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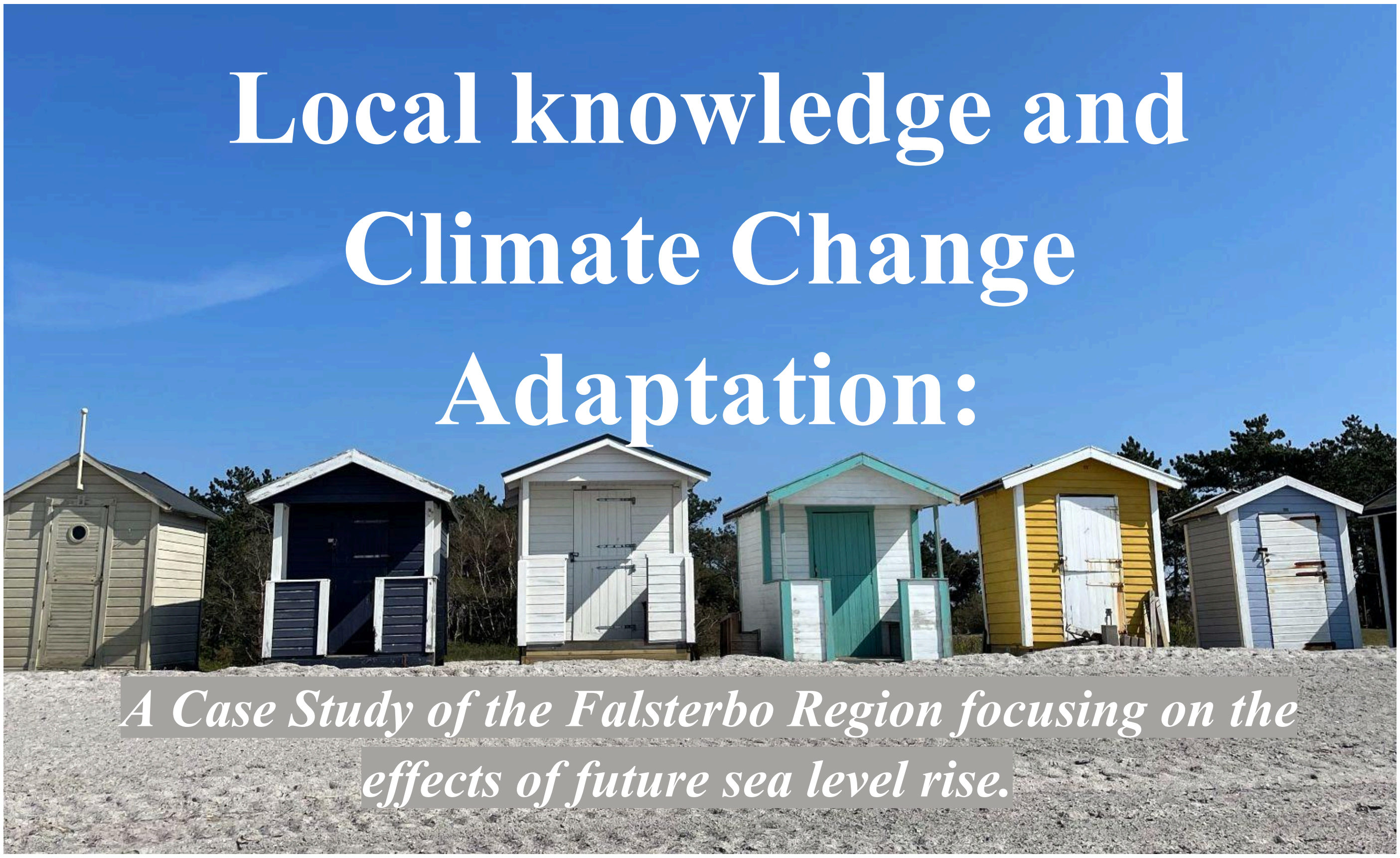

Local knowledge and Climate Change Adaptation:

A Case Study of the Falsterbo Region focusing on the effects of future sea level rise.

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Abstract

Local knowledge in vulnerable communities can be vital when developing adaptation and mitigation strategies especially as issues such as sea level rise in Falsterbo become more prominent as global warming increases. At present, traditional local knowledge is often explored within indigenous communities but significantly less so in western communities. The importance of local knowledge, in regards to climate change, needs to be prioritised on a global scale, with a multifaceted approach from all levels required to tackle climate change.

This study highlights the knowledge gap between a vulnerable local community and empirical data regarding sea level rise. Through data collection with a survey that had 32 respondents, and mapping with ArcGIS pro which compared the survey estimates with sea level rise data from the European Environment Agency, utilising the Scalgo Live model. The results found 75% of respondents were regarded as having no to low knowledge of future sea level rise impacts. This was obtained through a knowledge assessment, with varying demographic factors such as length of residency and gender determined to be unassociated with the degree of knowledge held assessed through the Fisher's Exact Statistical Test.

This study highlights the importance of information regarding climate change. Communities cannot become more involved until they are appropriately educated on the potential future risks they may face. Thus, adaptation and mitigation strategies have been developed in Falsterbo, but the importance of local knowledge is undervalued.

Keywords: *Local Knowledge, Falsterbo, Sea-level rise, Fisher's Exact Test, Adaptation, Survey*

1. Introduction

This study aims to assess the level of local knowledge in understanding and addressing future sea-level rise in the Falsterbo region of Sweden. Rising sea levels are an inevitable aspect of our future. Climate change, caused by the increase of global greenhouse gas emissions since the mid 19th century, has led to increased melting of the cryosphere and thermal expansion of the Oceans (Bergkvist Andersson, 2021). These warming levels have led to sea levels rising at a faster pace than ever before (Arnesten, 2019). High sea levels lead to coastal flooding, which in turn damages the surrounding infrastructure and coastal environment (Azevedo de Almeida & Mostafavi, 2016).

Local knowledge can be defined as the unique knowledge developed over an extended period of time and held by a given society in a specific location (Naess, 2013). Local knowledge has been assessed in various communities worldwide in relation to their environment and the climate impacts within their community. Research showcases many of these previous studies focus on developing countries and indigenous communities (Harris, 2021). This study aims to shift that scope and focus on a community in the Global North who is currently facing the possible detriment of climate change. The necessity to prioritise local knowledge globally in climate adaptation strategies is being increasingly recognised as valuable within climate adaptation and risk assessments. Addressing the ongoing climate crisis demands a comprehensive approach that integrates perspectives and knowledge from all available resources.

The Falsterbo peninsula within the Vellinge municipality, is one of many areas in the western world at risk of current and future climate change impacts. The properties on the peninsula are vulnerable to the rising sea levels. The future climate related risks led to the local municipality deciding to take action with adaptation measures against the imposing threat. A physical construction to protect the community was proposed by the municipality in 2018 (Bergkvist Andersson, 2021). With the encroachment of rising sea levels, adaptation measures are becoming more and more prevalent worldwide. This paper explores the degree to which local residents are informed of the current landscape of sea level rise. In addition, it includes their lived experiences while also investigating the necessary adaptations that are required for future implementation

1.1 Aim of Thesis

Sea level rise is expected to become an imminent problem in the future for many coastal regions across Sweden (Hieronymus & Kalén, 2020). This study will look specifically at the Falsterbo region. It is vital to understand the importance of local knowledge towards adapting and mitigating the incoming risks of sea level rise.

The main aim of this study is to quantify local knowledge regarding the understanding of future sea level rise in the Falsterbo region of Sweden. It will achieve this by:

1. Investigating local residents' knowledge of sea level, through a survey of quantitative questions.
2. Quantifying local knowledge through a knowledge assessment and analysing the association with differing demographic factors of the respondents, utilising Fishers Exact Test.
3. Evaluating existing and proposed climate change adaptation strategies, in light of local perspectives and knowledge gaps.
4. Providing visual representations of rising sea levels in Falsterbo through data collection and mapping under the worst case scenario of the Representative Concentration Pathway 8.5 (RCP 8.5) for four differing future scenarios.

By answering these questions, this thesis hopes to deepen the understanding of sea level rise impacts in the Falsterbo region. Through not focusing solely on the climate change impacts, but also on the citizens who reside there.

1.2. Hypothesis

The survey will present the knowledge level of local residents within the region of Falsterbo. The respondents are expected to have a high knowledge level regarding the threat of future sea level rising, and the knowledge level the residents possess will be associated with their proximity to the risk of sea levels rising (i.e. the Baltic Sea). Additionally, the depth of local knowledge will be associated with demographic factors such as length of residency and these presumptions will be the basis for the alternative hypothesis in the Fisher's exact statistical analysis, Furthermore the association between gender and knowledge level is expected to hold no significance. The knowledge assessment will also provide insights into any potential knowledge gaps where new strategies and efforts may be implemented for increasing knowledge of future sea level risks.

The data collection is crucial for providing mapped data on projected sea level rise under the RCP 8.5 worst case-scenario. The maps are visually compared with the mean answers of the respondents, providing high levels of similarity between the local perceived future sea levels and the empirically mapped data. Proposed mitigation and adaptation techniques are analysed accordingly, with the mapped data on projected sea level rise under the RCP 8.5 worst case scenario whilst also taking into consideration locals perspectives.

2. Background

2.1. Study Area

The study area consists of the Falsterbo area, located in the Vellinge Municipality, as seen in Figure 1. of Skåne County. The trumpet-shaped peninsula is located in the southwestern area of the Baltic Sea (Blomgren & Hanson, 2000). The peninsula extends approximately 7.5 Kilometres (km) in all directions and in many areas is less than 2 metres (m) above the sea level (Klarén et al., 2023). The population in Falsterbo as of 2021 was approximately 7506 inhabitants (Vellinge kommun, 2024). The area is renowned for its spectacular views and beautiful coastline. The area has large assets of property, with private real estate surmising a total value of more than 40 billion SEK (Alström, 2013). The formation of the peninsula began 6-7000 years ago during post-glacial time (Hanson, n.d.). The peninsula is composed of simple geologic stratigraphy, with a 10m layer of fine sand resting upon a clay-till. The composition of the peninsula leaves it vulnerable to ongoing erosion with wave action. Specifically on the top layer of the peninsula where fine sand rests. These areas, although highly prone to erosion, are significant locations for recreation considered by the locals. However, most at-risk areas are uninhabited.

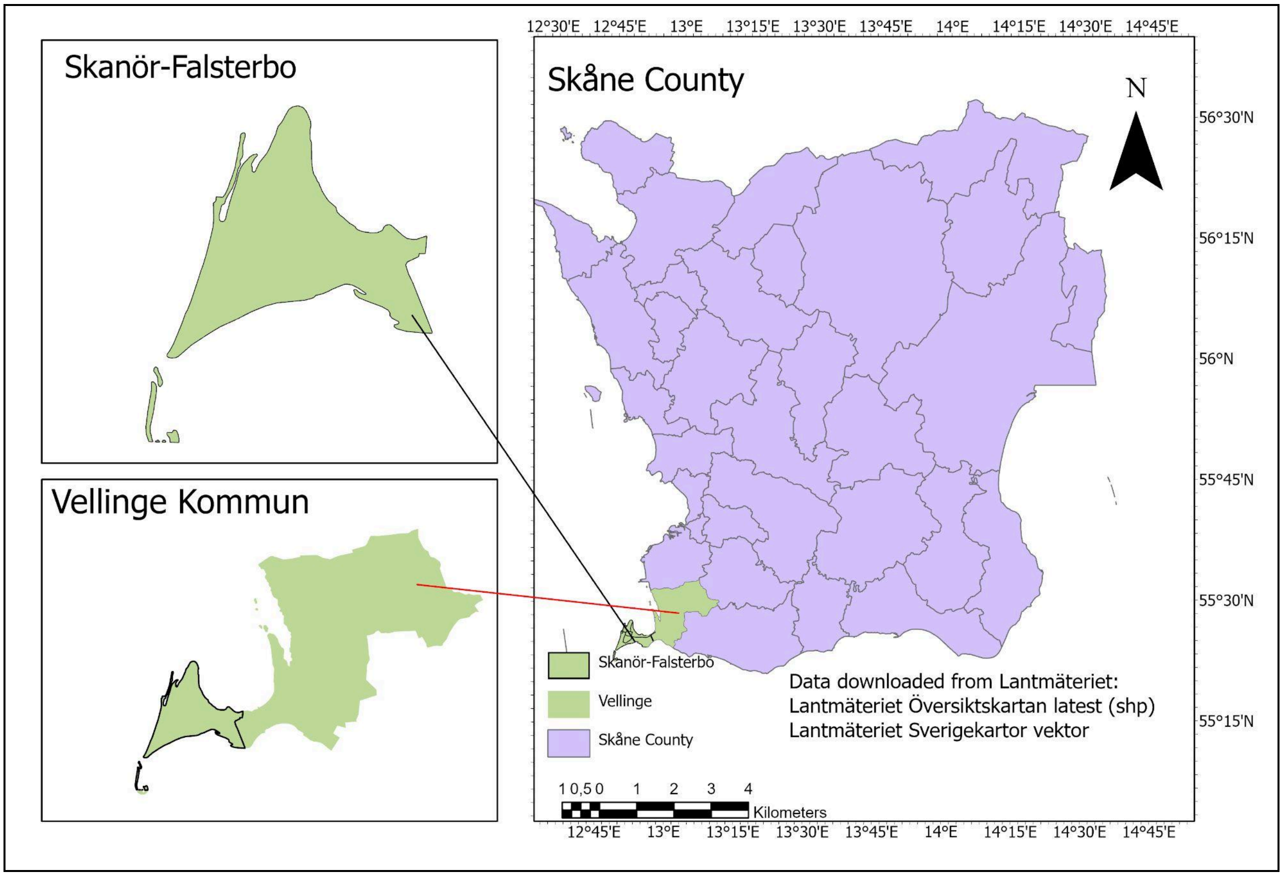

Figure 1. The map of the study area including the surrounding Municipality and County.

2.2. Sea level rise

According to the Intergovernmental Panel on Climate Change (IPCC) sixth assessment report (AR6), ‘It is unequivocal that human influence has warmed the atmosphere, ocean and land. Global mean sea level increased by 0.20 [0.15 to 0.25] m between 1901 and 2018.’ (Calvin et al., 2023). Sea level rise affects different regions globally and is an increasing threat that's arisen as a by-product of global warming. As the planet continues to warm due to anthropogenic sources, the melting cryosphere (Earth's frozen regions - ice sheets, glaciers etc.) plays a major role, with meltwater run-off increasing the water volume of our oceans. In addition, warming temperatures lead to thermal expansion, where the density of the water is decreasing, resulting in the water mass to have a larger volume (Bergkvist Andersson, 2021). Changes in regional sea level areas are impacted by wind patterns, circulation patterns, waves, and storm surges.

In Sweden specifically, it was found that high water levels were connected with northerly and north-easterly winds, although strong westerly winds have been found to raise sea levels up to 0.5 metres (m), leaving coastal regions like Falsterbo extremely vulnerable. Over 50% of coastal wetlands globally have been lost over the last 100 years. This is a result of not only sea level rise, but also localised human pressures and extreme climatic events. Future estimations are also concerning with global warming predicted to reach 1.5 °C. Furthermore, even with the lowest Greenhouse gas emission scenario Shared Socio-economic Pathways 1-1.9 (SSP1-1.9), it is likely to exceed the 1.5 °C goal under every higher emission scenario (Calvin et al., 2023).

Future emission scenarios SSPs or RCPs are scenarios developed in climate modelling and are critical for future predictions of different greenhouse gas concentrations. The RCPs were developed for the IPCCs fifth assessment report and describe four future 21st century pathways with the 8.5 scenario focused on in this study, assuming continued growth in emissions. SSPs were recently introduced in the lead up to the current IPCC sixth assessment report ('Understanding Shared Socio-Economic Pathways (SSPs)', n.d.). SSPs models make assumptions of how population, education, energy use, technology may change over the next century, and associate these changes with assumptions about the level of ambition for mitigating climate change offering broader and more nuanced pathways ('Understanding Shared Socio-Economic Pathways (SSPs)', n.d.). SSPs have five future pathways. Although this study will focus on RCPs, as the recent development of SSPs leads to a lack of information regarding the outcomes from these future scenarios and information regarding sea level rise under SSPs is limited, SSPs still remain vital in long term planning against climate change ('Understanding Shared Socio-Economic Pathways (SSPs)', n.d.).

Nevertheless, the IPCC states the future has a certain sea level rise. 1-in-100 year extreme events are projected to occur at least annually in more than half of tide gauge locations by 2100, under all considered scenarios (Calvin et al., 2023). Moreover, risks towards ecosystems, people, and infrastructure will increase with the increasing sea-levels beyond the year 2100 (Calvin et al., 2023). Nevertheless mitigation and adaptation strategies are being implemented, as mentioned in section 2.3. Certain future events are unavoidable, even with a limit on the global surface temperatures (Calvin et al., 2023). Specific aspects of the climate system have longer timescales on the response of changes to the climate. Sea level rise is one of these aspects of the climate system, and rising levels are going to continue occurring for centuries due to continued ocean warming and cryosphere melt. Despite this, a rapid sustainable shift towards reducing greenhouse gas emissions would limit further sea level rise acceleration, However, if global temperature rise continues to happen up to 2 °C or 3 °C, and a continuation of overshooting the earth's resources occurs, large ice sheets may completely melt leading to several metres of sea level rise. Such high risks for vulnerable ecosystems depend on current and future efforts for adaptation (Calvin et al., 2023).

The effects of climate change are less towards resource rich communities and most of these communities showcase low to moderate responses towards climate change, which is apparent in the mitigation and adaptation strategies upheld (Calvin et al., 2023). Therefore, the vulnerabilities for resource rich regions are lower, although they will still face imminent effects of rising sea levels. In comparison to lower income communities that are equally if not more so vulnerable. Bangladesh is a country which faces threats such as 3m sea level rise by the year 2100. Despite the fact it is still one of the lowest per capita emitters of greenhouse gases (Shamim, 2008: Alam, 2010). However, If maximum action is collectively taken in adaptation and possible retreat efforts from all income classes, the effects even at 100 cm sea level rise will be minimal (Calvin et al., 2023).

2.3. Adaptation and mitigation measures

2.3.1 Globally

As of today, efforts towards adaptation planning and implementation have progressed across all sectors. Despite the progress, adaptation gaps continue to exist as well as maladaptation occurring across varying sectors and regions. As stated by Harris many prevailing policies, practices and human behaviours still require change, so that humanity can collectively address climate change effectively (Harris, 2021). Internationally, countries collaborate to unearth solutions to the current climate crisis. They attempt this through the creation of international agreements in the hopes to achieve collective action (Harris, 2021). Many international climate agreements exist such as the Coalition of Parties (COP) and The United Nations Framework Convention on Climate Change (UNFCCC) as well as the Intergovernmental Panel on Climate Change (IPCC). These Intergovernmental agreements work by informing each other on the current detriment of the planet and usually setting target goals towards mitigation like the 1.5 °C goal set at the Paris Agreement. Protocols such as the Paris Agreement in 2015 or Kyoto Protocol in 1997 have allowed for further policy developments and target setting (Calvin et al., 2023).

Although these goals exist, they hold few consequences if not met by the countries agreeing to them, such as European Unions (EU) implementation of carbon budgets. Without consequences to meet the targets set annually, there is a continual increase in greenhouse gas emissions. The current IPCC report declared the 1.5°C global goal as highly unlikely to be reached. On the contrary to the goals not being met, the efforts that have been implemented have led to an enhancement of energy efficiency, a reduction in deforestation rates, accelerated technology deployment, and in some cases reduced emissions (Calvin et al., 2023). Despite the improvements that have been made, certain countries still face disproportionate effects of climate change. Therefore, it is a larger national interest for certain states to promote collective action towards climate change. This power imbalance places strain on international agreements being formed in an equitable manner. Albeit slow, progress is occurring with the UNFCCC stating over 150 countries claiming to plan to reduce their greenhouse gas emissions (*UNFCCC*, n.d.-b).

Regarding global climate finance strategies implemented towards the climate crisis, it was found that only a small proportion was targeted towards adaptation. The overwhelming majority went toward mitigation, even with global climate finance being on an upward trend since the last IPCC report (Calvin et al., 2023). Mitigation strategies such as reducing emissions is something that falls on all sectors in every country. Whereas, adaptation is more location specific and a topic that often has to be localised to specific sectors and countries and therefore is more complex to be addressed at a global level. With adaptation strategies targeting local levels, mitigation processes should be addressed by international policy makers in sectors of energy, transport and agriculture (Tol, 2007).

2.3.2 Local Adaptation and Mitigation

Whilst international organisations are necessary in combating climate change, local mitigation and adaptation strategies often fall on the hands of local policy-makers and communities (Calvin et al., 2023). At risk communities take greater leaps towards adaptation strategies if the necessary funding exists. Local communities that are at risk of rising sea levels or varying consequences of the changing climate, have to actively adapt to the threat their communities face.

Local adaptation strategies globally vary, depending on the risks encountered. The Netherlands has lived consistently adapting to rising sea-levels. To adapt to this, they have adopted dynamic dykes which have automated the flood walls' ability to adjust the height depending on the sea-levels (van Alphen et al., 2022). In addition, polders were implemented for holding water throughout flooding events. The Dutch maintain adaptation as their primary strategy for overcoming flooding risks to their infrastructure and are renowned for sharing their expertise with coastal communities in similarly vulnerable positions (van Alphen et al., 2022).

The IPCC emphasises the importance of conserving high-carbon ecosystems like wetlands, forests, and mangroves to address climate change and sea-level rise. Maintaining biodiversity in 30% of Earth's land and water systems not only reduces coastal erosion and flooding but also has the potential to enhance carbon uptake and storage (Calvin et al., 2023). These local mitigation strategies have significant global implications. Furthermore, many individual states are prioritising the transition to renewable energies, exemplified by Auroville in India, which primarily relies on solar power to meet all its electricity needs (Miriyala, 2023).

Local efforts towards both adaptation and mitigation rely on collaboration and learning from one anothers strategies as well as financial support provided locally, nationally or internationally (Calvin et al., 2023). Local communities worldwide are constantly adapting and learning to challenge the threats of rising sea levels and climate change (Calvin et al., 2023).

2.3.3. Locally Specific in Falsterbo

Whilst many communities in Sweden are at risk to sea level rise rates, temporary storm surges in relation to the rising sea levels has been outlined as one of the main threats to coastal areas in Sweden, with Scania located in the south of Sweden (where Falsterbo lies) already experiencing greater degrees of coastal erosion and flooding. Within Sweden, mitigation tactics are the focus of the centralised governments and adaptation responsibilities lie with local governments, similarly to the dynamic between international and local levels worldwide as aforementioned. Whilst structural adaptation is a relatively new strategy in Sweden which refers to the altering of structures to moderate potential damages (*UNFCCC*, n.d.-a). Strategies such as beach nourishment and fortification have been utilised to protect against coastal municipalities in Scania several times in the past. The construction of the flood barrier in the Falsterbo peninsula is one of the first hard infrastructural adaptive measures in Sweden (Bergkvist Andersson, 2021).

According to the Vellinge municipality, the protective embankment, referred to as a protective dyke, will be built around the coastal areas and isthmus. The dykes and a wall-like construction, as well as the already existing dunes, will form the necessary protection in the area against future rising sea-levels. The protective barrier is estimated to be 21 km long, with completion estimated for the year 2031 (Alström, 2013). The highest point of the wall will pan to be 3m above sea-level, notwithstanding the fact 80% of the sea wall will be lower than 1.5m. With approximately 95% of buildings in Falsterbo standing below three metres in height, the construction of this sea wall will provide crucial protection (Alström, 2013). Prior to its construction, nearly all areas in Falsterbo had faced flooding, underscoring the significance of implementing this sea wall. The safety dam is mainly financed by the Vellinge municipality with some external financial support from the Myndigheten för samhällsskydd och beredskap (MSB) (in english: The Swedish Contingency Agency) and from the EU. The project started officially on the 24th of April 2024 (*Skyddsvallen*, n.d.). This decision to implement such extensive adaptation measures stems from the local municipality. Although the process of construction is just beginning it is a major step towards climate change adaptation in Falsterbo, Sweden.

2.4. Local Knowledge in Climate Change Adaptation

2.4.1 The Value and Challenges of Local Knowledge

Local knowledge is crucial in solving the current climate crisis. Local communities possess a wealth of knowledge surrounding their local ecosystems and environments and it can be vital when policy makers formulate mitigation or adaptation strategies for a community (Kettle et al., 2014; Mendes, 2022). Whilst many studies have been conducted regarding local indigenous knowledge (IK) or traditional ecological knowledge, (TEK) they are primarily based upon communities in developing countries (Mendes, 2022; Sillitoe, 2021).

Challenges arise when attempts to alter aspects of a community are not met with support from people living within these areas. Isolating local communities in the global and local level climate change discussion may lead to a lack of support from varying local communities, additionally lowering the success of top-down implemented climate strategies (Mendes, 2022). The risks associated with overlooking the local level in the global climate debate include losing comprehensive perspectives, disregarding the cultures and struggles of local communities, and marginalising them (Mendes, 2022). This study takes a perspective of epistemic justice which underscores the equal significance of all voices, particularly in the context of adapting a community to its changing environment within the climate discourse (Sillitoe, 2021).

With most communities worldwide having constant access to varying sources of information at any given moment, why are there still gaps between the climate knowledge that exists and its social and widespread use (Zhou & Shen, 2022)? Western communities such as Falsterbo, Sweden, are not exempt from this phenomenon. Climate change, often laden with scientific complexities and misinformation, can foster misconceptions among individuals (Zhou & Shen, 2022). There are many global climate networks working to increase information availability to varying communities worldwide such as the IPCC, UNFCCC and the European Environmental Agency. Yet, ensuring information spread at the local level often relies on individual initiative.

The importance of incorporating local perspectives is apparent, but those within vulnerable communities are not always equipped enough to aid in informing local adaptation responses. The UN highlights the importance of educating audiences in regards to the climate crisis. It states, ‘Education is a critical agent in addressing the issue of climate change. The UN Framework Convention on Climate Change (UNFCCC) assigns responsibility to Parties of the Convention, to undertake educational and public awareness campaigns on climate change, and to ensure public participation in programmes and information access on the issue’ (Nations, n.d.). Allowing local perspectives to be heard in the ongoing climate emergency does not come without risks but, most importantly, it raises vital contributions (Sillitoe, 2021). Therefore, targeted educational efforts to improve climate literacy in vulnerable communities like Falsterbo is highly important. Vulnerable peoples' knowledge and needs should be equipped enough to aid in informing local adaptation responses. Not building on local knowledge brings the risk of maladaptation when building resilience within communities (Reid, 2015) .

2.4.2. Assessing Local Knowledge

The measurement and analysis of people’s knowledge in the context of complex issues, such as climate change events, is challenging to quantify (Tobler et al., 2012). Unlike empirical scientific data that is readily quantifiable, local knowledge is often qualitative. The qualitative nature of local knowledge leads to doubts surrounding the validity of it when assessing climate change events, such as sea level rise. Although this study highlights the importance of local knowledge, several researchers place criticism on local knowledge, emphasising the misconceptions within personal perceptions and lack of reliability in contrast to scientific information (Zhou & Shen, 2022). When climate change predictions diverge from people's personal experiences, it can fuel disbelief and resistance toward proposed policies (Lewandowsky, 2021). In the face of rampant misinformation, local knowledge may prove inadequate for effective collaboration with climate science. For the analysis of empirical data it is still necessary to rely on climate science (Sillitoe, 2021).

Despite these challenges, measuring local knowledge remains vital for revealing knowledge gaps in vulnerable communities like Falsterbo. Understanding the current knowledge levels allows for education to be expanded on in the deficient areas of erudition. Prior research has indicated that possessing accurate knowledge about climate change is vital for support towards climate protection policies (Tobler et al., 2012). Conversely, a lack of knowledge may influence people's attitudes toward climate change and hinder public engagement. The lack of engagement through not understanding is evident in the United states, where public understanding has been correlated to climate action (Weber & Stern, 2011).

However, Various methodologies are now available to assess knowledge systems, including qualitative approaches, anecdotal evidence, and algorithmic information theories (Fanelli, 2019). Tobler outlines three different knowledge assessment scales in his analysis and compares their structures, from the Rasch scale to the Mokken scale which he contrasted with the Guttman scale (Tobler et al., 2012). Through different knowledge assessments researchers can grasp the status of a community's knowledge system and employ strategies to improve the existing knowledge systems, or work on incorporating the knowledge into risk adaptation strategies within a community (Tobler et al., 2012).

3. Methodology

3.1. Materials:

The methodology began with literature collection on the chosen study area. In addition to this research on the current climate conditions regarding sea levels, future sea level rise predictions, and the impacts of these scenarios were examined. Mitigation measures and adaptation strategies were also assessed from varying literature sources at both a global scale and focusing specifically on Falsterbo. Data on the study area was also imported from Lantmäteriet and Scalgo Live and then analysed further with ArcGIS pro version (2.7.0, 2020 Esri Inc.), to garner elevation in the region, placement geographically and to visualise the unique layout of the vulnerable peninsula under differing rising sea levels. Additionally further statistical analysis was carried out utilising Excel version (Microsoft® Excel® for Microsoft 365 MSO (Version 2304 Build 16.0.16327.20200)).

3.2. Data Collection:

The protocol was to visit the study area, conduct surveys with locals in the Falsterbo region to assess their awareness of sea level rise in the region as well as local knowledge regarding the issue. The survey was formulated based on research of previously conducted studies and with the goal of answering the formulated research questions of this study (Sraku-Lartey et al., 2020; Tobler et al., 2012). The focus group was aimed at those who plan on living in the area for the foreseeable future in hopes to assess local knowledge in comparison to empirical data of the region. In order to do this, questions on the survey would take into consideration their own knowledge on sea level rise in their region in the future under the highest emission scenario RCP8.5. Furthermore the possible effects of sea level rise and the effectiveness of current adaptation measures being put in place.

The survey was initially piloted towards 3 students in Lund. These pilot surveys are not included in the results but were utilised for indicating the comprehension of the formulated survey questions. The survey was further clarified utilising the input from the piloted students, this included expanding on the instructions in the survey as well as providing clarification to include units in question 6 of the survey (as seen in the Appendix Figure.1.)

The survey consisted of four major components 1) The demographic of the participant; 2) Perceptions and knowledge of the future occurrence of sea level rise under the RCP 8.5 scenario as outlined in the survey; 3) what factors are causing climate change; 4) the effectiveness of current mitigation strategies and what they would propose.

The survey was handed out in person during an excursion to the study area on the 9th of April 2024. The randomised sampling of the survey was initially planned through randomising what direction to walk in North, East, South or West and interact with the first person encountered, randomise the direction again and repeat. Once in the area, the sparsity of people to interview became apparent. The day was spent canvassing the entire area multiple times and interacting with every single person that was encountered, this method led to a high rejection rate of about 50% but maintained the lack of bias whilst surveying. The survey took approximately 10 to 15 minutes to complete and the respondents verbally answered the questions whilst the responses were being transcribed.

Once the survey information was collected, further data collection was conducted as previously mentioned to retrieve data for mapping the study area and providing visualisation of the survey results, with regards to future sea level rise. The study area data was downloaded from Lantmäteriet and inputted into ArcGIS Pro. The data for sea level rise and elevation in the area was downloaded from Scalgo Live in ASCII format and converted to a raster for further analysis within ArcGIS.

3.3. Data Analysis:

3.3.1. The statistical analysis

Once the survey results were collected from 32 participants, analysis of the data was carried out with perceived sea level rise from the participants analysed against empirical data collected from the European Environment Agency and the IPCC. The results were analysed utilising Excel for the statistical analysis to see if the knowledge regarding future risks of sea level rise is correctly assessed. The analysis used descriptive statistics surrounding the demographic of the respondents and the Fishers Exact Test to detect if an association between the demographic characteristics of the survey respondents and their knowledge of sea-level rise was apparent. Although knowledge on climate change (sea level rise in this case) was assessed, the measurement of such knowledge was difficult since there is no uniform and standardised way to measure it (Tobler et al., 2012).

This study assessed the knowledge levels of respondents utilising a knowledge assessment scale developed by Veronica M. Mpazi and Kagoma S. Mnyika (Mpazi & Mnyika, 2005). Using this methodology, each question regarding perceptions and knowledge of sea level rise was scored as either correct or incorrect, with a value of 1 assigned for each correct answer and a value of 0 assigned for each incorrectly answered question. Following analysis, a frequency distribution was conducted to distinctly identify the highest and lowest scores, with 4 being the highest possible score as the assessment was based on 4 questions. Subsequently, a cutoff point was established to delineate levels of knowledge: low, median, and high as seen in Table 4. in the section 4.2. below. A total of 4 questions were used for the scoring process, assessing local knowledge on future sea-level rise in differing years. When assessing the accuracy of the estimates for sea level rise in the years 2040, 2060, 2080 and 2100 the correct answers were taken from the European Environmental Agency (EEA). The EEA based their answers on a mean for the RCP 8.5 emission scenario as seen in the Appendix figure 2 (*European Environment Agency*, n.d.). The range of the mean was utilised as the buffer for what answers were considered correct and incorrect. The range for the year 2040 was 0.14m to 0.25m, 2060 had a range of 0.25m to 0.45m, 2080 had a range of 0.35m to 0.65m, and 2100 had the largest range varying between 0.53m to 0.95m.

Once assessed, the level of their knowledge was then evaluated with the varying demographics of the respondents, this was assessed utilising a Fishers Exact Test on certain variables to test if there was a significant association. A Fisher's Exact Test is utilised when the sample size is insufficient for a chi-square analysis or when more than 20% of expected values in a chi-square analysis are less than 5 (4.5 - Fisher's Exact Test | STAT 504, n.d.). As the study collected 32 participants for the survey, the chi-square statistical test was invalid to use. Other tests, such as ANOVA, require larger sample sizes, similar to chi-square. Additionally, it requires parametric data, unlike the categorical data collected from the survey. For other tests such as Pearson's correlation, data needs to be continuous, unlike the data that was collected. Therefore, Fisher's Exact Test is the best suited analysis for the data that was analysed, if there was a larger sample size the association would have been assessed utilising chi-square.

The Fishers test was found to be more accurate than the chi-square or G-test of independence as it can test with samples of all sizes (Fisher's Exact Test of Independence - Handbook of Biological Statistics, n.d.). The Fishers Exact Test utilises two nominal variables, thus, for this test the knowledge assessment categories were broken down into two categories, no knowledge and some knowledge. Those in the low, median, and high knowledge categories were summarised into the 'some' knowledge category for this analysis as seen in Table 5. Section 4.1. of the results. The two categories of no and some knowledge were selected as opposed to no-low and median-high for representative reasons.

The Fisher's Exact Test assesses the null hypothesis of independence through applying hypergeometric distribution to the numbers in the cells of the table. Hypergeometric distribution function is utilised often within random sampling for statistical quality control (Hypergeometric Distribution | Probability, Sampling, Randomization | Britannica, n.d.). The created table for all analysis carried out was 2 × 2, with no knowledge/some knowledge on the columns and the assessed hypothesis on the rows; whether gender is associated with knowledge (male/female in the rows), if distance to the Baltic Sea is associated with knowledge (>1 km/ <1 km in the rows), and if length of time lived in a vulnerable area is associated with knowledge (>25 years/ <25 years in the rows).

Table. 1 – showcasing how the Fishers contingency table is constructed.

Fisher's Exact Test.	**No-Knowledge**	**Some-Knowledge**	**Total.**
Variable1	n11	n12	n1.
Variable2	n21	n22	n2.
Total.	n.1	n.2	n

The computation for probability of the Fishers contingency table with the associated cell frequencies was then calculated utilising hyper-geometric distribution as seen in Equation 1. below. Unlike most statistical tests, Fisher’s Exact Test did not use a mathematical function that estimates the probability of the test statistic; instead, it was calculated that the probability of getting the observed data, and all data sets with more extreme deviations, under the null hypothesis have the same proportions.

$$P\{n_{ij}\} = \frac{n_{1\cdot}!\, n_{2\cdot}!\, n_{\cdot 1}!\, n_{\cdot 2}!}{n\,!\, n_{11}\,!\, n_{12}\,!\, n_{21}\,!\, n_{22}\,!}$$

Equation 1. The Fisher's Exact Test Equation where the numbers in the equation are linked to table 1. ! represents a factorial where the number (n) in this case is multiplied by decreasing positive integers. P represents the probability outcome. (2 x 2 Contingency Table: Fisher’s Exact Test, n.d.)

To begin the analysis, all possible two-way tables are generated to provide a desired marginal total. Each table was calculated for a probability output using the calculation shown in Equation 1. above. Furthermore, each possible table was created utilising the extreme deviations, each table was created until 0 is reached on both tails of the probability. John H. Mcdonald of Delaware University states ‘a two-tailed probability when assessing Fisher's Exact Test should almost alway be used’ as a two tailed probability tests for both directions of an association and a one-tailed tests for a specific direction of association (Fisher's Exact Test, 2017). Once all tables were created the probabilities of all combinations that have lower probabilities than the observed data were summed, this provides a two tailed p-value to compare with the significance level set at 0.05. If the output p-value was greater compared to the significance level then one can fail to reject the null hypothesis as outlined in Table 6. If the output p-value was greater than the significance level, the alternative hypothesis is then accepted stating the association between the independent variables is significant. The variables under consideration include examining the potential correlation between gender and knowledge level, proximity to the Baltic Sea (indicating vulnerability to sea level rise), and whether residing in a vulnerable area for an extended period increases one's awareness of sea level rise. These analyses were conducted using Excel, employing Fisher's test.

3.3.2. Visual Analysis

Once the statistics on the survey data had been calculated, further analysis was conducted to provide visualisation of the effects of the sea level rise. The sea level rise was mapped in the Falsterbo region regarding the highest emission outcome scenario under different years (as mentioned in the survey questions). The data was collected and inputted into ARCGIS pro. The data was then clipped to the study area and presented alongside the municipality and county. The sea level rise and DEM were clipped solely to Falsterbo and converted from ASCII format to Raster with the ARCGIS tool 'copy raster'. Once in Raster format, the varying sea level rise layers were set in the Scalgo live site based on the years 2040, 2060, 2080, 2100 and then downloaded (*SCALGO Live Global*, n.d.). To ensure the elevation layer was correct, the elevation was reclassified using the 'reclassify tool' in ARCGIS for each sea level rise layer. If the sea level rise was 0.75m, the elevation map was reclassified to ensure only areas below 0.75m were shown to see if the layers corresponded with one another. Maps were then created with a 1m DEM layer and sea level rise variables over four different years (2040, 2060, 2080, and 2100). This was based on the given values from the European Environmental Agency and four other maps were created with the calculated mean for the same four years from the survey results. The data for the survey results were quantified in Excel. The maps were created to provide a visual comparison between the provided knowledge from the EEA on sea level rise in the area and the local knowledge of the residents living within Falsterbo. The maps created showcase how the region may be affected if the necessary mitigation and adaptation measures are not taken into account under the RCP 8.5.

4. Results:

The Results are presented in two steps. Section 4.1. aids in answering the objectives 1,2 and 3 by outlining the survey results and the knowledge assessment, assessed with the statistical Fisher's Exact Test. Section 4.2. displays the answer to the objectives 4, providing visual representations of rising sea levels in Falsterbo.

4.1. The Survey data:

The conducted survey led to a collection of 32 respondents. The analysis showcased that 50% of those interviewed were females and 50% male. Of all respondents, 69% were over the age of 50, with the mean age at 58 years for those interviewed. Furthermore, on the length of time lived in Falsterbo the results displayed that all respondents (100%) had lived in Falsterbo for 3 years or more, with 50% having lived there for more than 25 years. 78% of respondents lived within 1km to the nearest waterbody.

It was important to also ascertain how the respondents perceived their own level of knowledge on sea level rise. Out of the 32 respondents 44% found they had a moderate to very high level of knowledge regarding sea-level rise with only 15% considering themselves to have a very high level of knowledge. Among those who considered their knowledge level very high they also availed of all sources to inform themselves about sea-level rise as stated below in Table 3.

Table 2. - Descriptive results of the respondents' demographics calculated utilising Microsoft Excel.

Participants demographic:	Number.	Percent.
Participants That Are Male	16	50%
Participants That Are Female	16	50%
Participants Over The Age of 50	22	69%
Participants Under The Age of 50	10	31%
Lived in Falsterbo Over 3 years	32	100%
Lived in Falsterbo Over 25 years	16	50%
Participants Living 1km or Closer To The Water	25	78%
Participants Self Assessed Moderate to High Knowledge	14	44%
Participants Self Assessed High level of Knowledge	5	16%

The sources of information for the survey respondents is outlined with 81% availing of news and varying forms of media sources to inform themselves and 50% relying on information to be given by the local authorities, 34% read up on scientific reports and 50% of respondents collect information on sea level rise from their own personal considerations. 25% of respondents inform themselves on all of the above resources.

Table 3. - Information sources of respondents.

Where have you heard information about sea level rise?	Number.	Percent.
News & Media	26	81%
Local Authorities	16	50%
Scientific Reports	11	34%
Personal Observations	16	50%
All of the above	8	25%

The results from the knowledge assessment presented below, which utilised four questions when scaling the participants' knowledge level. 2 participants scored average to high, 6 participants were ranked as low knowledge and 24 were placed in the not very knowledgeable category. These results indicate a lack of higher knowledge levels in regards to future rising sea levels with over 75% of participants incorrectly answering every question. Although, as displayed in Table 3, every participant stated they availed of differing sources of information on sea level rise.

Table 4. - Knowledge assessment analysis, the awarded grade for the knowledge assessment is listed in parentheses next to the knowledge level.

Level of Knowledge	Frequency	Percent
Not Very Knowledgeable (0)	24	75%
Low Knowledge (1)	6	18.75%
Average Knowledge (2)	1	3.13%
High Knowledge (3)	1	3.13%

Once the knowledge assessment was reclassified for the Fisher's Exact Test showcased in Table 5. The majority of respondents were still placed in the no knowledge category scoring 0 in the conducted assessment.

Table 5. - Recategorised knowledge assessment analysis.

Level of Knowledge	Frequency	Percent
No Knowledgeable (0)	24	75%
Some Knowledge (1-3)	8	25%

The results outlined in Table 6, showcase how none of the statistical tests displayed significance, with distance to the sea having the least significance with a p-value of 0.73, and length of time having a p-value of 0.45. Gender and knowledge level had the smallest deviation from the set significance level of 0.05 with a p-value of 0.129.

Table 6. - Fishers Exact Test results.

The Accepted Null Hypothesis For Each Fishers Exact Test.	Significance Level	P-Value.
There is no association between gender and knowledge level.	0.05	0.129
There is no association between length of time lived in Falsterbo and knowledge level.	0.05	0.453
There is no association between distance to the Baltic sea (vulnerability) and knowledge level.	0.05	0.728

When answering question three of the objectives of this study it was important to ascertain the respondents current perceptions of efforts to address sea level rise. Therefore, this question is outlined in section 3 of the survey featured in the appendix figure 1. Respondents were asked to rate the current efforts in addressing sea level rise. The results are showcased in Table 7. below. The mean response found the respondents perceiving current efforts as just above average. With the mode (the most common answer) at 1 highlighting the residents' perception of current efforts being poorly handled.

Table 7. - Respondents perspectives of existing sea level rise adaptations and mitigations.

How effective are current efforts to address sea level rise?	Number	Percent
Average rating	2.7	
Amount who perceive it's being handled optimally (i.e., rated as 5)	5	16%
Amount who perceive it's being handled poorly (i.e., rated as 1)	10	31%

4.2. Analysed visual representations of Sea level rise

The sea level rise maps are outlined below with all figures utilising a 1m DEM layer ranging from -0.48 to 18 metres in height. The sea level data varies in heights according to the assessed predicted values under the RCP 8.5 scenario and the mean values of the participants answers from the survey. All data was downloaded from Scalgo Live for the analysis. The effects shown in the below figures represent the sea level rise increase on the current sea level and the knock-on effects in land with increase of water levels inland considering the elevation.

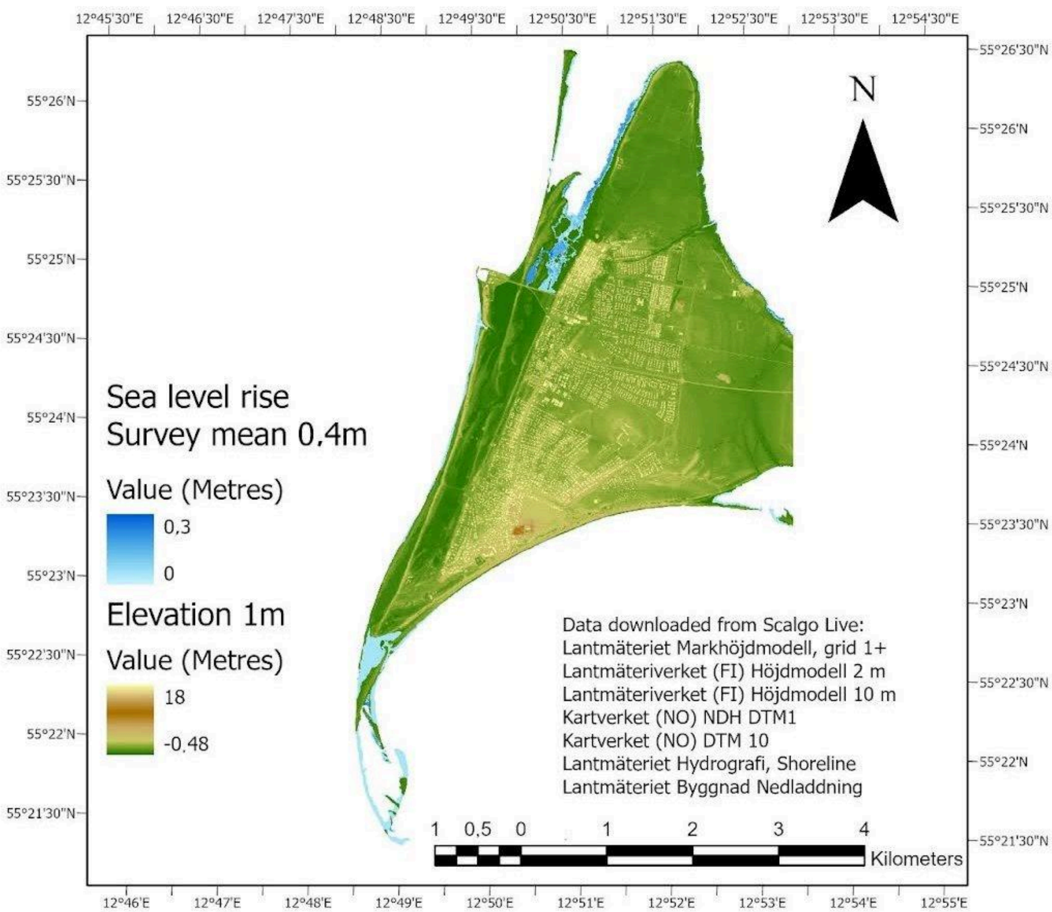

Figure 2. Sea Level rise in the Falsterbo region based on the mean of survey responses for the year 2040 under the highest emission scenario of RCP 8.5.

Figure 2 depicts sea level rise for the year 2040 based on the average of the responses to the survey. The peninsula and Northern areas have light flooding. The sea level rise is 0.3 metres on land (although set at 0.4m) which is only 0.07 metres difference from the estimation for 2060 by the EEA. Therefore, the respondents estimates are very similar to mapped data from later years, despite the estimations being 20 years apart.

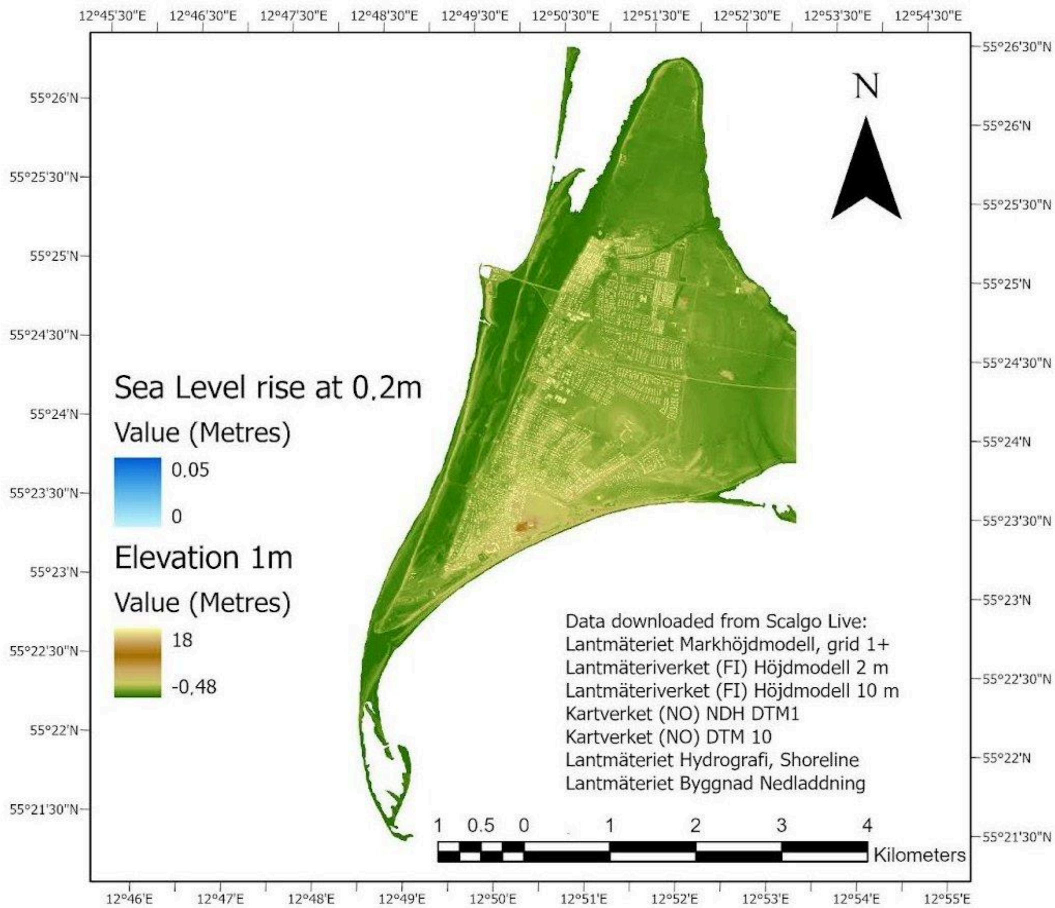

Figure 3. Sea Level rise in the Falsterbo region as outlined by the European Environmental agency for the year 2040 under the highest emission scenario of RCP 8.5.

Figure 3 displays sea level rise at 0.2 metres as predicted under the worst case scenario RCP 8.5. Visible within the map the sea level rise reaches a height of 0.05 metres which is hardly visible on land and poses no major threats of flooding with rising sea levels. The difference between figure 2 and 3s predictions is only 0.1m which is a slight over-estimation by the respondents, the effects of the 0.2m overestimation pose a significant difference in the flooding risks Falsterbo would face in the year 2040.

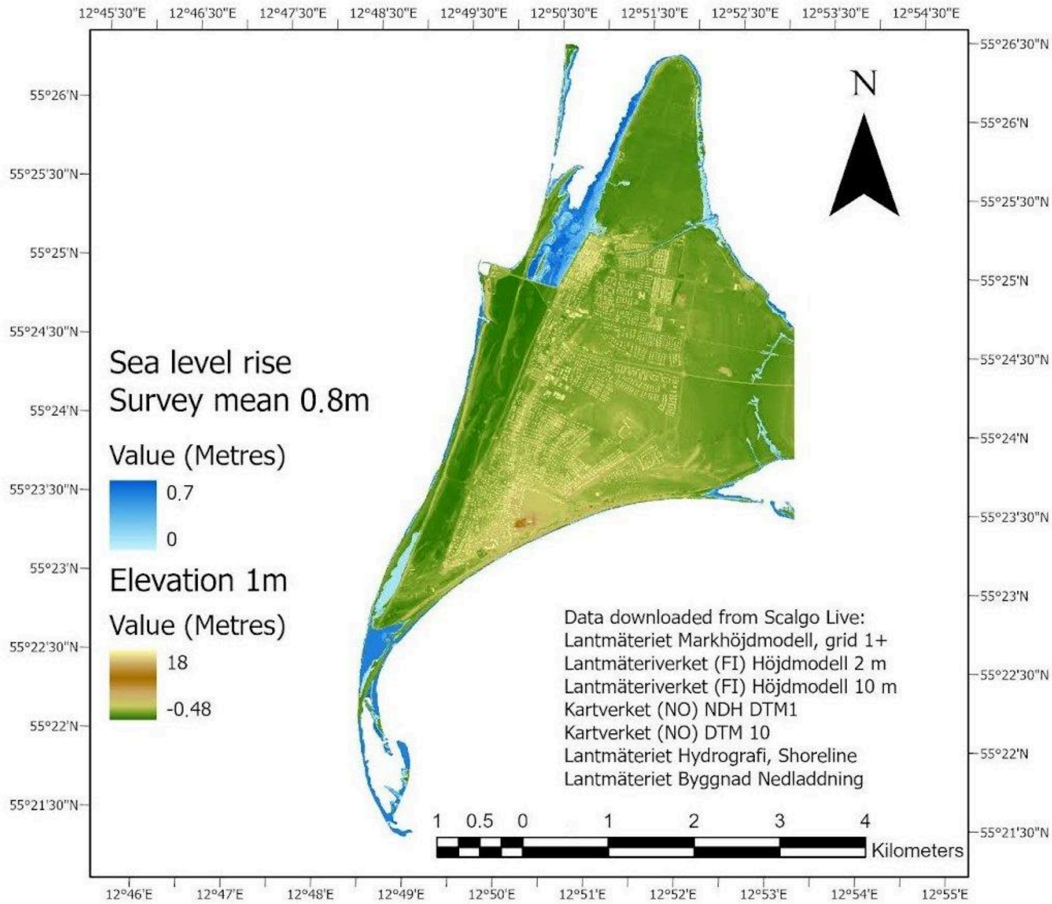

Figure 4. Sea Level rise in the Falsterbo region based on the mean of survey responses for the year 2060 under the highest emission scenario of RCP 8.5.

Figure 4 depicts sea level rise for the year 2060 based on the average of the responses to the survey, the peninsula and Northern areas are inundated, whilst the remaining area is unaffected by the predicted rising sea levels.. The sea level rise is 0.7 metres (0.8m downloaded from Scalgo) which is only 0.07 metres difference from the EEAs estimates for the year 2100. The respondents estimates, albeit incorrect for the year estimated, are representative of future years estimations by the EEA.

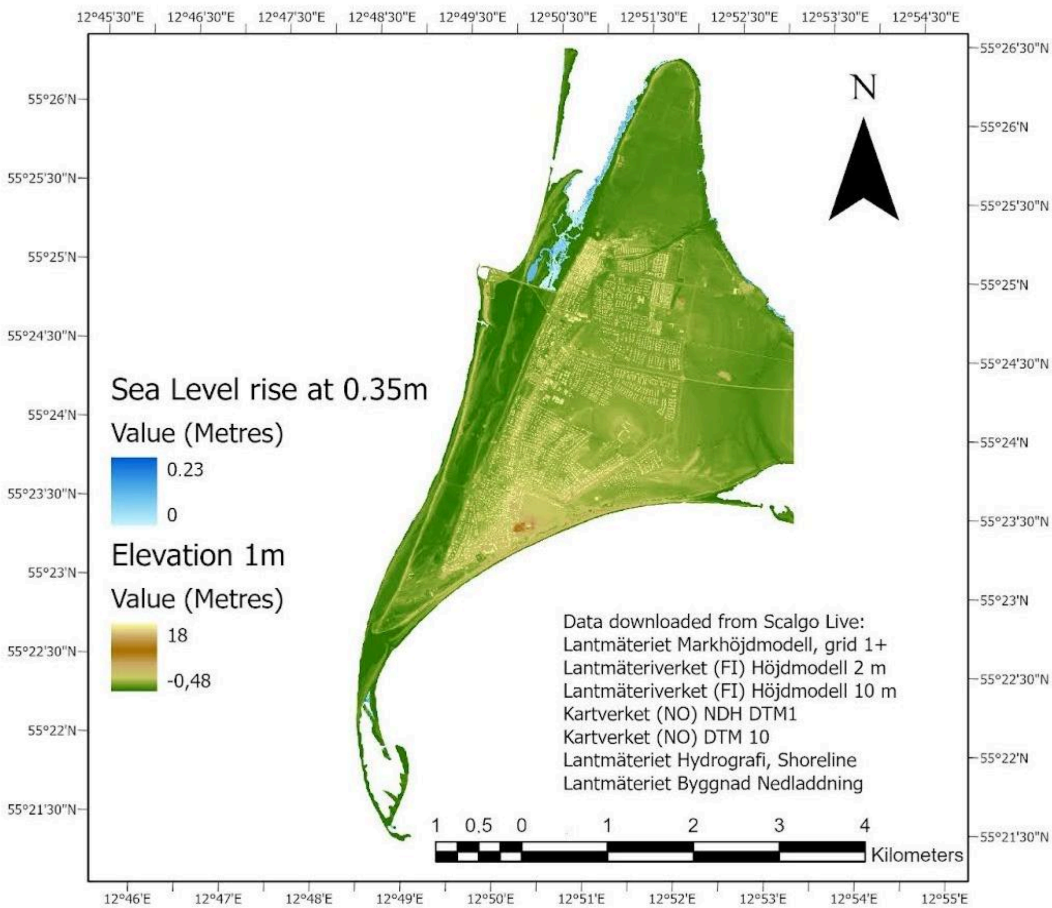

Figure 5. Sea Level rise in the Falsterbo region as outlined by the European Environmental agency for the year 2060 under the highest emission scenario of RCP 8.5.

Figure 5 showcases the potential effects of Sea Level rise in Falsterbo under the RCP8.5 scenario in the year 2060, assuming that no proactive mitigation or adaptation strategies are implemented. Under these conditions the sea level rise is predicted to reach a height of 0.23 metres on land (downloaded as 0.35m). The sea level rise effects are significantly less than the figures 6-9 below, despite minor flooding visible in the Northern region and the peninsula.

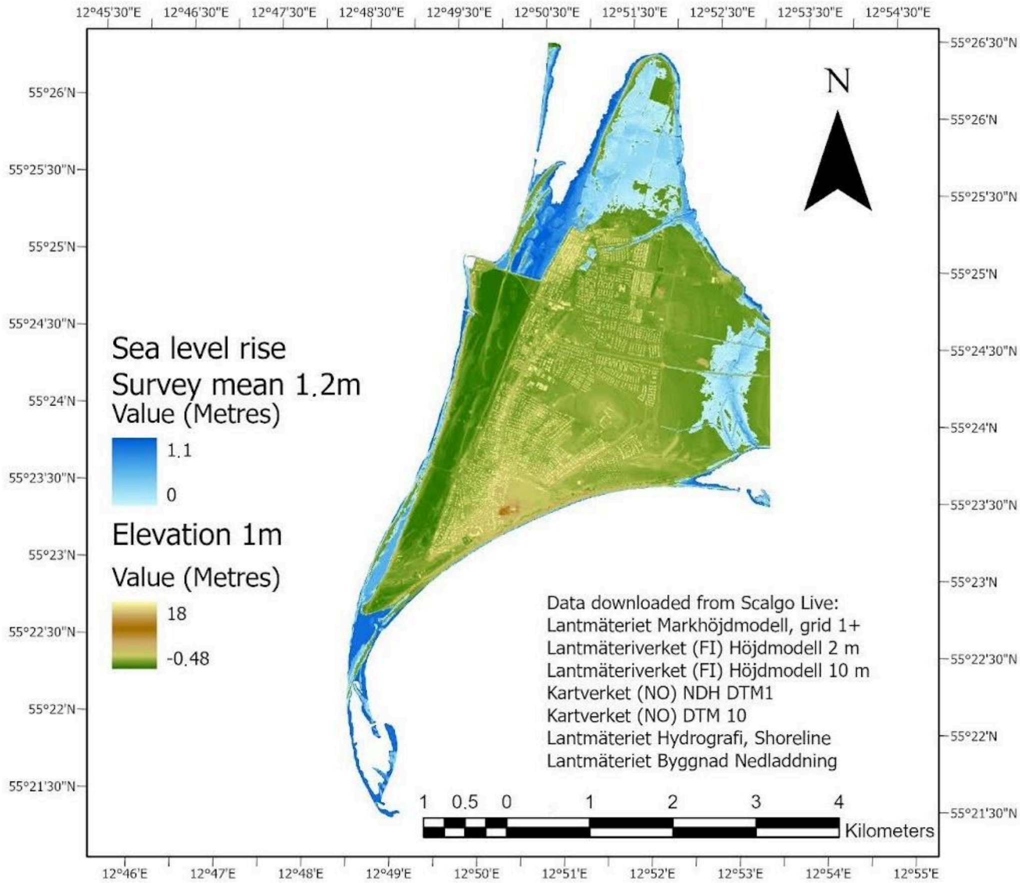

Figure 6. Sea Level rise in the Falsterbo region based on the mean of survey responses for the year 2080 under the highest emission scenario of RCP 8.5.

The figure above exhibits sea level rise in the year 2080. The sea level rise is based on the mean prediction from the survey participants in the region of Falsterbo mapped above. The mean response predicted sea level rise at 1.2 metres. The effects of this degree of sea level rise completely floods the peninsula, with the Eastern coastal flooding still occurring slightly. However, the central land area still remains unaffected by the flooding. Furthermore, there is a noticeable discrepancy between the predicted sea level in Figure 7 below and the survey's average prediction. Figure 6 shows that the sea level values have increased by 0.65 metres compared to the values in Figure 7, which is less of a gap than Figures 8 and 9 yet still significant.

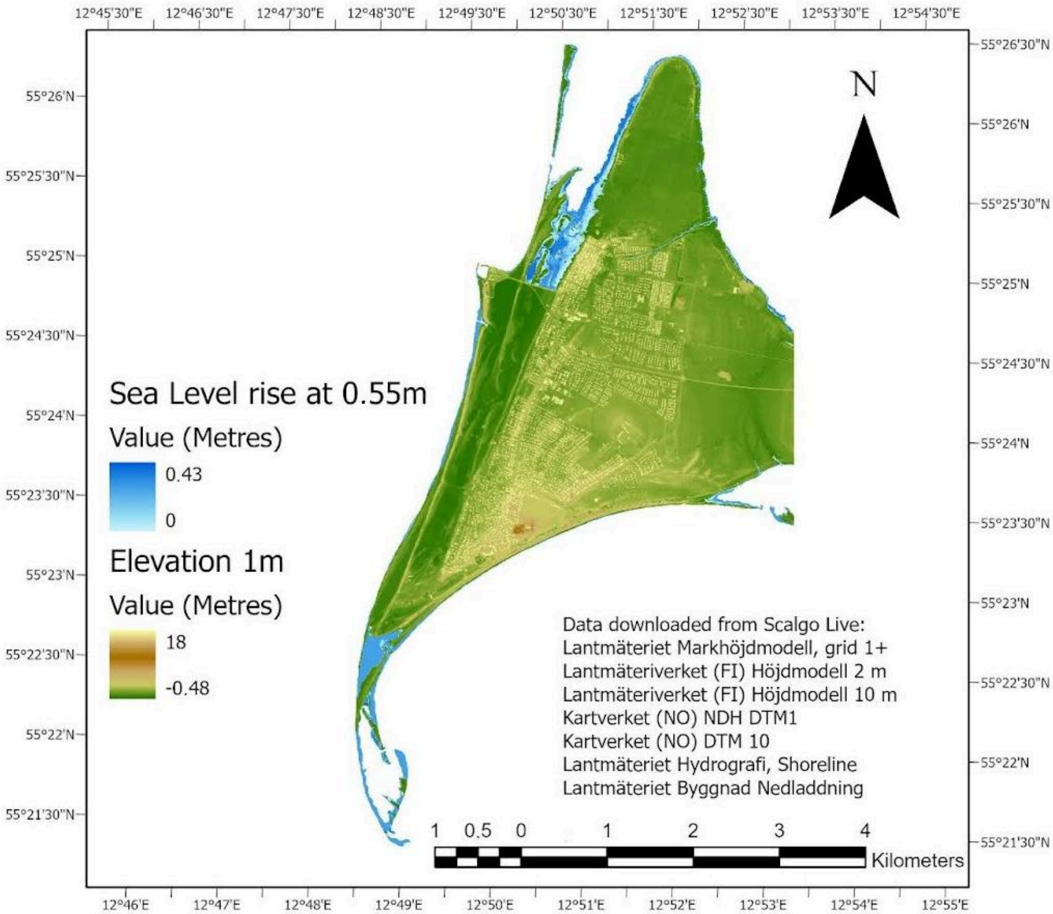

Figure 7. Sea Level rise in the Falsterbo region as outlined by the European Environmental agency for the year 2080 under the highest emission scenario of RCP 8.5.

The results showcase the potential effects of Sea Level rise in Falsterbo under the RCP8.5 scenario in the year 2080, assuming that no proactive mitigation or adaptation strategies are implemented. Under these conditions the sea level rise is predicted to reach a height of 0.43 metres on land although 0.55m increase on current sea levels. The sea level rise has significantly less effects than the sea level rise at 0.75 metres as shown in Figure 9. Nonetheless the peninsula is still significantly inundated, the Eastern region faces minimal effects of inundation. The Northern area is still mostly flooded yet the Western and central areas face no impacts from the rising sea levels.

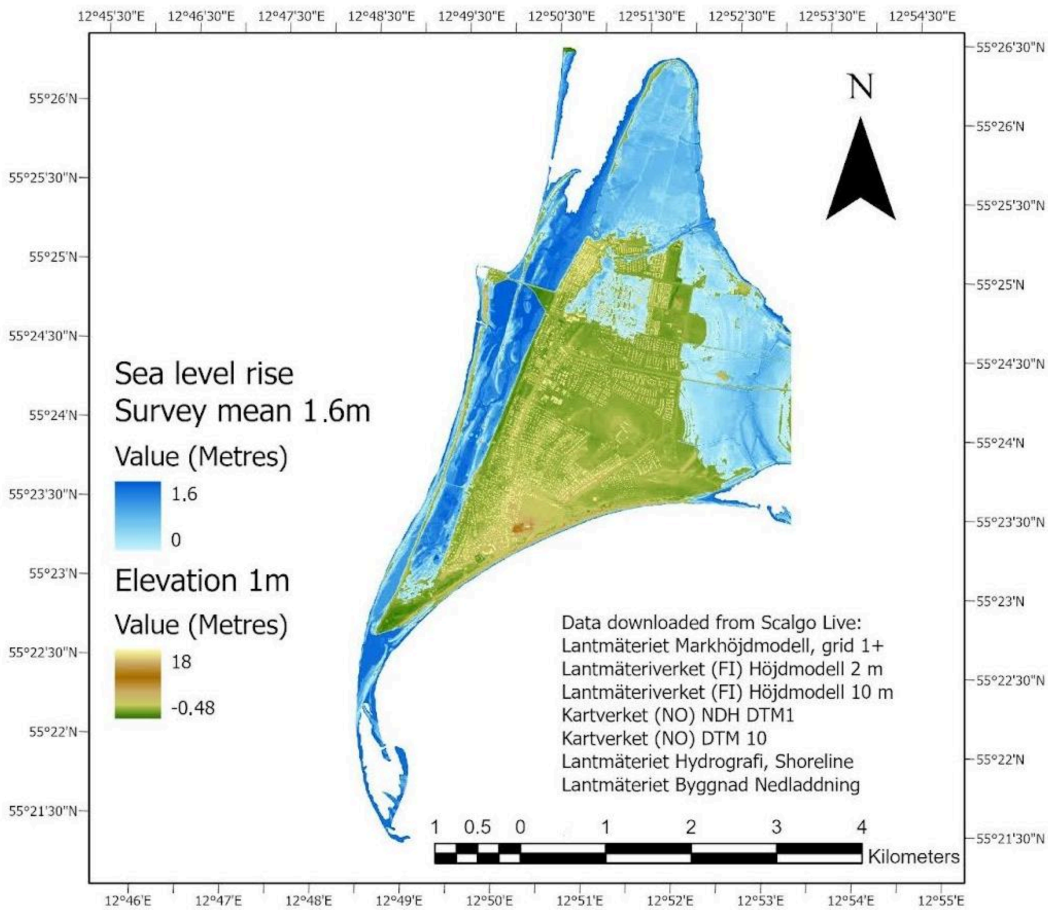

Figure 8. Sea Level rise in the Falsterbo region based on the mean of survey responses for the year 2100 under the highest emission scenario of RCP 8.5.

The above figure exhibits sea level rise for the same year as Figure 9 (2100). The sea level rise is based on the mean prediction from the survey participants in the region of Falsterbo mapped above. The mean response predicted sea level rise at 1.6 metres. The effects of this degree of sea level rise leaves the entire Eastern border completely inundated additionally, significant portions of the Northern and Western areas, although the central land area remains unaffected by the flooding. Furthermore, there is a noticeable discrepancy between the predicted sea level in Figure 9 below and the survey's average prediction which exceeds the sea level values shown in Figure 9 by 0.85 metres, a significant over-estimation. The near metre divide in estimates between Figure 8 and 9 highlights the knowledge gap between local knowledge and scientific data on climate change.

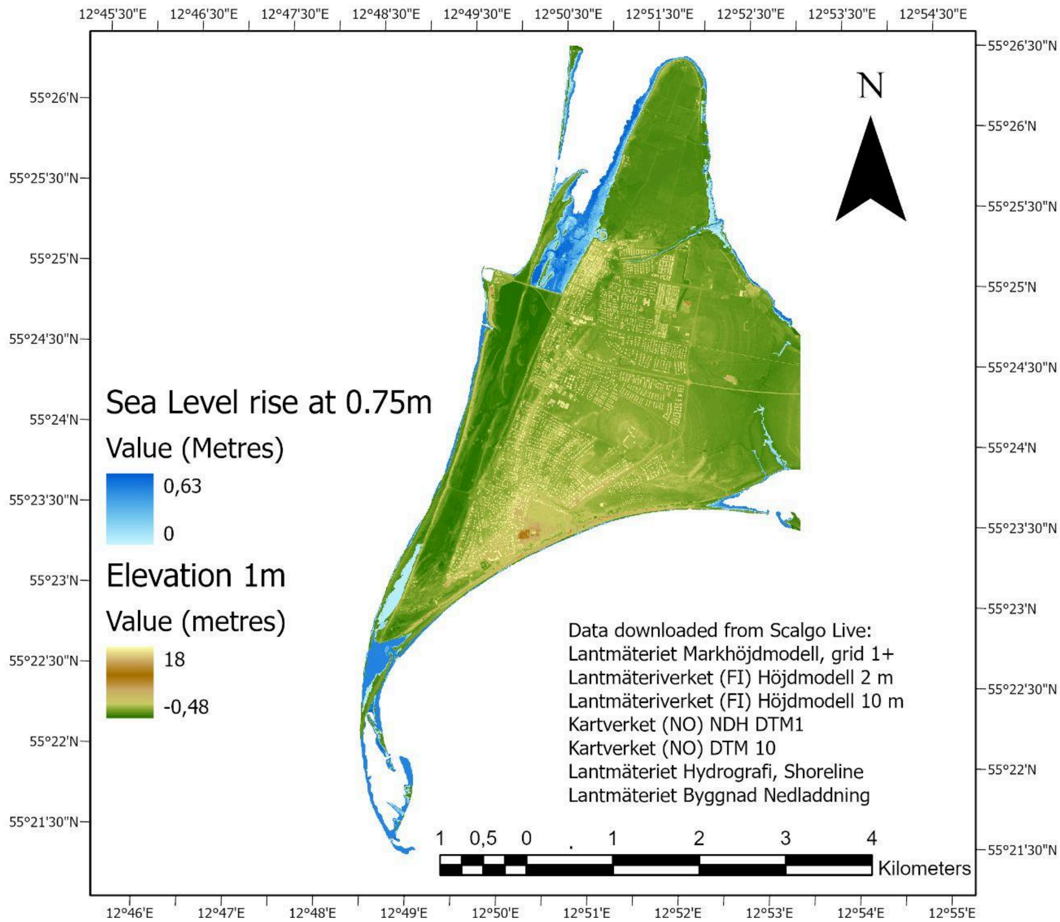

Figure 9. Sea Level rise in the Falsterbo region as outlined by the European Environmental agency for the year 2100 under the highest emission scenario of RCP 8.5.

These Results showcase the potential effects of Sea Level rise in Falsterbo under the RCP8.5 scenario in the year 2100, assuming that no proactive mitigation or adaptation strategies are implemented. Under these conditions the sea level rise is predicted to reach a height of 0.63 metres on land although a 0.75m increase of height on current sea level rise. This degree of sea level rise will almost completely inundate the entire peninsula in the South. In addition, the Northern region, closer to where Skanör resides, is expected to have more drastic flooding inland. However, it does not continue inland due to a 3m elevation of a natural barrier in the land preventing further flooding. The strip of land running alongside the coastline from the North East to South prevents further flooding to lower elevated areas.

5. Discussion:

5.1. Review of the analysis:

Within the results the descriptive statistics showcase the varying demographic factors of the participants but are these factors representative of the study area? The average age interviewed was 58 which aligns with the population distribution. The majority of residents in Skanör-Falsterbo fall between the ages of 40-64 at 32% (Vellinge kommun, 2024). The gender of the participants was 50/50 which was not intentional but happened to be the distribution of the residents encountered. All participants acknowledged having been informed of sea-level rise from varying sources of information as outlined in Table 2. The assurance of awareness on sea level rise led to a belief in the participants holding a higher knowledge level regarding future predictions. The demographic of the participants was reflective of the selected study area.

The expected outcome of this thesis with such widespread sources of information was that those in a vulnerable community would host a high degree of awareness regarding future predictions of sea level rise in their local area. However, the knowledge quantification proved this to be untrue with three quarters of participants guessing outside the range set for each future year prediction under the RCP 8.5. The range was utilised to allow a degree of variance in the correctness of the responses. The results of the knowledge assessment were unexpected as all participants said they availed of different sources of information and most rated their knowledge level on sea level rise quite high as seen in Table 2. With over 43% of participants ranking their knowledge moderate to high, these self-assessed perspectives on their knowledge level were not represented in the knowledge assessment. The misconceptions, evident when regarding future sea level rise, may stem from misinformation spread through different media sources or an overall lack of education on future impacts to sea level rise or the difficulty of the questions posed. The knowledge assessment led to a further exploration into if other factors may play a role in the degree of knowledge one possesses. This led to the Fisher's Exact Test being conducted for further insight into the knowledge gap in such an affluent vulnerable community.

The Fisher's Exact Test aimed to investigate the factors that may be associated with one's knowledge level regarding future risks. However, none of the assessed factors held association to the knowledge level. Gender was expected to not hold any association although it was hypothesised that length of time in a vulnerable area or distance to the rising sea levels may hold association; the general lack of knowledge discovered through the knowledge assessment showed there was no association. The knowledge level and lack of association places precedence on the evident knowledge gap between scientific data and local knowledge. The results highlight how those living in one of the most vulnerable environments in Sweden, with significant access to resources and information sources, possess a majority of low knowledge regarding the reason their community is vulnerable to climate change.

The survey estimates all ranged higher regarding sea level rise than the model predictions, this over-estimation regarding sea level rise was also analysed in New Zealand where similar responses were acquired with a majority of over-estimations from the general public (Weber & Stern, 2011). In Falsterbo the near 1m difference in respondents' estimated perceptions of sea level rise and the model output evidence was an unexpected outcome regarding local knowledge within these communities. The overestimation of future climate change predictions in the Falsterbo region may be due to a combination of factors as was similarly analysed in New Zealand (Weber & Stern, 2011). With the vast majority of participants availing of information from news and media sources as seen in Table 5. which often portray the worst case scenario, in hopes to maximise attention, this may have led to a perceived over exaggeration. Additionally, the wording of the survey, asking for a worst case outcome under RCP 8.5 may have led participants to over-exaggerate their assumed answers (Weber & Stern, 2011). However, overestimation of future climate change events may lead to accelerated support of proactive measures and personal accountability. In addition, over-estimating may lead to unnecessary fear and anxiety in assuming future scenarios will be much worse than predicted to be (Weber & Stern, 2011). Therefore, it is still important that those living in vulnerable areas should be prioritised in regards to correct information dissemination. The municipality and local policy makers or other informant sources should place precedence on taking active steps to ensure that the residents within Falsterbo are fully informed of the risks their community may face. Effective communication and information spread is evidently necessary to close the existing knowledge gap between science based predictions and local knowledge estimations.

Nonetheless, despite the inaccurate estimations from the local residents of sea level rise being extensively higher than actual predictions, these overestimated predictions emphasises the importance of the accurate environmental monitoring that takes place (Weber & Stern, 2011). Environmental monitoring aids in learning what adaptations are necessary, whilst also highlighting the necessary increase of fact-based information being spread to these local communities. In light of the predicted sea level rise both by local residents and the official data, the construction of the sea wall in Falsterbo is validated as a necessary adaptation strategy. The predictions provided by research sites such as the European environmental agency and SMHI provide the necessary scientific basis for such infrastructure projects as the sea wall in Falsterbo.

To mitigate misinformation it is imperative that local policy makers intensify the efforts to accurately inform locals of climate risks and the protective measures being implemented as adaptation efforts. Outlined in Table 7 currently residents view the measures implemented towards sea level rise locally as average or less than. Moreover, the municipality of Vellinge should expand its climate focus to not solely adaptation measures but also proactive mitigation strategies, such as adopting local sustainable community practices for example encouraging individuals to live car-free which mitigates 2.4 tonnes of carbon dioxide equivalent per year (Wynes & Nicholas, 2017). Furthermore climate mitigation strategies can coincide with mitigating the current knowledge gap as local communities cannot work towards a more sustainable community if they are not accurately informed on the climate they are working to protect. By adopting not only the current adaptation efforts but enhancing accurate community knowledge and engagement, Falsterbos adaptation and mitigation practices will better navigate the challenges posed by climate change and specifically rising sea levels.

5.2 Limitations

The initial research on the background consisted of many documents found entirely in Swedish. Finding information on a smaller community in Sweden exclusively in English posed a greater challenge than anticipated. Many of the Swedish sites or articles found were translatable into English. Unfortunately, not all pdfs have a translation function so those articles were inaccessible for background research. The formulation of the survey led to difficulties, for example finding research conducted on similar communities in the west. A majority of previously conducted surveys focused on more open-ended questions without focus placed on statistical analysis.

The travel time to and from Falsterbo, resulted in over 4 hours due to delays, this consequently left less time than anticipated for infield data collection. The methodology for excluding bias whilst surveying was scrapped once in the area and the sparsity of people was acknowledged. The procedure shifted with a large portion of the time surveying spent on canvassing the entire area in search of people. Once encountered every person was asked to participate in the survey. However, this led to a high rejection rate of approximately 50% which left a remaining 32 participants, of which many stated a preference to not speak english. The presented language barrier may have posed a difference in the accuracy of capturing participants' responses. As only 32 participants were interviewed, less than 1% of the population was represented in the survey responses, having a greater sample size would have led to a more representative sample in the analysis.

The knowledge assessment was based on four questions, which in retrospect should have been increased. As prior knowledge, quantification studies base their knowledge assessment off of 10 or more questions (Mpazi & Mnyika, 2005). Quantifying knowledge as a whole is inherently challenging. Especially when investigating climate science due to much spread of misinformation and varying perceptions this leads to a greater influx of opinions featuring in the knowledge assessments. The questions posed may also have been difficult to answer regarding giving exact numbers. Additionally, local knowledge can be investigated or valued in many ways. Therefore, to consider those who did not answer any of the four questions chosen for analysis correctly as possessing no knowledge entirely is incorrect. Rather the specification needs to be made that the responses indicate a lack of knowledge regarding those particular questions.

Sources of error surrounding the chosen statistical test, prior studies utilised the chi-square test when analysing association with survey respondents. The chi-square test was initially utilised within this study for analysis before realising the sample size was not large enough when testing with a chi-square test. The results and methodology utilised initially for analysis are explained in section 2. of the Appendix.

Furthermore, the analysis that was conducted when presenting figures for sea level rise, to highlight the knowledge gap between actual predicted data and the survey predictions. The concept to model sea level rise through ArcGIS Pro was initially explored, but due to time constraints creating a sea level rise model would have been outside the time scope of this study. Furthermore, finding data that allowed for presentation of sea level rise was the next challenge. There are many models of sea level rise globally, however, many of them are closed access. Scalgo Live was one of the only sources found to allow sea level rise data to be downloaded into ArcGIS Pro for analysis; comparison of two models would have increased the map accuracy.

5.3. Future studies

If the study was to be expanded on or alternatively further investigated, it would be interesting to model the adaptation measure of the sea wall being built in Falsterbo. To further investigate specific comparisons between survey respondents' estimates of sea level rise and the empirical predictions the sea wall was based on. Additionally, an expansion on the knowledge assessment conducted to include more questions when assessing the degree of knowledge, such as analysing knowledge of not only future events but past climate change events as well (such as major flooding events in the region). Additionally, an expansion on what knowledge is being tested on to include other environmental factors regarding climate change outside of solely sea-level rise, for example; change in temperature or to further investigate change in precipitation levels. Subsequently, once knowledge is assessed the expansion of local information regarding sea level rise is necessary through the local media and municipalities. In addition, reevaluate the steps towards including local perspectives in the climate change debate, specifically in communities in the global north. Ultimately, any future studies that will evaluate the importance of ensuring a higher degree of knowledge regarding climate change are crucial for the multifaceted approach towards tackling climate change.

6. Conclusion:

This study highlights the significant gap in local knowledge in regards to sea-level rise within the selected study area of Falsterbo. This study aims to underscore the importance of incorporating local knowledge with responses to climate change, although the over-estimations in future predictions by local respondents discovered through this analysis needs to be tackled prior to the inclusion of local knowledge in Flasterbo.

The evidence presented within this thesis highlights the necessity for targeted initiatives and programmes for increasing understanding of the actual predicted climate change impacts. Knowledge enhancement in communities is not just about increasing the amount of information available but also ensuring that it is accessible and locals are encouraged to avail of it. With an increase in information spread from reliable sources such as local policy makers as opposed to media outlets there can be greater engagement from the Falsterbo community with their local municipality towards future mitigation and adaptation projects and possibly a reduction of climate induced anxiety (Weber & Stern, 2011).

Ultimately, this thesis advocates for local communities to be more involved in the development and implementation of climate change strategies. It aims to highlight the importance of awareness surrounding the topic of climate change. As the world's temperatures increase annually and the risks due to climate change increase with it, it is more important than ever that education on such a vital topic is prioritised. Everyone should have a say in how to tackle these definitive future global problems. The environment cannot be prioritised if people do not know enough about it.

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8. Appendix:

Section 1; Demographic of participant

- Age: ______________________
- Gender: ___________________
- Length of residence in Falsterbo: __________________
- How close do you live to the water? (approx km): __________________________

The 1 to 5 scale represents: (1: no knowledge/no concern to 5: High Knowledge/High concern)

Section 2: Perceptions and Knowledge of Sea Level Rise:

- How well informed are you on sea level rise? 1 2 3 4 5
- In the future years to come with Sea Level rise in Falsterbo, taking into consideration analysed worst case scenario RCP 8.5 - how much do you think Sea Levels will rise in the years from our current year: in (m,cm or mm)
  - 2040: _______
  - 2060: _______
  - 2080: _______
  - 2100: _______
- Where have you heard information about sea level rise? (News media, Local authorities, Scientific reports, Personal observations, Other (please specify)

Section 3: Understanding Causes, Impacts, and Adaptation

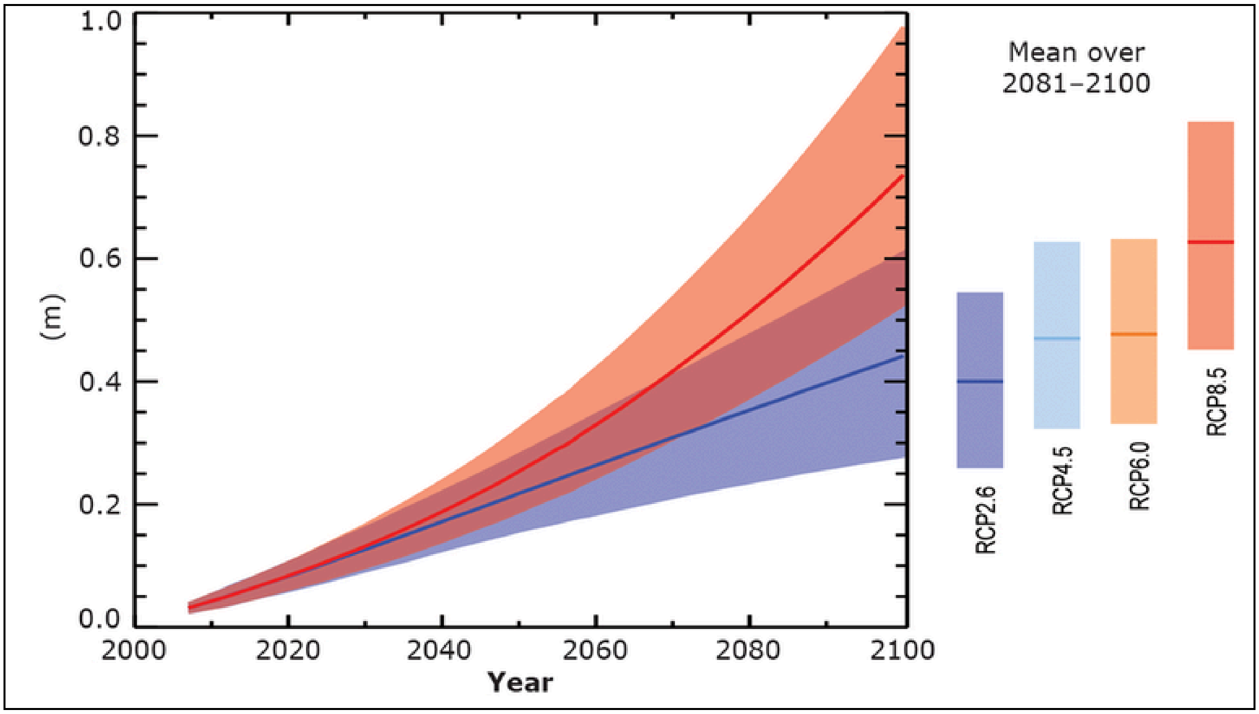
- What do you believe are the main causes of sea level rise? (Melting glaciers, Thermal expansion of oceans, Human activities, Other)

- What do you think are the biggest potential impacts of sea level rise on Falsterbo? (e.g. Coastal erosion, Flooding, Damage to infrastructure, Other)

- How effective do you believe current efforts to address sea level rise are? 1 2 3 4 5
- What added measures do you think could be taken to adapt to sea level rise in Falsterbo?

- Additional Comments:

Appendix. Figure 1. - The presented Survey during in field data collection in Falsterbo.



Appendix. Figure 2. - The European Environmental Agency's graph for predicting sea-level rise within Europe under the emission scenarios of RCP 2.6 and RCP 8.5.

Appendix. Section 2. - Outlining the Chi-square methodology initially used:

The methodology for the chi-square test differs significantly from Fisher's Exact Test as the steps for a chi-square involves a systematic computation process, starting with the collection of observed data to populate an observed frequency table (O). Each category, such as 'male with high knowledge' or 'female with low knowledge', is noted, based on survey responses. The observed table is utilised to create an expected frequency table (E). This is showcased below in equation 2:

Expected value = (The specific (O) row total x The specific (O) column total) / the overall total of participants

Eq.2

Once the expected range is calculated the test is invalid when more than 20% of expected values in a chi-square analysis are less than five, which was the case in this analysis. However, this condition was not realised until further computation was completed. Nonetheless, the further calculations were carried out utilising: the two prior created tables; the data table of observed ranges (O) and the table of Expected ranges (E), the next step was to utilise equation 3.below,

$$((O) - (E))^2 / (E)$$

Eq.3

With this table curated for each cell of the new Table 3 utilising the Equation 3, the X^2 (chi value) could now be found by summing up each cell in Table 3. The degrees of freedom was the last necessary calculation and can be calculated with Equation 4:

$$Df = (\text{Number of rows} - 1) \times (\text{Number of Columns} - 1)$$

Eq.4.

Once the degrees of freedom and chi value are found, the excel formula 'CHISQ.DIST.RT' is used to input the results of the chi squared value and the degrees of freedom to get an output for the p-value. A significance level of 0.05 was decided prior to the statistical analysis. If the output p-value is greater compared to the significance level than the null hypothesis is failed to reject. If the output p-value is greater than the significance level the alternative hypothesis can be accepted, stating the association between the independent variables is significant.

Nonetheless, once the Chi-square test was completed the constraints on the sample size and expected frequency were realised leading the results to be invalid. Although, comparing the results with Table 5 the association was insignificant, with all calculated variables (the same as the Fisher's Exact Test) being found to be greater than the set significance level as seen in Table 8 below.

Table 8. - Chi-Square test results.

The Accepted Null Hypothesis For Each Chi-Square Test.	**Significance Level**	**P-Value**
There is no association between gender and knowledge level.	0.05	0.149
There is no association between length of time lived in Falsterbo and knowledge level	0.05	0.184
There is no association between distance to water (vulnerability) and knowledge level	0.05	0.792

In addition, the next steps to find which statistical test led to the utilisation of the statistical Fisher's Exact Test. The Fishers Test is commonly used when the conditions for a chi-square are not met. The Yates correction was also a plausible alternative and is possible to employ when chi-square conditions are not met. Yet many studies found the Yates correction to be unreliable and too conservative when used in calculations. Therefore this method was disregarded, leaving the Fisher's Exact Test as the chosen analysis method. It was best suited for the sample size and was recommended as the strongest alternative to the chi-square test (*Which Test Should I Use to Determine the Statistical Significance of a 2x2 Contingency Table? Chi-Square? Fisher's Exact Test? Something Else? - FAQ 1114 - GraphPad*, n.d.).