understanding the effects of herbivory as a management tool is crucial not only for coastal management but also for biodiversity, plant succession, nutrient cycling, and ecosystem dynamics.

The results of this research show that letting cows and sheep graze freely in the dune areas is a sustainable and effective way of strengthening coastlines. This form of management is not necessarily bound to Texel and can thus be implemented in other coastal areas.

1E: Forest management and biodiversity

1E alpha: Effect of rewetting degraded peatland on plant biodiversity in De Dennen

Biodiversity is globally rapidly declining due to human activities. One potential restoration method currently under research involves rewetting drained areas and restoring peatlands. The island of Texel, situated in the Wadden sea, is home to a forest De Dennen, which was previously a peatland until the area was drained. Nonetheless, a part of De Dennen was rewetted in the early

2000s which might have affected the biodiversity. Therefore, this paper aims to assess the impact that rewetting has on the biodiversity of the rewetted area with that of a similar, drained area in De Dennen. This will be done through exploring the difference between the plant biodiversity in the rewetted and drained areas of De Dennen on Texel as well as examining how plant biodiversity relates to the distance from rewetted surface water bodies.

It was important to define biodiversity for this research. In this case, species diversity was investigated, this encompassed finding the number of different species in a specific part of Texel. This was done by measuring the relative abundance (evenness). The species data was analysed with the Shannon-Wiener index. To address the research question, the mean of the Shannon-Wiener index of all quadrats within the rewetted and drained area were calculated and compared with one another.

The gathered results have resulted in the following conclusions being drawn, firstly, biodiversity is higher in the rewetted area in De Dennen than the drained area, based on a significant difference in the Shannon-Wiener index between the drained and rewetted area. Secondly, there is a significant moderate negative correlation between plant biodiversity and the distance from surface water bodies.

Plausible policies to be implemented include those promoting the restoration of drained areas through rewetting, to aid biodiversity conservation. This recommendation is supported by the gathered results and could be applied globally, with governments responsible for implementation and potential financial compensation for land use changes. Each case could be evaluated individually to determine whether the land's current use can be feasibly replaced with rewetting of the area instead. Additionally, a complementary policy would involve developing regulations to encourage research and monitoring of rewetted areas globally. This would help assess the long-term impact of rewetting on biodiversity, ecosystem health, and local communities, particularly its effects on agriculture, tourism, and land use. Furthermore, large-scale studies are needed to investigate these long-term effects, given that the carried-out research was very small scale.

1E beta: Invertebrate Biodiversity in Rewetted and Non-Rewetted Areas in De Dennen on Texel

This research explores the relationships between forest properties and soil invertebrate diversity within the forest De Dennen on Texel, specifically focusing on the differences between rewetted and non-rewetted areas. The main research question guiding this research is: How do forest properties correlate with soil invertebrate diversity in rewetted and non-rewetted areas within the targeted forest section of De Dennen?

The practice of rewetting is the restoration of natural hydrological conditions in previously drained or degraded ecosystems. The efficiency in improving invertebrate biodiversity within this forest ecosystem is being analysed. To address this, the research conducts an analysis considering measurements of various forest properties. This is done by measuring the soil temperature, moisture, pH, EC, plant cover and the number of invertebrates species.

The findings reveal trends between forest properties and soil invertebrate diversity. It shows that lower soil nutrient concentrations corresponded with higher soil invertebrate diversity in rewetted areas. This was shown by a decreased pH value and an increased electrical conductivity (EC) value. However, non-rewetted areas showed a contrasting relationship, suggesting a connection

between high soil nutrients and high invertebrate diversity, which is influenced by management practices.

Furthermore, the analysis of plant cover demonstrated varying connections. An increase in plant cover was linked with higher invertebrate diversity in the rewetted areas, while the opposite was observed in the non-rewetted areas. This shows the importance of considering habitat preferences of soil invertebrates and the different impacts of forest management strategies on biodiversity. In addition to this, soil moisture appeared to be a significant factor. Showing a positive trend with invertebrate diversity, especially in non-rewetted areas. This underlines the important role of water management in the biodiversity within forest environments. The following recommendations are suggested for stakeholders involved in forest management and conservation efforts:

1. Given the varying impacts observed in rewetted and non-rewetted areas, there is a need for reconsideration of the effectiveness of rewetting as a biodiversity restoration technique in the forest area De Dennen.
2. Implementing forest management strategies that consider soil nutrient levels, plant cover, and soil moisture can optimize biodiversity conservation and ecosystem resilience.
3. Acknowledging the limitations in data quantity, further research is recommended to validate findings and explore the long-term effects of rewetting on biodiversity.

In short, this research shows the connectedness between forest properties and soil invertebrate diversity and highlights the importance of adaptive forest management approaches in sustaining the soil invertebrate diversity in the forest ecosystem of De Dennen on Texel.

1F: Nature management and carbon storage in forests

1F alpha: Maximizing Carbon Storage in Texel forests Research Report

This executive summary provides an overview of a research study on the maximization of carbon storage on Texel. The main research question is “How can carbon storage be maximized in forests on Texel?”. This has been divided into two sub questions “How does distance from the sea influence carbon storage of De Dennen and the Krimbos?” and “How does the difference in age of the two forests influence carbon storage?”. This research aims to understand the effects of sea winds by using the relation between the distance from the sea and the amount of stored carbon in trees. Also, the impact of the forest age in relation to trees' ability to store carbon is researched. Carbon storage has an important role in climate change mitigation (Nowak et al., 2013). Temperate forests are considered important carbon sinks, even though most research is focused on tropical forests (Lal & Lorenz, 2012). Additionally, there are few studies regarding sea winds and their effects while also having uncertainty about how age affects carbon storage (Lv et al., 2024). Research showed that salinity affects ecosystems in different ways (Smart et al. 2020). Therefore, coastal winds may affect ecosystems on coastal areas or islands, such as Texel. Additionally, age can be an important factor in the ability to store carbon. The data necessary for this research was collected in the forests of the Dennen and Krimbos on Texel. The circumference and genera of the trees were collected from forty plots over a three-day research period. The collected data is used in two allometric equations to calculate carbon storage. The results from the first sub question were insignificant and showed a weak correlation between the two variables ($N= 40$ plots, test statistic= -0.236, p-value= 0.142). The results from the second sub question were also insignificant ($N= 219$ trees, $w = 217.00$, $p = 0.659$). This means that the main

research question cannot be thoroughly answered, however future recommendations can be presented for future research. A change in methodology is needed so that results are more precise, such as including a control variable in the sampling methods. For example, only measuring the same tree genus or soil type etc and the many other factors affecting carbon storage should not be overlooked. Additionally, a better protocol for obtaining genus a and b parameters for allometric equations is needed to ensure accurate results in the future.

1F beta: Maximizing Carbon Storage in Texel's Forests

This research aimed to find out how carbon storage could be maximized in the forests of Texel. To assist in addressing this main research question there was a specific focus on soil type and forest age. From the literature review, the overarching effect that these two independent variables have on carbon storage was made apparent. By understanding whether the age and soil type of the forests affect carbon storage, the research question can be answered, providing a basis for stakeholders to make informed management decisions.

To give an overview of the utilized methods, the soil type and forest ages were determined before entering the field. A specific methodology was designed to create objective data sets representing trees within preselected plots. After the collection of data in the field, the recorded measurements were inputted into analysis software such as Microsoft Excel and JASP.

The study found a positive correlation between forest age and carbon storage, with older forests holding significantly more carbon. No significant difference was observed in carbon sequestration based on soil type. However, trees on sandy loam soils showed greater variation in carbon sequestration than those on sandy soils, suggesting more limiting factors in sandy soils. Additionally, a few very large trees were found to store the majority of carbon. These findings were debated in the discussion section, presenting conflicting results and further analysis.

Thus, conserving old-growth forests on sandy loam is crucial. Additionally, educating local stakeholders on the importance of old-growth forests and loamy soils can help maximize carbon storage on the island. Without community understanding, carbon storage efforts may fall short. These actions can position Texel as a leader in ecological and social sustainability

1G: Breeding birds on newly-created inland wetlands

1G: The effectiveness of Utopia in aiding birds' reproduction

Birds are of vital importance for the future of our ecosystems and that of mankind, birds do not only offer recreational pleasure for birdwatchers, they are also important for the livelihoods of people and ecosystems. Natural bird habitats are put under pressure by climate change and environmental degradation, a strategy to combat this problem is using artificial wetlands. Wetlands are the preferred breeding habitat for certain bird species prevalent on Texel.

This research compares Utopia, an artificial wetland on Texel, with other wetlands and bird breeding areas on Texel, the research question directing this research is: To what extent is Utopia effective in aiding birds' reproduction and diversity in comparison to other nature reserves on Texel? The research was conducted through on-site bird observations, where groups of observers identified the species and amount of birds on a location, observing from multiple spots around the locations. Observations took place at a total of 5 locations on Texel, specifically chosen for their similar characteristics, the observations took place during breeding season, to specifically research the breeding success of the different locations. To analyse the biodiversity of the

different locations, the Shannon-Wiener index was calculated for every measurement, this index is a measure for biodiversity. To analyse the data, different bar charts and scatter plots were used to compare different locations. To determine if there was a statistical difference, the Chi-squared test was used.

Findings showed that Utopia is a successful breeding habitat for certain birds, especially for the big sterns and black-headed gulls. It is less successful in terms of biodiversity when compared to other locations. Additional research is needed to find out exactly how effective Utopia is in providing bird reproduction and diversity. The advice for future research on this topic is to make sure that the observers are experienced birdwatchers and have an efficient way of collecting the data, so as to decrease the differences between observers and keep to the expected schedule.

2. Water and Salinity

2A: Best solutions according to entrepreneurs

2A: The Perspectives of Hospitality Entrepreneurs on the Consumption of Freshwater on Texel

This research paper revolves around an imminent sustainability problem regarding limited freshwater resources on islands, in this case, specifically on Texel in the Netherlands. Various interviews were conducted posing questions regarding the perspectives entrepreneurs in the hospitality industry have on the consumption of freshwater on Texel and whether they implemented any management strategies. Explicitly, the research question of “How do entrepreneurs on Texel perceive and address the impact of tourists on freshwater consumption?” has been interpreted.

A conceptual framework regarding the relationship between entrepreneur perspectives and strategy implementation has been utilized to structure this report and provide an insightful conclusion regarding the main research question. A series of eight interviews were conducted with various hospitality businesses on Texel, such as restaurants/bars, hotels and golf courses. This provided diverse perspectives and understandings surrounding the topic.

The results of this paper focused on three identified sections; Overarching Responsibility, Perception of Tourists, and Strategies Implemented. There were varying opinions regarding the questions asked, creating interesting results and discussion. Some emphasized the importance of media attention, and it was raised that effective communication to tourists was crucial. Opinions on the impact of tourism were mixed as certain entrepreneurs saw tourists as essential for the economy whereas others found the strain of tourists great on the island. Optimal solutions were discussed on a business level and a larger island-wide scale which varied in effectiveness. In addition, both barriers and motivation to implementing solutions were observed.

General trends as to how decisions regarding whether strategies would be implemented were observed and allowed for further discussion of implications. However, this paper is based on a series of eight interviews and the conclusions may appear situational and related to these entrepreneurs. Overall, the main recommendations for entrepreneurs would include changing infrastructure within their business and ensuring sufficient awareness is raised. Nevertheless, there is no clear solution to this paper as varying perspectives and concepts need to be considered, resulting in an interdisciplinary approach to create viable solutions.

2B: The problem of freshwater use

2B alpha: Navigating the water issues on Texel: Investigating the awareness of residents and non-residents

This study measures the awareness levels of both tourists and residents on Texel regarding the freshwater scarcity and salinisation issues that the island faces. It also aims to identify the primary sources of information for both groups which are used to keep informed on any sustainability issues on Texel. Lastly, it aims to identify the perceived roles of several stakeholders that influence the previously mentioned issues. This is done through a structured questionnaire consisting of eleven questions, with respondents from Texel itself. Using this structured questionnaire, we found that 40% of respondents are unaware of the freshwater scarcity and 55%

are unaware of the salinisation issues. With residents showing a higher level of awareness as compared to non-residents. The primary sources of information for both groups are local newspapers and social media, and tourists also rely on tourist information centres to keep informed. Most respondents believe local and national authorities should take the lead in addressing the issues at hand. Residents show a preference toward local authorities to take more action. Non-residents also show the trend to be more open towards individual action. The findings of this study can guide educational campaigns and help them identify their target audience. It was found that a larger part of both residents and tourists were unaware of the salinisation issues as compared to the freshwater scarcity that Texel faces and that non-residents showed a larger unawareness to these issues as compared to the residents of Texel, which means that the target audience should include non-residents more rather than the residents and should stress the freshwater scarcity more. It can also guide the policy measures that are to be taken to increase awareness and promote the sustainable water management on Texel. In the study it was found that a large part of the residents and non-residents still rely on the in-person channels of communication as compared to the digital channels, this means that policies should include both and not neglect one in favour of the other. Relatably, it was found that both groups think that the local authorities have the largest part to play in solving the water related issues on Texel. This finding is imperative because it highlights the sentiment of the population and can help guide the first movements of improving the sustainable water management policies on Texel.

2B beta: Perceptions on Water Usage and Awareness of Water Scarcity among Residents and Tourists on Texel

Purpose of Report

The primary aim of this report is to investigate how tourists and local residents on Texel conceptualize their water usage and to assess their awareness of water scarcity. Understanding these perceptions and awareness levels is essential for developing effective water conservation strategies on the island.

Methods Used

The study employed a mixed-methods approach, combining quantitative and qualitative data collected through a community survey. The survey was conducted in the most densely populated regions of Texel with equal participation from 34 residents and 34 tourists. The survey encompassed both closed-ended and open-ended questions to gain an understanding of perceived water usage and awareness of water scarcity among the respondents. Quantitative data were visualized through graphics, while qualitative data was coded and displayed in tables.

Findings and Conclusions

The study reveals that both tourists and locals on Texel self-report to having a conscious approach to their own water usage, though with notable disparities between their behaviors and awareness. Tourists tend to report shorter shower times and lower daily water use than residents, often learning about water conservation measures through social media and word of mouth. Residents, while also mindful of their water use, are more likely to be informed through local news and express a consistent interest in further learning about water conservation. Both groups recognize tourism as a significant factor affecting water usage on the island, alongside broader environmental issues like climate change and droughts. Despite these differences, there is a shared awareness of the need for water conservation, though levels of engagement and perceptions of change over time vary.

Recommendations

- Use communication tools such as social media for tourists and local news for residents to spread awareness about water conservation measures.
- Develop specific engagement strategies for short-term and long-term visitors to increase interest and awareness in water conservation.
- Increase educational efforts on the impact of climate change and droughts on water resources, linking these broader issues to local water conservation practices on the island.
- Encourage community participation in water conservation initiatives to foster a collective responsibility toward sustainable water usage.
- Implement regular surveys and other types of monitoring mechanisms to track changes in water usage habits and awareness, allowing for adaptive management of water resources.

2C: Salinity surface water

2C: Spatial distribution of salinity on the island of Texel

Understanding the spatial patterns of salinity is crucial for sustainable water management strategies in Texel. This knowledge informs targeted efforts to protect local biodiversity, as increased salinity can adversely affect native flora and fauna. Additionally, managing salinity levels is essential for maintaining the productivity of agricultural lands. This study delved into the intricate spatial distribution of salinity across Texel's surface waters. By investigating its correlation with elevation, proximity to the east coast, distance from agricultural lands, and various types of water bodies.

The key findings highlight a significant negative correlation between elevation and salinity levels. Areas at higher elevations generally exhibit lower salinity, likely because of reduced tidal influence and less infiltration of saltwater. Conversely, no significant correlations were observed between salinity and distance from the east coast or distance from agricultural areas. This lack of correlation may stem from the complexity of factors influencing salinity dynamics or the limitations of available data. Moreover, the study found no substantial relationship between salinity levels and the type of water bodies; lakes, ditches, or canals. These results underscore the diverse and nuanced factors at play in salinity distribution within Texel's water systems. Several limitations in the study's methodology were acknowledged. These include the reliance on a relatively small number of sampling locations. Furthermore, the potential inaccuracies in depth measurements that may not always capture the deepest points of water bodies. Additionally, the omission of variables such as rainfall patterns, wind direction, and atmospheric pressure, which can also influence salinity levels.

Based on the findings, recommendations for future research and action include expanding the scope of data collection to encompass more diverse locations and considering a broader array of influencing factors. Collaborative efforts among stakeholders including farmers, water management agencies and environmental organizations. These efforts consist of developing and implementing effective strategies for mitigating salinity's negative impacts.

Furthermore, continuous monitoring of salinity levels is advocated to track changes over time and facilitate adaptive management practices. Monitoring is crucial for ensuring the long-term health

and resilience of Texel's water resources. Particularly, nowadays with the potential environmental shifts and anthropogenic pressures.

In conclusion, this research contributes to advancing our understanding of Texel's water dynamics. It lays a foundation for developing sustainable practices that safeguard the island's ecological integrity and support its communities in adapting to evolving environmental challenges.

2D: Water and biodiversity

2D alpha: The effects of salinity on biodiversity of terrestrial plants on Texel

The research presented in this paper focuses on the possible relationship between biodiversity and salinisation. Global climate change and its increasing temperatures affect the salinity levels of areas everywhere on Earth. This increased salinisation could potentially affect the biodiversity in these areas. In this research, the potential correlation between salinity and biodiversity has been studied on the island of Texel, with the main research question: How does the salinity in water bodies affect the nearby terrestrial plant biodiversity across areas with different water body types based on the European Water Framework Directive (EFWD) (2000/60/EG) on Texel?

The approach for collecting the data on Texel was by sampling the salinity levels, slope, and temperature of eight waterbodies with duplicate samples across three different areas. Then, next to each of these bodies of water within 1 metre, the biodiversity was measured. This was done by placing a quadrant of 0,5*0,5 m randomly, counting the number of species, and estimating the cover percentage within this quadrant. The plant species in these quadrants were identified, and the number of individuals of these species was counted and written down.

The main findings of the research endeavour to answer the main research question and its subquestions. Most results showed weak and insignificant correlations. The most relevant correlation found was between water temperature and salinity levels. Comparing these two variables showed a moderate correlation ($\rho = 0,518$) with p

2D beta: Salinity and Plant Biodiversity on Texel

1.1 Introduction

On the island of Texel, the Netherlands, there are distinct environmental challenges presented by factors such as rising sea levels and saltwater intrusion. One of these challenges is the plant biodiversity around Texel's water bodies. This research aims to investigate the correlation between salinity and plant diversity on Texel. The main research question is: What is the effect of water bodies' salinity on plant biodiversity on Texel? Understanding this relationship is crucial for developing management strategies that can help conserve and promote freshwater ecosystems because they are important for ecological health and biodiversity.

1.2 Key findings

Multiple important findings have come out of this research. The first finding is that there is a moderate negative correlation observed between electroconductivity of the soil (which is a measure of salinity) and richness of plant species. This suggests that when salinity increases, plant diversity declines. Secondly, a moderate positive correlation between electroconductivity of the water bodies and plant diversity is observed. A possible explanation for this is the presence of salt-tolerant species. Furthermore, the research shows spatial variations in salinity across

Texel, with higher salinity levels on the eastern side in comparison to the western side of the island. The last key finding that is worth naming is that lower pH values negatively impact plant diversity.

1.2 Research limitations

This research does have a few limitations that are to be addressed. Foremost, the generalizability of the research findings might be limited because the sample size is relatively small, namely 21 samples. Another limitation is that the nitrogen compounds (nitrate and nitrite), which can influence salinity and plant diversity, could not be measured due to complications (faulty strips). Lastly, this research is limited because the plant diversity was measured around the water bodies and not in the water bodies.

1.3 Recommendations

Further research recommendations, management/conservation strategies, and policy changes:

- To confirm the findings of this research and to explore the influence of other environmental factors on plant diversity further research that includes the following methods is recommended:
 - A larger sample size.
 - o Nitrogen compound-, sediment composition-, and water depth measurements
 - Measure plant diversity directly from the water bodies. (To provide a more precise picture of how salinity affects plant diversity across different habitat types.)
 - The geographic distribution of salt and freshwater bodies suggests a potential influence of prevailing winds and ocean currents on the salinity patterns. Further research could investigate these factors.
- Management strategies should consider the salinity levels of specific water bodies to create conditions favourable for diverse plant communities. Strategy recommendations consist of:
 - (Re)planting native plant species in impacted areas by changed salinity levels.
 - Creating buffer zones around freshwater bodies using these salt-tolerant plant species. (To mitigate saltwater intrusion.)

2E: Geese induced eutrophication in dune lakes

2E alpha: To What Extent Do Geese Feces Influence Water Quality and Eutrophication?

The purpose of this research paper is to investigate the relationship between the issue of dune lake eutrophication on the island of Texel, and how geese populations on the island are related to this problem. This leads to the main question, which is- to what extent are they responsible for eutrophication and affect water quality? More specifically, through literature review, we first aim to find out how geese droppings could potentially be responsible for the eutrophication of freshwater systems, in particular through their droppings. We then apply our knowledge in practice by conducting fieldwork on the Island, particularly by examining the nutrient levels in water bodies, because research has shown that wetland areas contain higher levels of nutrients such as nitrogen and phosphorous, if the bird population is more dense (Mariash et al., 2018). Ultimately, we aim to understand how these elevated nutrient levels in freshwater systems impact water quality and ecosystem health.

Eutrophication is a phenomenon of freshwater body enrichment which manifests itself in forms of excessive algae growth, and is caused by excessive concentrations of plant nutrients such as nitrogen and phosphorus (Harper, 1992). This problem has been documented as an environmental issue since the 1950s and remains to this day to be a sustainability issue, causing significant problems in water bodies, such as lakes and coastal waters. On Texel in particular, overtime, there has been an increase in geese populations, which has raised concerns about whether or not they play a crucial role in this process. On the island, we selected 15 primary water body sites and 6 backup locations all throughout Texel, to get the best overview of the entire island. We ended up visiting 12 locations. Measurements were made, including water transparency with a secchi disk, pH Levels using a pH meter, and electric conductivity with an EC meter. We then also counted the specific amount of geese species, as well as other birds on site, and including the amount of feces in the surrounding area. We then used this collected data to compare and connect our findings with existing literature in order to create links and patterns which would validate our results.

Our research has revealed a few findings and created links between eutrophication and geese populations, as well as agriculture. Most importantly, geese have not shown to significantly contribute to elevated nitrogen levels in dune lakes, nor do they create a clear link to pH levels in water. However, agricultural runoff has also been shown to be a contributor to plant nutrient levels in water ecosystems, and perhaps is more responsible for higher nutrient levels in water bodies than geese.

Several limitations such as lack and malfunction of equipment, possibilities of outside influences, such as salinity affected by sea water, and lack of period research on geese and EC, all cause difficulty drawing a singular conclusion. We can assume that geese contribute to nitrogen and phosphorus levels, however pH levels in water are due to eutrophication through algae overgrowth, and are not directly correlated to geese. When it comes to suggesting measurements, they must emphasize an interdisciplinary approach, which will create a balance between ecological, social and environmental perspectives. Focus could be placed on different parameters of eutrophication, such as dissolved oxygen and chlorophyll-a concentration. In combination with nitrogen and phosphorus levels, they can create a better picture of the level of eutrophication in a certain waterbody

2E beta: Geese-induced Eutrophication in Dune Lakes of Texel, The Netherlands

This research investigates to what extent geese faeces contribute to eutrophication in the dune lakes of Texel. Eutrophication is caused by excessive nutrient inputs into freshwater ecosystems. Geese release significant amounts of nutrients into the ecosystem, through their faeces. Eutrophication can lead to detrimental effects such as algae bloom and anoxic events (Carpenter, 2005), which reduce water quality and reduce oxygen levels in the water, leading to a higher fish mortality rate and loss of biodiversity around the dune lakes (Chislock, 2013).

To investigate the extent of geese-induced eutrophication, we conducted fieldwork on Texel, where we took samples from six different and separated dune lakes. Our goal was to sample three lakes with minimal geese activity, and three lakes with an elevated level of geese activity. At these sites, we measured plant biodiversity, water pH levels, and water visibility. To get a clear view of the impact of geese, we compared the results from the lakes with minimal geese activity with the results from lakes with more geese activity. Our findings revealed that the lakes with higher geese

activity showed lower species richness, and lower pH levels, indicating a moderate correlation between geese presence and eutrophication indicators.

However, this correlation is not strong, this is mainly due to the limited sample size, and non-significant p-values. For any future related research, the usage of a larger sample size is recommended to be able to draw a more decisive conclusion. This research does provide valuable insights into the role of geese in eutrophication in the dune lakes of Texel, and its ecological consequences.

3. Imagining futures for Texel and mobility

3A: The future as imagined by young Texelers

3A: The correlation between education and the engagement of youth on Texel

Texel, the biggest Waddeneiland of the Netherlands, is home to 13,817 residents of which 15.6% are under the age of thirty (Texel in Cijfers - Gemeente Texel, z.d.). While Texel is perceived as a nice and relaxing tourist destination, it is seen as a less convenient place for young residents to build a future. The youth on the island considers the options for their future limited, with the lack of educational opportunities as the biggest driving force. This impacts the youth's interest and engagement with the island's development. The purpose of this study is to examine whether there is a correlation between the accessibility to educational opportunities, and the way in which young residents express interest in the development of Texel. The way in which the accessibility to educational opportunities shapes the youth's engagement and interest is determined through interviews. During fieldwork on Texel, multiple interviews were conducted. The age of the interviewees ranges from sixteen till twenty-three years old, giving us a realistic look into the youth's perception of both their and the island's future. To analyse the data, the Brain Drain Conceptual Framework is used (Azad et al., 2010). This framework provided the codes for the analysis of the interviews, with accessibility of educational opportunities as the independent variable and the engagement and interest of young Texelers as the dependent variable. After the analysis, the findings revealed that limited educational options force many young Texelers to leave Texel to pursue higher education. While Texel's geographical location and early boat schedules discourage young Texelers from studying on the mainland, some young Texelers are motivated to move to the larger cities for broader educational prospects. In terms of the engagement and interest in the island, many interviewees showed a lack of knowledge and interest in sustainability challenges faced by Texel, although they did show concerns about local issues, such as littering, tourism, and drug use. As the results show great diversity, so do the implications of the findings. Firstly, establishing more diverse and higher education options on Texel may reduce the need for students to leave the island, promote stronger community bonds and increase the engagement with the island's development. Additionally, offering financial aid specifically for the youth on Texel can address the high cost of living, encouraging them to return to the island after their studies. This can help increase a lifetime-long connection with the island as well as a broader diversity of age groups on the island, leading to a more futuristic and sustainable Texel.

3B: The future as imagined by Texels hospitality sector

3B: Insights on sustainable practices, barriers and opportunities in lodging establishments in Texel

This research project explored sustainability practices within Texel's lodging industry. It focused on environmental and socio-cultural aspects, the influence of tourism seasonality, and the perspectives of lodging establishments on their current sustainability performance, challenges, and opportunities for achieving a fully sustainable tourism model.

Background

Texel's hospitality sector holds the key to a more sustainable future and the sector's choices regarding tourist experience, environmental responsibility, and social engagement will significantly influence whether Texel thrives in a sustainable way. However, implementing sustainable practices in the hospitality sector can be expensive. Therefore, researching current sustainability efforts, identifying key barriers and exploring potential opportunities is crucial.

Methodology

Our research methodology included a comprehensive literature review, and in-depth open-ended interviews conducted with employees of six lodging establishments. Using NVivo 14 software, data analysis identified key themes within the interviews.

Conclusions

Texel's lodging establishments demonstrate a growing commitment to sustainability. This was evident mainly in their efforts to conserve energy and water, and their socio-cultural involvement by supporting local communities. However, challenges remain, particularly in waste management and employment. Additionally, the data revealed financial constraints, infrastructural limitations, the seasonal nature of tourism as key barriers for further implementation of sustainable practices.

Policy Recommendations

The implementation of policies in the hospitality sector is crucial to achieving sustainability. Policies could help regulate innovation in the sectors targeted in this report. The involvement of locals, the preservation of culture, and keeping the workforce local are important steps in decreasing commute emissions and boosting the local economy. The environmental aspect of sustainable development should incorporate energy-efficient technologies, adopt water-saving measures, and improve the waste management system. Better recycling practices and a better waste collection system should be implemented. Collaboration with the municipality to improve waste processing, and waste sorting from the source are crucial. The use of local products and services would help boost the economy, reduce food miles and emissions of transportation. Access to education, financial support, and the promotion of collaboration among stakeholders can guide the hospitality sector on Texel on their journey towards a more sustainable future (Eke Eijgelaar, 2022).

3C: The future as imagined by Texel residents

3C: Tourism and the Future: A Texel Residents' Perspective

Texel has experienced a significant rise in tourism in the last few years. Tourism brings a lot of economic benefits, but it also causes challenges for the residents. This research is to identify the impacts of tourism on Texel focusing on the perspective of the residents.

For over a century, tourism has been really important for the economy of Texel. It creates jobs and boosts local businesses. Van der Duim (2004) emphasised the economic benefits and opportunities for promoting local products. But, since the 1990s, concerns about the impact on residents' quality of life have grown. Tourism affects the space and freedom of residents. The

need for sustainable tourism became clear over time. Tourism drives economic growth, but it also causes pollution and ecosystem damage. Impacts on the residents vary by individual perspective. Some stated key issues include infrastructure pressure, overcrowding and traffic congestion. (Cottrell, 2004). Sustainable tourism practices are necessary to balance tourism's benefits with resident well-being (Bosman, 2011; Horn, 2015).

The data was collected by surveys taken between May 21st and May 25th. The survey included questions about demographic characteristics, the effects of tourism, and preferences for the future of tourism. The achieved sample size was 75 participants, which ensured a representative demographic distribution. The analysis is done using JASP and Excel.

The first research question is to find out how residents perceive the current effects of tourism. Notable to see is that 59% of participants agreed to the increase of environmental waste, especially in Den Burg and De Koog. Half of the participants reported discomfort due to overcrowding, traffic congestion, and unsafe traffic situations caused by tourists. Residents also noted that tourism raises the cost of living, with the youngest (18-24) and oldest (65+) age groups feeling the greatest impact. Interestingly, 33% of participants disagreed that tourism increases the crime rate on Texel.

The second research question investigated residents' preferences for the future of tourism on Texel. Key findings showed that 40% of participants want to keep tourism important in the future. However, residents stressed the need for sustainable tourism that protects the environment and keeps the housing market stable. Their top priorities for the future are preserving the natural environment and improving residents' quality of life.

The results match previous research, showing stable trends in how residents view tourism's impact. However, the survey had some limitations, like differences in how questions were asked and a bias in responses. There was also a demographic imbalance, with more older people participating, which might not fully reflect younger residents' views. Limited data collection time and focusing on specific areas of Texel also restricted the inclusion of perspectives from all over the island.

To create a balanced and resilient tourism industry, Texel needs to involve the community and adopt sustainable practices. Addressing tourism's effects on residents while maximising its benefits requires teamwork and proactive steps. Future research should focus on including residents in tourism decisions and ensuring diverse demographic representation. By prioritising sustainable tourism, Texel can boost economic prosperity and improve residents' well-being, ensuring long-term community support and involvement.

3D: The future of housing and work

3D: Factors Contributing to Escalating Housing Prices and Their Impact on Local Residents

This research paper opted to uncover the social, economic, and environmental factors contributing to the increase in the housing market of Texel. To do so, semi-structured interviews were conducted with Texel's municipality, a real estate broker, and the residents of Texel. This gave detailed information as to why the prices increased, as well as statements about how the locals felt about this challenge. Furthermore, identifying the root causes of the house price escalation allows for the implementation of targeted interventions aimed at addressing inequalities in housing affordability and access. The purpose of the report is as follows;

Unveil the factors contributing to the escalating housing prices on Texel
Understand how the residents are affected by the emerging housing prices.

These findings showed that a majority of the residents felt unaffected by the prices as they had bought their homes years prior to the surge in prices, or they lived with partners or families with existing homes. Some younger residents mentioned they struggled to find homes at a more affordable price but had existing solutions such as living with roommates or with their families. The main discoveries deducted from the interviews consisted of the understanding that the residents did not feel very affected by the rising prices. Furthermore, the locals were rather insistent that tourism and new residents were essential to their economy, and while the prices affected younger generations trying to find homes, most residents felt unaffected by high housing prices. Additionally, the municipality ensured that existing regulations were put in place to help locals buy homes, such as by having homes under the price of 600,000 euros reserved for them. Finally, most of the residents interviewed claimed that they supported the municipality's choice to accommodate the market to help young Texel generations get access to homes.

To conclude, the main issue regarding rising housing prices remains that low house mortgages made it so that older and wealthier retirees bought homes on Texel. Hence, younger generations were left unable to find adequate and affordable housing or well-paying jobs on Texel and were forced to either live on the mainland or live with housemates. Substantial change needs to be implemented to further accommodate the residents of Texel to find cheaper housing and protect their community.

Our policy recommendations consist of the following list;

- Increasing the levels of awareness of potential buyers (especially second-home owners) about its effect on the residents of Texel.
- Renovate and reinforce coastal measures for future rising sea levels to protect citizens and their homes.
- Developing strong community incentives to encourage younger generations to live on Texel.
- Pushing the municipality to continue looking for ways to accommodate Texel residents by offering lower prices, giving start-up grants, and restricting access to cheaper homes only to young Texelers or residents of Texel.

4. Renewable Energy

4A: Perception of operating wind farms

4A: Texel Locals' Perception of Wind Farms on the Island

This research paper aims at looking at the perception of locals of Texel island regarding the impacts of wind farms, both positive and negative. The research question we came up with is as follows: How do residents of Texel perceive and experience different impacts of wind farms, and what are the motivations for their choices? Wind farms are a great alternative for green energy which is emerging more and more with the recent climate goals. In the Netherlands wind farms are abundant therefore it is surprising that there are none within the large island of Texel. There are many impacts that come with wind farms and thus getting to know the most and least important ones can give insights for the future of sustainability. We want to look at how locals see wind farms and if the NIMBY concept can be applied in this case. After having carried out interviews with locals out in the open and having used a tool provided to us by a Phd student collaborating with us, our findings showed us that the most important impacts perceived and experienced were around the negative impacts wind farms can have for the bird population of the island as well as its overall aesthetic. As Texel thrives on its beauty and bird watching in nature reserves it is only normal that the residents be skeptical of any potential harm at these. The most important positive impacts were around the reductions of emissions wind farms bring as well as its sustainable energy. The least important impacts were around anything that directly affected the residents such as shadow flickers and job opportunities as the residents deem that there are enough jobs available. The recommendations we came up with for future projects surrounding this topic would be to first of all;

- Make sure the wind farms are either on a plot of land far from living spaces and any areas with bird populations. Thus an ideal location would be off shore.
- Another recommendation would be to minimize the impacts that may affect the aesthetic of the island. Wind farms could still bring up new workers as jobs will be opened.
- Finally, mental models are a representation of one's perception and opinions therefore it is almost impossible to negate any negative views on wind farms, but limiting the worst ones is the best outcome for any future project.

4B: Electrification of residential energy demand in Texel

4B: Potential for Electrification in the Residential and Transport Sector on Texel

The transport and mobility sector are primary contributors to Texel's greenhouse gas emissions. Therefore, electrification of these sectors is an important strategy toward decarbonisation. However, limitations on the grid capacity on Texel poses challenges. This paper addresses the research question: **"Which electrification strategy among the transport and housing sectors on Texel has the highest potential of reducing CO₂ emissions while minimizing electricity grid expansion needs?"**. Data were collected from literature and interviews on Texel, and different scenarios were developed to answer this question. A target of 5 million kg of CO₂ reduction from a reference scenario has been established as a guideline.

Firstly, in the transport sector, two sub-scenarios are evaluated. Both scenarios start from an upgrade of vehicles that rely on fossil fuels, but the first focuses on fully electric cars and the second on hybrid cars. Estimates show that there is a difference in both sub-scenarios in terms of efficiency, electricity consumption and CO₂ emissions, although the impact of this possible measure on reaching the proposed target may not be as significant.

Secondly, for housing, electrification of the heating system by upgrading from a lower energy label to A++ is assessed. A switch from label G to A++ has the highest potential, based on the ratio of CO₂ emissions saved annually per m² divided by the electricity consumption needed for the conversion.

While the electrification scenarios with the highest potential are identified, grid expansion on Texel is still necessary. This brings us to the recommendation for the stakeholders. Firstly, the local government should prioritize smart and flexible planning to reduce peak demands and to align demand with supply during seasonal fluctuations and daily variations. Secondly, expanding the grid capacity on Texel and of the cable connecting Texel to the mainland is crucial to accommodate the rise in electrification.

In this research, economic aspects and combinations of the electrification scenarios are not addressed, which should be the focus of further research. Additionally, understanding residents' attitudes toward electrification and smart energy technologies, and the ecological and tourism impact of electrification needs further research. Altogether, an integrative and interdisciplinary approach is essential for the successful decarbonization of Texel.

4C: Potential for solar PV and islander preferences

4C alpha: Potential Solar-PV and Islander Preferences

Purpose of Report

Texel has set for itself the aim of eliminating fossil fuel consumption and achieving full self-sufficiency by 2030. To achieve self-sufficiency, the island's energy demand must be generated locally; the municipality plans on achieving this using solar photovoltaic (PV) panels and wind turbines. Currently, only 5% of the island's energy is generated locally. An important reason for this is the fear that the construction of solar-PV panels may damage the beloved landscape of Texel, negatively impacting Texel's tourism industry, which forms the backbone of the island's economy. Thus, it is crucial to ensure that the island's touristic appeal is preserved. As a result, the optimal implementation of solar-PV is difficult to gauge, given that large amounts of land are required for solar-PV infrastructure. This report seeks to address this issue with the research question 'How can inhabitant preferences influence the optimal implementation of solar-PV to help reach energy self-sufficiency on Texel?'

Methods

Research was conducted with qualitative and quantitative approaches, investigating the various ways in which inhabitants' preferences influence the optimal implementation of solar-PV on the island. Semi-structured interviews were conducted with a randomized sample of twenty-six participants. Data was analysed through thematic analysis, with recurring themes and patterns in the transcripts being identified, defined, explained, and compiled into a codebook. Segments of text representing different themes and categories were assigned codes, and using cross-comparison, findings from interviews were compared to validate and enrich qualitative findings.

Finally, findings were synthesized into a coherent narrative highlighting key implications for solar-PV implementation.

Findings and Conclusions

Regarding economical aspects, most responses suggested that the main economic benefit of rooftop solar panels is the lower energy bills, and that the main economic drawback is the large initial investment. The economic potential of solar parks, otherwise referred to as utility-scale solar-PV, was also appreciated, and no respondents suggested any economic downsides to solar parks. As for aesthetic aspects, some locals criticised solar panels for disrupting the island's landscape. While most respondents preferred solar parks over wind parks, inhabitants nonetheless described solar parks as unattractive. By contrast, most indicated that they did not find rooftop panels to be visually burdensome, and some mentioned that they had become used to seeing solar-PV panels on rooftops. Between solar parks and rooftop solar-PV panels, a majority showed preference toward the latter. Lastly, a popular opinion regarding the outlook of solar-PV investments was that their future is contingent on the government's policies, and furthermore, that the current government did not adequately support solar-PV investments. The primary obstacle for constructing utility-scale solar parks was their unsightliness. The most common solution to address this aesthetic concern against solar parks was to hide solar-PV installations, most commonly using greenery as concealment. The results indicate that personal economic gain was a clear motivator for the use of solar-PV. Therefore, understanding the reasoning behind this motivator and creating large scale incentives will engage more inhabitants with the transition toward self-sufficiency, enhancing willing participation and improving the perception of the energy transition on Texel.

Recommendations

The responsibility in resolving the issues of motivators and obstacles largely lies within the municipality of Texel and the Dutch government. Recommendations include:

- Address aesthetic concerns in the development of solar parks through strategic placement and landscaping buffers;
- Create further financial incentives for individual investment in solar-PV;
- Strengthen social engagement and support;
- Increase grid capacity.

4C beta: Potential Placements for Solar PV on Texel to Achieve Energy Self-Sufficiency

This report evaluates the most suitable locations for the development of Solar Photovoltaic (PV) systems on Texel to achieve energy self-sufficiency. To determine the best locations to develop solar PV installations, multiple key factors were considered such as, current land usage, economic costs, and existing policies.

Introduction

Texel initially aimed to become energy self-sufficient by 2020, but this target has been shifted to 2030. This aspiration is part of the municipality's broader goals to become more sustainable (Coalition Texel, 2022).

Main Findings

1. **Spatial Considerations:** The report highlights the need to balance technical feasibility with social acceptance. Texel's land use is predominantly dedicated to agricultural and natural reserves, making islander preferences and current land usage critical.
2. **Optimal Locations for Solar PV:** The research used GIS mapping to identify the most suitable locations for solar PV installations. The study considered various factors, including radiation potential, current land usage, proximity to the power grid, and legal restrictions. Optimal locations were primarily found on rooftops and parking areas due to current policy restrictions against large-scale solar farms on open fields.
3. **Comparison with Ameland:** Ameland is used as an example of a successful case of regional/local energy transition in the Netherlands. Ameland's policies are compared to Texel's to showcase the potential of large-scale solar PV development on Texel. Ameland has similar sustainability goals and characteristics as Texel but is, in contrast to Texel, also on track to reach these goals. Therefore, this comparison illustrates how Texel could benefit from broader policy changes to allow larger solar installations on agricultural land.
4. **Final map:** The above-mentioned points were categorized and used to develop GIS-maps, which were overlaid to determine the most optimal locations for solar PV installations.

Results

A third of the island's land is occupied by nature reserves and half is used for agriculture. As nature reserves fully exclude the possibility for solar farms, and agricultural land usage creates a high opportunity cost for solar PV installations this poses a significant challenge to solar PV development. This is also reflected in the current political decision to not give out any permits for solar PV installations in the field. Due to this, it is highly unlikely that Texel will achieve more than 16% energy self-sufficiency through solar PV with the current policy. Self-sufficiency could be achieved with 10% of the island's area together with rooftops and car parks if current policy were to change.

Policy Recommendations

1. **Expand permitted land for Solar PV:** Policies should be adjusted to allow solar installations to be installed in more locations such as non-nature reserve meadows and agricultural fields. This expansion could include exploring Agri-photovoltaics, which combines agricultural activities with solar energy production.
2. **Learn from Ameland:** Adopting some of Ameland's strategies, such as using visual barriers and integrating solar farms into the landscape, could help mitigate local resistance and align Texel's policies with its sustainability goals.

Conclusion

Achieving energy self-sufficiency on Texel by 2030 requires more area than currently permitted by the municipalities policies. The development of large solar PV installations is currently hindered by social acceptability which has influenced current policies. With the current policy the technical potential is only 16% of total energy usage, through solar PV on roofs and car parks, while without this policy only 10% of the island's area is needed along with roofs and car parks to fully satisfy demand. Policy changes are thus essential in reaching the goals set by Texel. Without them attaining sustainability and self-sufficiency in energy is unrealistic.

4D: Understanding local stakeholder actions to alleviate double energy vulnerability

4D: Understanding local stakeholder actions to alleviate double energy vulnerability on Texel

Introduction

Double Energy Vulnerability (DEV) focuses on the problems of energy and transport poverty, where households can experience trade-offs between energy and transportation expenses. Energy poverty refers to the inability to afford adequate household energy, low income and poorly insulated homes. Transport poverty is the inability to access affordable means of transport that are reliable in a given society. This paper focuses on the awareness and management of DEV among stakeholders on Texel, a Dutch island that has specific socio-economic structures that compound these risks.

Research question

How do ‘stakeholders’ perceive and take into account double energy vulnerabilities on Texel?

Methods

In person, qualitative semi-structured interviews were administered with key stakeholders of Texel including municipal officials, energy firms, and local organizations during May 22-24, 2024. Interviews ranged from 11 to 25 minutes and were conducted in different parts of the island. Recordings of these interviews were transcribed and coded by hand to look for emergent themes and patterns.

Findings

The study highlighted that 80% of the stakeholders did not know the term DEV but were able to identify problems associated with energy and transport poverty on their own. Barriers to addressing DEV that were identified included: lack of awareness, of necessary infrastructure and of adequate economic resources. Nevertheless, all stakeholders acknowledged the need for cooperation to improve energy and transport accessibility.

Discussion

The results show that there is a lack of awareness of DEV among the stakeholders. Researchers and stakeholders highlighted the importance of interrelated policies and the role of community participation in managing DEV. Some of the areas that could be enhanced include interviewing all target groups. This research provides relevant policy recommendations on how to tackle DEV by adopting more holistic analytical frameworks. Improving the interaction with the stakeholders and the members of the Texel community will help to design an appropriate strategy for addressing and preventing DEV.

Future research

It is important for future studies to look further into the relations between energy and transport poverty especially in rural areas like Texel. Correlational studies may be helpful in identifying the differential effectiveness of implemented strategies over time and implementing long-term solutions to building stronger and more resourceful communities.

Conclusion and recommendations

Texel's vulnerability to DEV can be addressed through heightened awareness, sectoral cooperation, and precise policy implementations. Some of the recommendations can include: increasing awareness of stakeholders to DEV, working closely between the energy and transport industries and providing policies on energy optimization and affordable means of transport. In the future, more attention should be paid to assessing the effectiveness of the mentioned strategies and to search for new approaches aimed at preventing DEV.

4E: Exploring households' struggles with double energy vulnerability

4E: Exploring Double Energy Vulnerability and Sustainability: A Qualitative Assessment of Households' Pro-Environmental Behaviour in Texel, The Netherlands

Households suffering from double energy vulnerability (DEV) suffer from both domestic and transport energy poverty. This has been an emerging issue in recent years, and it is important to make sure that these households do not get left behind in the sustainable energy transition. Thus, in collaboration with the Sweden-based research project, Just-PEPP, this report sought to answer the question: How does being exposed to double energy vulnerability influence the attitude and opinion on pro-environmental behaviour for households in Texel? The chosen method of semi-structured interviews was tailored to identify indications of DEV and to understand how this affected pro-environmental behaviour. The interviews were conducted door-to-door at a social housing neighbourhood and non-subsidised households. A total of 22 interviews were collected which were coded according to themes that were prepared beforehand, and to those that emerged during the coding process.

1.1 Results

Results reveal that only 11% of non-subsidised households show indications of domestic energy poverty (DEP) as opposed to the 67% within the social-housing neighbourhood. The same trend was observed with transport energy poverty (TEP) indicators, with 72% of non-subsidised and 100% of social housing households showing indications of TEP. The social housing neighbourhood had the option of paying a monthly fee to rent solar panels installed on their roof by the municipality. This dampened the potential threat of DEP. In general, TEP was more prevalent than DEP, as the lack of connectivity between the island and the mainland and the lack of readily available public transport in most places on the island affected everyone. Particularly so for subsidised households, as private vehicles were often unavailable to them (either due to costs or mobility issues). Pro-environmental behaviour was observed in both types of households. However, reasons for partaking in such practices differed vastly between the two groups. While subsidised households mentioned cost efficiency as the main driver an overwhelming majority of the time, non-subsidised households often acted out of principle. Overall, we noticed that exposure to DEV did not lead to a significantly less environmentally conscious pattern of behaviour. Instead, it made it so that pro-environmental practices were weighed against the cost that adopting those practices would bring, and if the costs outweighed the benefits, the practices would generally not be adopted.

1.2 Recommendations

We recommend policymakers to investigate providing a better public transport network around the island, and to provide better more direct housing support to those suffering from DEV so that pro-environmental practices can be facilitated as much as possible.

4F: Tourists and renewables

4F alpha: Tourists and renewable energy on Texel

The Dutch Island of Texel is renowned for its breathtaking scenery, biodiversity, and rich history. Its accessibility makes it a popular tourist destination, attracting thousands of visitors every year. Tourism has become an important part of Texel, making it its main source of revenue, with tourists having a significant influence on decision-making. Given its major role, it is essential to include tourism in all decisions, especially those related to Texel's energy transition. The island aspires to shift towards renewable energy and become self-sufficient. However, to achieve these goals, local stakeholders need to pay attention to the tourism sector, as it represents Texel's main income, an important part of the energy consumption, and is the most resilient to installation of renewable energy infrastructures. This report addresses the question of how tourism and energy consumption impact Texel. To do so, in addition to scientific literature, we went directly to Texel for a few days to gather the opinions of locals and tourists on the subject through surveys. Using QR codes placed in touristic spots and structured interviews, we collected around one hundred responses on topics such as energy consumption, renewable energy, and potential actions to take. Afterwards, we analyzed the data to understand commonalities and differences in practices and opinions, seen with tourists and locals regarding the island's energy transition. Both groups are aware of the impact of tourism on Texel's energy consumption and mainly agreed on which renewable energy source can be implemented on the island. However, residents generally care more about having sustainable accommodation and energy sources than tourists. Regarding renewable energy infrastructures, the results are mixed with a similar percentage of people that do and do not mind the view. In summary, responses showed us that most respondents are aware of issues linked to energy distribution and consumption on Texel. However, residents are more inclined to take concrete actions to change things. Based on our findings, we recommend the following policies: accommodations must promote energy-saving practices, local government should create awareness campaigns explaining the importance of renewable energy infrastructures for Texel, and for tourists, a fee should be set up to enter the island.

4F beta: Tourism and renewable energies on Texel

In recent years the Netherlands has been making steps towards an energy transition from fossil-based to green energy. In 2019, 8.7% of all energy used in the Netherlands came from sustainable sources. By 2050, the government wants to be almost entirely energy neutral (Ministerie van Algemene Zaken, 2024). The municipality of Texel has expressed to have the same ambitions, as shown in their 'Omgevingsvisie 2050' (Environmental vision 2050) (Omgevingsvisie - Gemeente Texel, 2001). However, as a very tourism-orientated island famous for its natural views and peace, making the change from fossil fuels to renewables such as wind energy could bring some problems. The disturbance of the view by wind turbines might drive away tourists for example. This would be disagreeable, since as many as 80% of the islanders are dependent on the tourism sector (Vlot, 2023). This report aims to examine the significance of these problems by asking the question: "To what extent would installing renewable energy sources affect tourism attraction on Texel and, consequently, impact the island's economy?"

To understand the views of Texel's tourists on this matter, we conducted a total of 68 surveys over the course of a three-day research stay on the island. The survey consisted of both closed and open-ended questions on the views of tourists regarding wind and solar parks. Our main findings were:

1. Most respondents, namely 47%, prefer solar parks over wind parks. This is the majority as 29% prefers wind parks and 24% had no preference.
2. If wind turbines are to be installed, 57% would prefer them to be offshore. The reasoning behind this was mostly the fact the participants thought this to be less bothersome to the islanders and views as well as a more effective use of space.
3. Only 29% of respondents were against or strongly against the placement of solar and wind parks on Texel. The remaining 71% answered to be neutral about it or even -(strongly) in favour.
4. Of the participants who voted in favour or strongly in favour of the placement of wind and solar parks, the majority preferred solar panels (51%) over wind parks (37%).

In conclusion, our results indicate the tourism sector would not be greatly affected by the placement of green energy sources such as wind turbines and solar panels, with some tourists even being encouraging of this. Following these results, recommendations for stakeholders such as energy companies looking to expand to Texel, could be to implement a mix of solar panels and wind parks, with a focus on solar energy and, if needed, offshore wind turbines.

4G: Power to the people

4G: Power to the people

With climate change becoming a more pressing issue, bench marks are being set to help achieve the goals that should mitigate this process. Since 2024 every municipality in the Netherlands is mandated by the national government to develop an “Omgevingsvisie”, a document addressing the developments for the future, with a focus on sustainability (Gemeente Texel, n.d.). Texel is doing exactly this, by implementing the “Omgevingsvisie 2050”, they will be improving the sustainability of Texel. More specifically, they have set one ambitious goal, becoming energy self-sufficient in 2050. This takes collaboration from the municipality of Texel and its residents. In our research our main aim is to answer the following question: Does the “Omgevingsvisie 2050” and the vision of Texel's residents for the future of Texel align, and how can local residents contribute to making this vision a reality? Following this aim we formulated two objectives: “Investigate what the vision of Texel's residents is on renewable energy and whether it aligns with the “Omgevingsvisie 2050”” and “Analyse and discuss the role of Texel's residents in achieving an energy-neutral future for the island.” To formulate an answer to these objectives we set up a survey, using Qualtrics. The final number of participants was 61, and represented towns in the Centre, North, South, West and East. Furthermore, we categorised the 61 responses on cardinal directions, resulting in the 5 regions Centre, North, South, East and West. Following we analysed this data, looking for synergies and trade-offs between participants from the same town and between different towns. Our main findings display a correlation of the centre of Texel and higher awareness for sustainability. The overall knowledge of the “Omgevingsvisie 2020” and “Omgevingsvisie 2050” was limited, the centre having the most participants that knew about it and the west having the least. Moreover, Texel residents are overall motivated to contribute to the energy transition, with slight differences per regional group. However, they are held back by a lack of funding and experience a lack of legislative modifications, needed for every resident to be able to contribute to the energy transition. Many participants were already limiting their energy

consumption, however mostly to save money and not necessarily to lessen the pressure on the earth. Furthermore, there were a few participants involved in community initiatives, such as small local solar parks to sustain various members of the neighborhood. Wind parks were however not favoured at all, the mean participant claiming they cause landscape pollution. Solar parks were overall approved as they pollute the landscape significantly less. With these outcomes we can conclude that the visions of the Texel residents and the “Omgevingsvisie 2050” for the future of Texel largely align, however awareness of the “Omgevingsvisie” is low among residents. Moreover, Texel residents can contribute to making this vision a reality by consciously reducing their energy consumption, as most participants were already doing, and by taking part in community initiatives or by privately investing in renewable energy. When doing this research there were some limitations that should be taken into account, such as the sample sizes not accurately reflecting the true population ratios, potentially leading to a bias. Furthermore, misinterpretations of the survey questions might have affected the answers of the participants. Potential policy recommendations to overcome these found obstacles are given in Figure 1.

Policy Recommendations

Ensuring Texel to be energy self-sufficient in 2050



Figure 1. Policy recommendations to ensure an energy self-sufficient Texel in 2050. Own work.