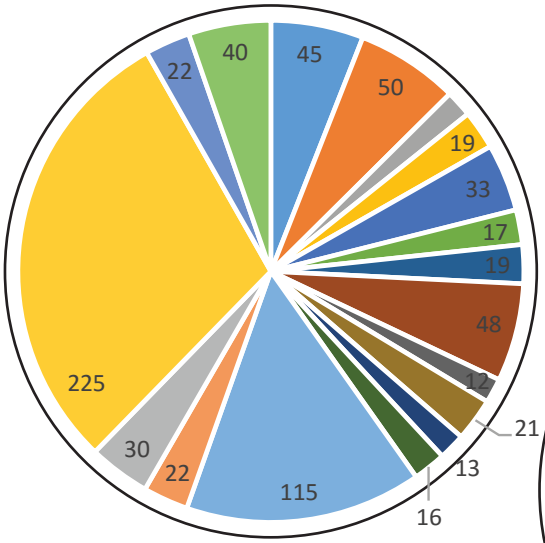
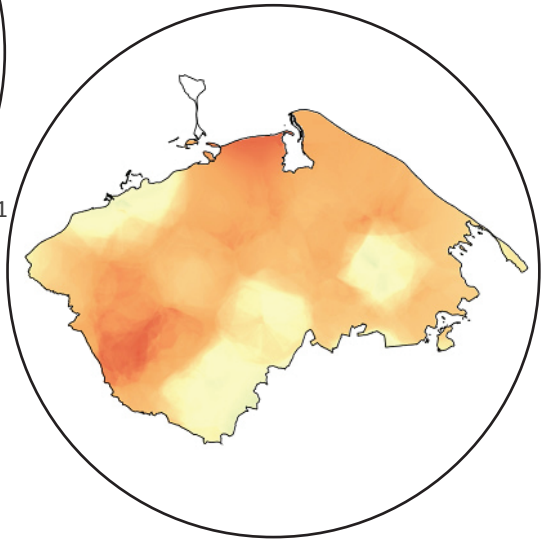
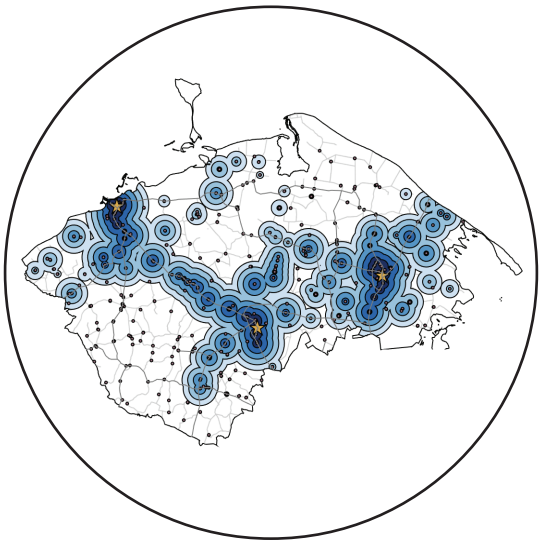
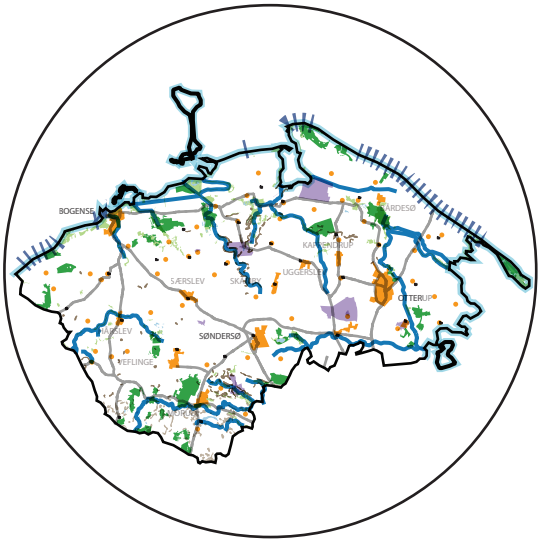
# EVALUATING RURAL DEPOPULATION BY COMBINING DEMOGRAPHICS, REAL ESTATE, LANDSCAPE ANALYSIS AND TRANSPORT OPPORTUNITIES WITH GIS TOOLS





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Aalborg University
MSc04 Surveying, Planning and Land Management
February 2016 - June 2016

AALBORG UNIVERSITY
*Students' report*

**Aalborg University**
**Study programme:**
**MSc in Surveying, Planning and Land Management**
**with specialization in Surveying and Mapping**
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**Title:**
Evaluating rural depopulation by combining demographics, real estate, landscape analysis and transport opportunities with GIS tools

**Project period:**
February 2016 - June 2016

**Participants:**
Adela-Ioana Moldovan

**Supervisor:**
Jan K. Staunstrup

**Number of copies:**
3

**Number of pages:**
80

**Submission date :**
8th of June 2016

**Abstract:**

Rural depopulation is a process happening word wide and has significant consequences on planning the cities where people choose to move, but most important, there is a strong focus in understanding the needs of the inhabitants that have not left their houses in search for a better location, or to formulate solutions in order to prevent this movement. For being able to find and to minimize the areas that are suffering from depopulation, the thesis is built around identifying aspects which are having a considerable impact when deciding to move from or into a new settlement. The process will be taken further by working with demographics, real estate data, landscape capabilities and public transport features, in this way the analysis being developed in the shape of new maps, tables and diagrams that will have the purpose of facilitating the vision behind the research and also getting a more precise understanding of rural depopulation by exemplifying with existing situations and numbers. It was discovered that in case of combining the results given by the various solutions, can be identified non-expected patterns which lead the student to achieve more knowledge of the subject.

Adela-Ioana Moldovan

# Foreword

This thesis is written by Adela-Ioana Moldovan, master student at Aalborg University and it is meant to summarize and to conclude the main aspects of the education taken in Surveying, Mapping and Land Management with Specialization in Surveying and Mapping. It is a continuation of the research carried during a project-oriented stay at Urland as part of the 9th semester of studies, having the nature of a more developed work on the subject.

The working period consisted of 1st of February 2016 and 8th of June 2016 and was meant to produce extensive knowledge regarding the way GIS softwares can be handled but also it was a good way to learn how to combine the results with other types of data in order to build a final outcome.

In the report the chapters are marked with a name and a corresponding number. Appendices are identified by their name and a letter and the most important ones are listed at the end of the paper, while additional ones are given in the CD attached, which has a content description at the end of the report.

In case citations are used, it will appear in text as [Sunter, 2015]. They can all be found in Bibliography where are ordered by the last name of the authors and the year of publication.

Coordinates are in UTM zone 32N with ETRS89 as the datum. Most of the needed data is provided by Urland and because of this and their support, time and effort that the whole team has invested, the student would like to thank them and to show her appreciation. Also special thanks go to the supervisor Jan K. Staunstrup for trusting the process and for giving the right guidance.

# Contents

# Introduction to rural depopulation

1

*'Understanding and comparing social and economic trends can play an important role in identifying where cities are succeeding and falling, sharing best practice and assessing where policy changes are needed', [Smith, 2014b].*

Nowadays there is a big change regarding demographics in the whole world as people are facing a global urban transformation. This can be synthesized using existing numbers and future predictions given by the United Nations. Back in 1950, the percentage of urban population was at 30% but after more than 60 years, in 2015, this has modified to 54%. The strong process of urbanization is expected to take even greater proportions as in 2050, two-thirds of the world will be urban. When looking at the way the number of population has evolved over time, the changes are and will be very significant: starting with 740m people living in year 1950 in the cities, continuing with the actual status of 4 billion and rising in 2050 with a predicted value of 6.3 billions. [Smith, 2014a]

All these transformations have a basis in the economic and social aspects which influence the way inhabitants are willing to move from one place place to another. On top of that, it should be pointed that political decisions must be modified in accordance to a desired equilibrium between the areas covered by rural and urban settlements and this can be done by creating more opportunities for people living in the country side, such as: improved infrastructure or minimizing the distance to interest places by opening locations that are found as being relevant for the inhabitants.

The cause of urbanization is known as rural depopulation and it is the result of the migration of people from rural to urban areas. Because of this movement, communities are loosing their cultural identity, becoming unsustainable as the locations considered as amenities for the residents, are closing. The new identity gained after the movement does not have a positive impact in overall terms, as the available resources are reallocated. By taking the Danish example, there is a decline also in the agricultural activities as large farms become more popular than the small sized farms that people used to have in the old days, by this increasing the livestock, but decreasing the activities in which people can be involved. The process of relocation is very significant mostly in places that are not easy to access, in the ones where the interest points are missing or their number is very small, [Moldovan, 2016]. These points are considered the public or private spaces that meet the basic needs of population, such as supermarkets, schools or hospitals.

When looking at the way the number of inhabitants have changed for Denmark, there can be seen a positive growth in urban population and a negative one for rural areas. Figure 1.1

presents how the percentages have changed since 1950, but there are also given future trends of the evolution until year 2050, as previously discussed for the whole world. The distinctions between rural and urban areas are differing from one country to another, but in the case of Denmark, the definitions have been previously investigated and mentioned in [Moldovan, 2016], as it follows: 'an urban areas corresponds to uninterrupted built-up area that does not exceed 200 meters between houses. This value may change only in cases where public spaces exist. A rural area is an open land region with non-continuously build-up areas and a small number of inhabitants. In other words, the countryside is the area located outside cities.'

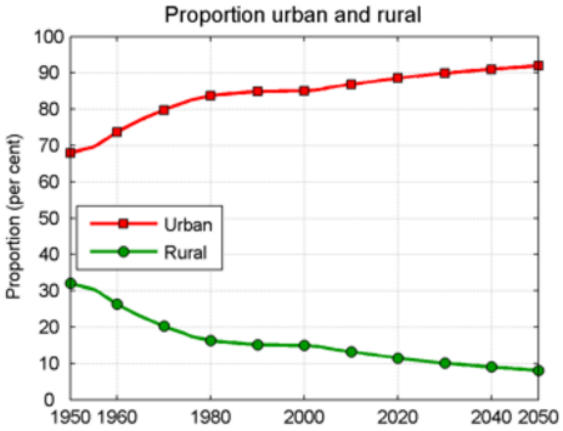


***Figure 1.1.*** *Urban and rural prospects, [United Nations, 2014]*

## 1.1 Factors and consequences

The causes that lead to rural depopulation are of course complex and multifaceted, and that is where theories and classifications play an important role. Because a significant number of individuals are moving to large cities, some areas are gaining a lot of people, being overcrowded, while small settlements suffer by this relocation, and in this way is not created a balance between the zones of the country. On top of that, most of the economic measures are focused on the areas with large concentration of inhabitants.

Because it is a very complicated process, it was desired to make a comprehensive diagram that can help the reader in understanding some of the reasons that force people to move towards the cities and what attracts people to the cities. Moreover, there are given the consequences that this process brings along with few solutions, as can be seen in Figure 1.2. There will be made a clear distinction in aspects such as unemployment or low salaries, which lay in the first category mentioned before, known as push factors; and pull factors which are, for example, better life standards or medical and educational facilities.

## 1.2 Isochrones

As it will be detailed in Section 1.3, it was previously discovered that in order to visualize the areas susceptible to rural depopulation, GIS methods can be handled, resulting in

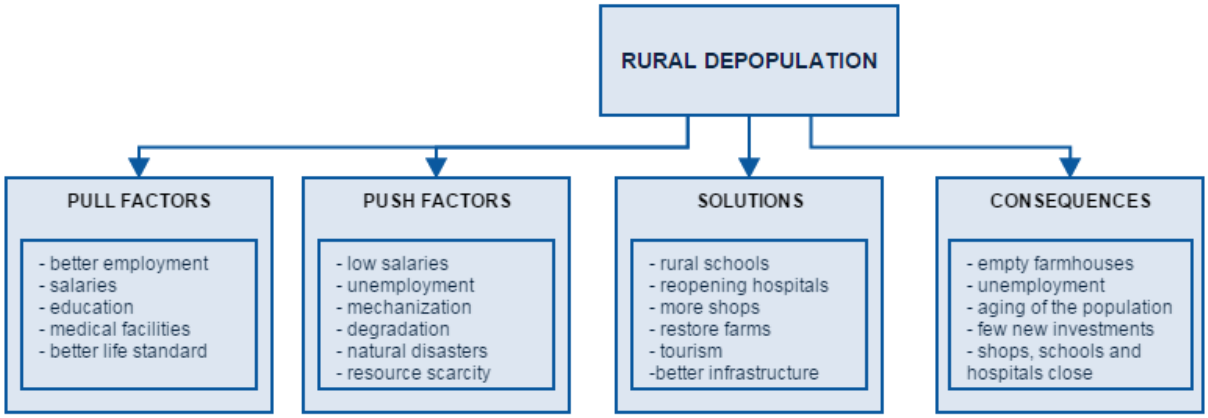


***Figure 1.2.*** *Diagram summarizing the factors, solutions and consequences of the rural depopulation, inspired from [University of Stellenbosch Telematic Services, 2013]*

maps that consist in areas that are accessible from a fixed point in a certain amount of minutes. These are called isochrones (iso=same, chronos=time) and they are very useful when making reachability analysis in case it is desired, for instance, to locate the right place for setting a new investment. Isochrones basically consist in a set of vertices which can be reached in a given period from a particular location.

This approach is used for identifying the correlation between transport time at one hand and depopulation dependency at the other hand with add-ons given by later introducing new aspects on top of this. It makes sense in the strong need that exists today for sustainable transport system but also for people living in the country side to understand which are the options that they might have regarding the transit to other locations.

Throughout different literature, isochrones can have various names but the most common ones are: travel time maps, reachability maps, travel-based maps, time contours and others.

## 1.3 Starting point of research

The basis of the research consists in a previous report that the writer made during the 9th semester as part of a company-stay with a young team of landscape architects from Urland. It was meant to provide a comprehensive understanding of the transport facilities for discovering the opportunities that settlements can hold, as places which are located closer to main cities can be more attractive for citizens and it also facilitates the dynamic between the urban and rural areas.

Even without reading the previous research, the facing one will give enough information for understanding the process, as it will be described in more details in Section 4.3 or can be found in complete version in [Moldovan, 2016].

The best example for assessing rural depopulation zones is to visualize the areas covered by 5 and 10 minutes drive from the large cities, as in Figure 1.3 and then to extract them as in Figure 1.4 and color the remaining part in order to be able to identify the zones that need further investments as they are susceptible to depopulation because of their hard

access and lack of amenities. If the process of rural depopulation has started, then it is necessary for authorities to take quick decisions for improving the existing infrastructure or for opening interest places for the people, in this way minimising the distance that they have to cover to reach, for example, the closest shop.

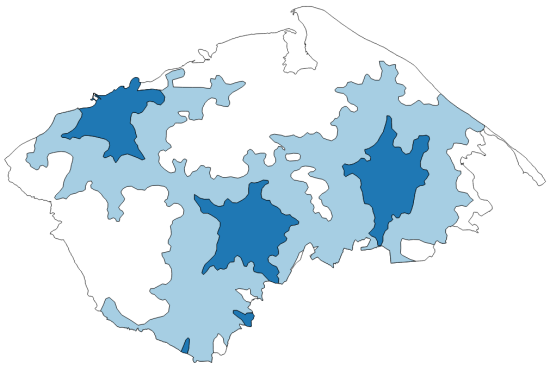

***Figure 1.3.*** *Areas covered by 5 and 10 minutes drive time in Nordfyns municipality*

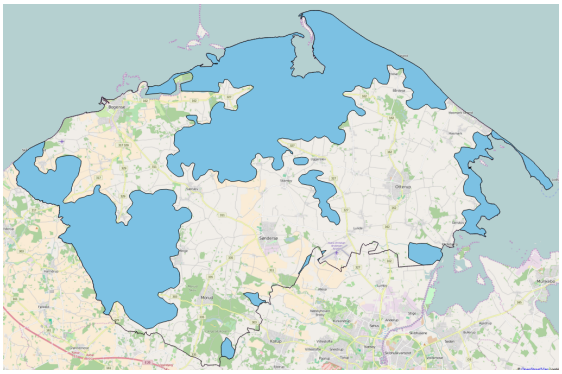

***Figure 1.4.*** *Zone that needs further investment*

The small villages from the blue part represented in Figure 1.4 can play different role in the development of the municipality. The ones located relatively close to towns can be an alternative in case of deciding to move out from the crowded areas. Some settlements can be considered attractive for recreational purposes, but there can also be another category of places that suffer from physical deterioration, have a strong need for maintenance, or they are located far away from the important points that people account for when living in a certain area. This last type is the most exposed one to remain uninhabited if there will not be taken any decisions that can produce major changes for communities. But it might as well happen that the municipalities are prioritizing the improvements needed for the large settlements, as these can provide the best facilities for the communities.

Because of the fact that the zones displayed above were not able to be compared with any other results of the same type, but just with the numbers of inhabitants for each city, it was desired to identify new solutions that can be combined for supporting the assumptions that were made in the starting point of the research, or for finding if there can be some changes in the outcome. That is why the first direction of the research work can be given by formulating the initial question:

**Why is depopulation a problem in the rural areas of Denmark and how can it me measured?**

## 1.4 Flowchart

This section is meant to give on overview of the project structure.

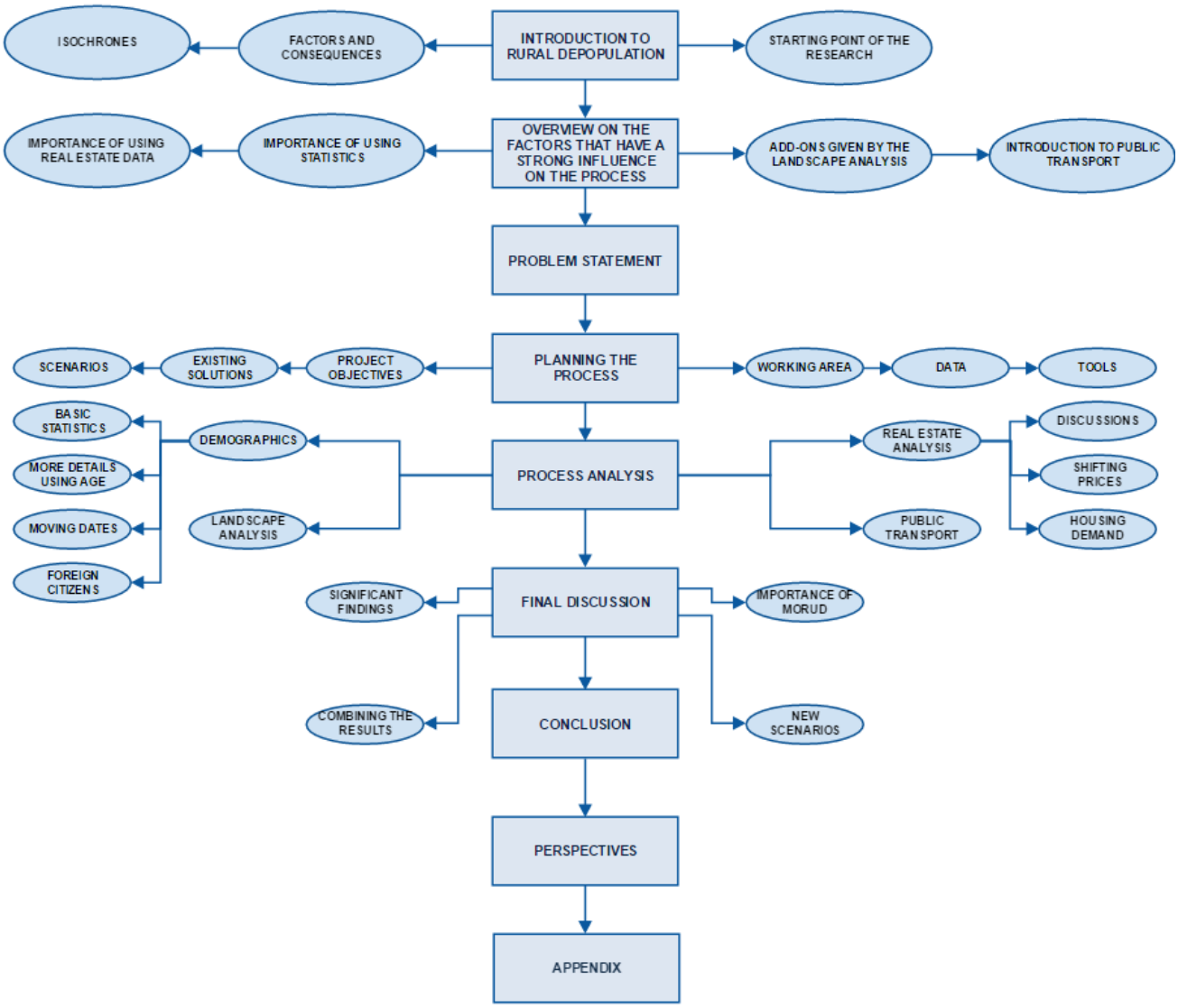


***Figure 1.5.*** *Flowchart of the project*

# Overview on the influencing factors 2

This chapter is built in order to provide a quick overview on the factors that have a strong influence on rural depopulation. The reader will be introduced to the theory behind using some of the best-known approaches for studying this process and will get familiar with their meanings and usability. Later, in Section 4.2 will be given more information for being able to understand their importance also from other's people points of view.

Because the previous research [Moldovan, 2016] was an introduction to GIS tools and to the problem of depopulation, in the facing report will be worked in more detail with this subject by considering some of the perspectives which were formulated and discovering the type of improvements that they can bring to the process. An introduction to these is given in the next sections.

The location analysis is a very important asset when deciding where to move. Along with this come all the aspects that play a decisive role in the development of a community, such as: demographics, economic prospects of the zone and potentials that rely in facilities like well-kept and attractive places, rivers, forests but also the closeness to main transport corridors or the opportunity of having quick access to public transport, as described in [Møller and Staunstrup, 2015].

The first feature implies understating the absolute and relative changes that occur over time in the number of population and in the way housing prices have modified. Then it should be made a GIS analysis of the public transport availability of the main cities from the study area, and the last part is built around the influence that the landscape can have for further decisions, by identifying the most desired features held by the municipality, but also the characteristics that are not to be expected in a neighbourhood.

## 2.1 Importance of using statistics

Density is an aspect of primary interest when working with sustainability researches, as it provides socio-economic patterns between the different areas of study, being an important factor in proofing the way numbers are changing for rural areas. Statistics enable a significant range of key indicators which are helpful for understanding the demographics.

Statistics Denmark (The central authority on Danish statistics) provided in January 2016 some interesting aspects which should be narrowed for the research area of the project in order to check if the numbers of the whole country can also be applied at smaller scale.

The indicators taken from [Statistics Denmark, 2016] are:

- total population of 5.7 million people
- median age 41.4 years
- 0.97 male per female
- (fertility rate) 1.73 children per woman
- population is growing with an annual rate of 0.22%

From the total amount of people, 87.67% are of Danish descendent which means that at least one of the parents was born in Denmark and has a Danish citizenship. The rest of 12.33% have a foreign background; this implies immigrants or descendants of immigrants, see Table 2.1. Most of these people are asylum seekers or persons that came for definite periods for study or work purposes. The most common countries of origin of the foreigners are: Poland, Turkey, Iraq, Syria, Germany, Romania, Iran, Afghanistan, Bosnia and Herzegovina.

| Population by ancestry in 2016 | |
|---|---|
| People of Danish origin | 87.67% |
| Immigrants | 9.47% |
| Descendent of an immigrant | 2.86% |

***Table 2.1.*** *Population by ancestry in Denmark in 2016, data from [Statistics Denmark, 2016]*

When considering the study area, which is Nordfyns municipality, it has been worked with the number of inhabitants for years 1982, 1993, 2002 and 2010, data that was provided by the supervisor. Figure 2.1 has the purpose to facilitate the visualisation of the way these numbers have changed over time by considering just the small settlements (with less than 100 inhabitants in year 1982) and displaying the years using different colors as it is presented in the legend. With orange color is the ascending order of the inhabitants from year 1982 and by comparing the corresponding line with the brown color used for representing the numbers for year 2010, it can be noticed that most of the settlements have suffered from a decrease in the number of population, and that is why it was chosen to exemplify just this category, as small settlements are the most likely to suffer from rural depopulation because of their lack of proper infrastructure or interest points.

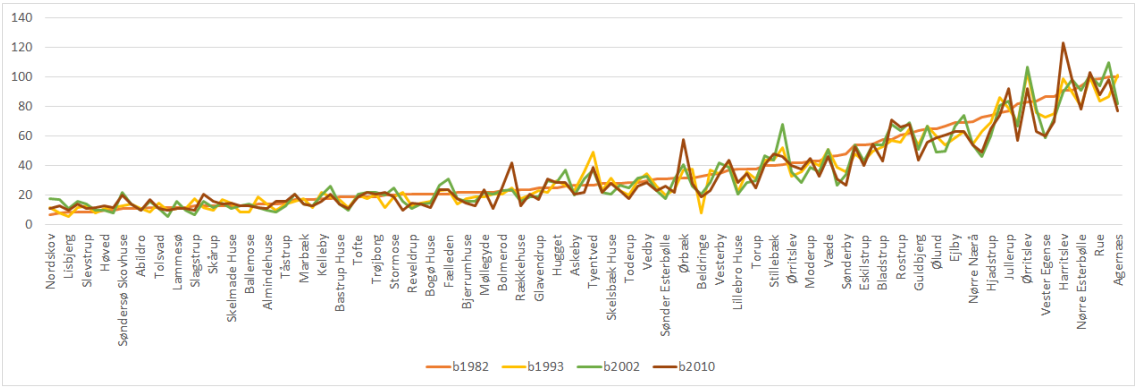


***Figure 2.1.*** *Evolution of the number of inhabitants in Nordfyns for years 1982, 1993, 2002 and 2010*

For a better understanding of the considerable modifications that have occurred in some places, it was chosen a particular case which is Tågerod and its changes can be identified in Figure 2.2. On the X axis are the different years, while the Y axis corresponds to the number of inhabitants. The same principle is also in Figure 2.3 where are the notable transformations from some of the middle sized settlements (Skamby, Lunde and Hårslev), which leads to the conclusion that not just small villages can have problems with the migration of people. This is happening because they have just one amenity that can satisfy people needs as it follows, [Moldovan, 2016]:

- Skamby: one kindergarten;
- Lunde: one kindergarten;
- Hårslev: one school.

By their decrease, the functions of the cities will also change as the needs of population become different based on the needs of people that have chosen not to change municipality.

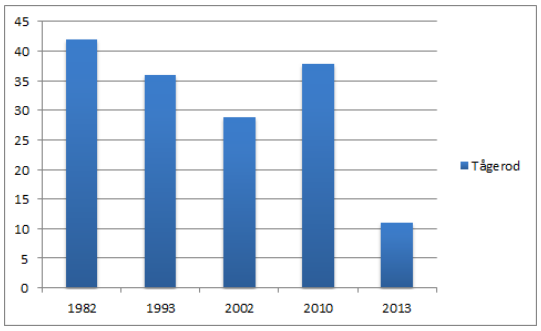


***Figure 2.2.*** *The changes in the number of inhabitants over years for Tågerod*

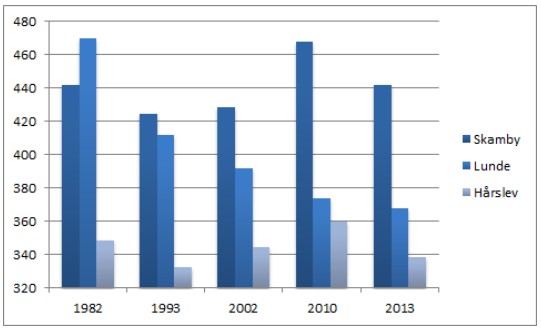


***Figure 2.3.*** *The changes in number of inhabitants over years for Skamby, Lunde and Hårslev*

It is challenging to discover what is the current status nowadays, as there was a boom in the number of immigrants in the last years. Moreover, usually they are given a place to stay further away from the main cities and they will have a large influence on the demographic trends. Also, it will be researched which other types of statistics can be relevant in the process.

## 2.2 Importance of using real estate

The purpose of using property values is to find out if there is any correlation between the individual housing prices and the population growth or decline. Maybe for some settlements there are several other factors worth to be taken in consideration when moving to a location (such as building size, distance to population centres or as described in Section 2.3) rather than just the value of the properties. The economic value is one of the key indicators for evaluating the sociological-based structures. On top of that, low property values can be an add-on for some people and this is not the result of an economically disadvantaged situation, but it can foresee a future wish for developing or improving the existing asset, [Møller and Staunstrup, 2015].

As described in [Skaarup and Bødker, 2010], Denmark has known a brisk growth of housing prices from the beginning of 2000s until early 2007 where the economic crisis played a significant role in the reverse development of the housing market, with prices declining rapidly until mid 2009, as presented in Figure 2.4. The fast evolution was derived from a consistent economic growth which was based on the establishment of mortgages that were not having payments for instalment and also had variable interest rates. In this way appeared a combination of low unemployment rates, succeeded by an increase in income and financial wealth.[1] After this period of major changes, the market appears to be

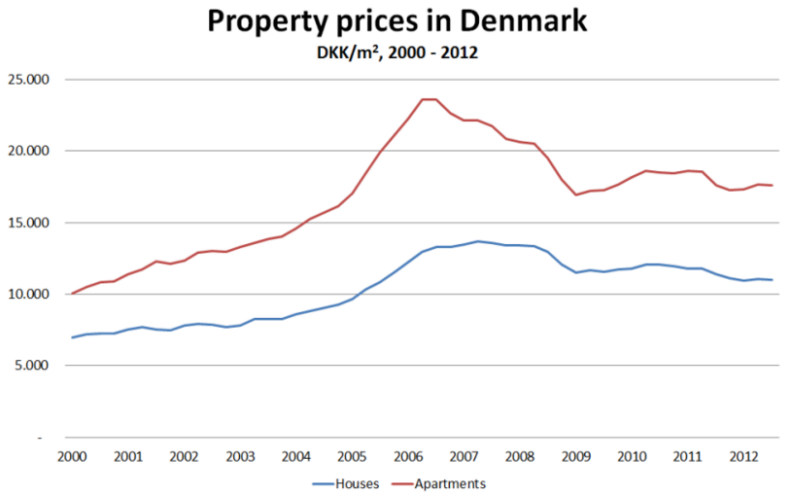


***Figure 2.4.*** *Evolution of property prices in Denmark, [RobinHus, 2014]*

normalized due to the support coming from the Government which targets the depositors through their protection and by offering guaranties, [RobinHus, 2014].

In Table 2.2 is represented the development of housing demand for Denmark in years 1981, 1990, 2000 and 2008. It is interesting to find out how these numbers have changed, in order to understand the current needs of population.

| | 1981 | 1990 | 2000 | 2008 |
|---|---|---|---|---|
| *Household size (persons)* | | | | |
| Houses, all country | 2.9 | 2.6 | 2.5 | 2.4 |
| Apartments, all country | 1.9 | 1.7 | 1.7 | 1.7 |
| *Home size (square meters)* | | | | |
| Houses, all country | 132 | 135 | 138 | 142 |
| Apartments, all country | 75 | 76 | 76 | 77 |

***Table 2.2.*** *Demand for housing, data from [Skaarup and Bødker, 2010]*

Apart from the square meters, there are other indicators that affect the selling price: number of rooms, bathrooms, physical location, year of construction, characteristics of neighbourhood such as crime rates, accessibility to public transport, quality of schools or

[1] *'Household wealth is measured as the difference between the household's current house value and the initial mortgage amount, with current house value being defined as sales price in the year the house is sold and an imputed price in subsequent years.',[Bayer et al., 2011]*

environmental aspects. All these and more are of significant relevance for the housing prices.

In economical approaches used for estimating the right price, it is used the hedonic pricing model ([Ecosystem Valuation, 2015]) which consists in evaluating the environmental features that are in connection with:

- amenities: closeness to interest points, views, proximity to open spaces;
- quality: of water, air, noise.

This method implies that a buyer is more interested in the characteristics and benefits that a property can offer, rather than the property itself, [Ecosystem Valuation, 2015].

## 2.3 Add-ons given by the landscape characteristics

When taking a closer look at the functions inside a city, there is a clear distinction between the parts assigned for production, nature and the actual settlement, being a great balance among them, which contributes to the overall function that each place holds, see Figure 2.5.

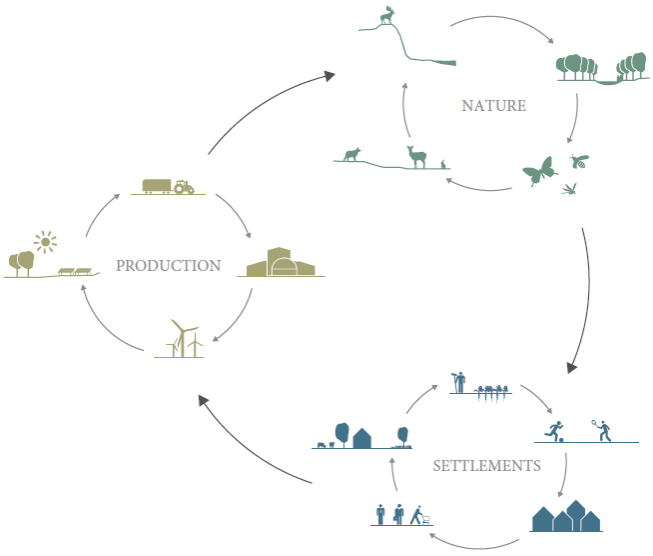


***Figure 2.5.*** *The balance that should exist in all the settlements*

But unfortunately in the parts located outside the cities, these three aspects are mixed, without existing areas with specific focus. It is very important to understand the capabilities that the places are holding in order to know what to contribute with or which types of families are the most suited ones in any given zone. In Figure 2.6 are provided three examples of settlements which have a lot of amenities that are directed for specific categories of people. From this approach results the need for making landscape analysis in order to emphasize the available resources that can maximize the potentials of each zone, in this way dividing the settlements based on the different desired characteristics of an area. For a clearer view of the image presented below, the reader can check Appendix A.

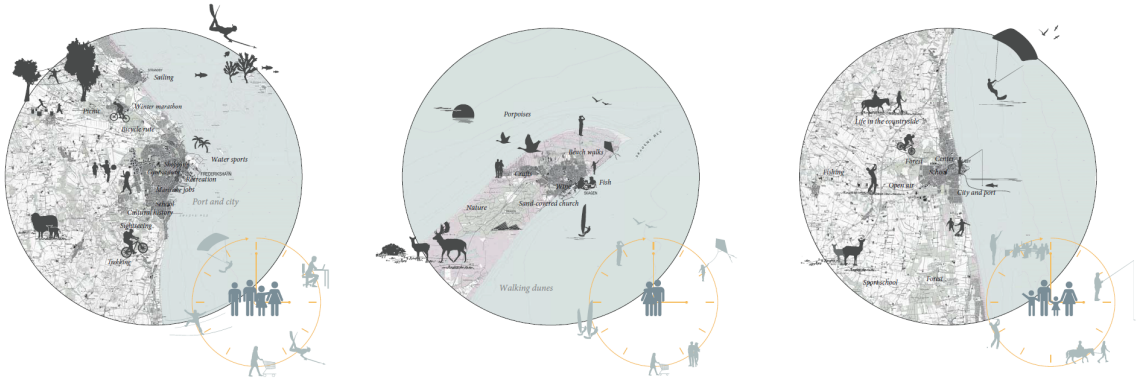


***Figure 2.6.*** *Different functions that settlements can have*

In general, this type of analysis is used for identifying the aesthetic features of the visible appearance by pointing out places that are assumed to be relevant, such as: lakes, forests, coast lines, beaches. But there can also exist factors considered as being barriers with a negative influence on the housing market: technical or industrial areas, farms or mining zones. This paper will bring together all the mentioned factors and will introduce other aspects for formulating a proper description of the strengths and weaknesses of the municipality.

## 2.4 Introduction to public transport benefits

A sustainable transport system is the result of a successful planning framework, where land use is integrated with various ways of transportation. Figure 2.7 presents the benefits (with green) and the disadvantages (with red) of choosing different means of transport. From the picture results the fact that buses costs are low, their carriage capacity is quite high, they are safer than cars and more fuel efficient. Factors such as price, environmental impact, and minimized congestions are aspects that highlight the importance of working closer with public transport opportunities for reducing car ownership and the rural depopulation process as people need a proper infrastructure in this direction.

For identifying the reachability areas, it is usually worked with public transport isochrones which define the areas where buses can be used in combination with walking distances from the arrival point in order to reach distances in certain amount of minutes from a specific location. It is important to point out that people tend to walk further to reach a faster and more frequent service and walking is also a positive factor for the public health.

This type of isochrones are based on a transit map where are displayed all the lines, stations and connections and the topological aspect is more important than the geographic one. It is associated with the term *routing* which is a list containing the indexes for all the stations and stops with information about connections with another routes, being characterized by a significant efficiency, robustness and simplicity. Working with public transport is an important factor in understanding the rural depopulation process as in this way can be identified the locations that have poor access, this being a primary feature when deciding to live in a particular area.

| Mode | Single journey range (km)/ optimal (feasibile) | Speed of journey within optimal range | Cost | Mass transport capacity | Reach / coverage | Safety | On-demand | Infrastructure investment | Comfort | Customer acceptance | Fuel efficency | Environmental, aesthetic and social impacts | Land use |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Walking | 0-2 (0-6) | ●● | ●●● | ●●● | ●● | ● | ●● | ●●● | ●● | ●● | ●● | ●● | ●● |
| Bicycle | 0-6 (0-30) | ●● | ●● | ●● | ● | ●● | ●● | ●● | ●● | ●● | ●●● | ●● | ●● |
| Motorized bicycle | 0-6 (0-30) | ●● | ●● | ●● | ● | ●● | ●● | ●● | ●● | ●● | ●●●● | ●● | ●● |
| Car | 3-300 (0-1500) | ● (urban) ●● (other) | ●● | ●●● | ●● | ●● | ●● | ● | ●● | ●●● | ●● | ●● | ●● |
| Motorcycle | 3-100 (0-1500) | ●● | ● | ● | ●● | ●●● | ●● | ● | ●● | ●● | ● | ● | ● |
| Bus (urban) | 0.2-20 (0.2-50) | ● | ● | ● | ● | ● | ● | ● | ● | ●● | ● | ● | ● |
| Coach (long distance) | 1-300 (1-3000) | ●● | ● | ●● | ● | ● | ●● | ● | ●●● | ●● | ● | ● | ● |
| Urban Rail / Metro | 1-20 (0.3-50) | ● | ● | ●● | ● | ●● | ● | ●●● | ●● | ●● | ●● | ● | ● |
| Conventional Rail | 10-300 (0.3-5000) | ● | ● | ●● | ●● | ● | ●● | ●● | ● | ● | ● | ● | ● |
| High Speed Rail | 100-800 (10-10.000) | ●● | ●●● | ●● | ●● | ●●● | ●● | ●●● | ●● | ●● | ● | ● | ● |
| Boat | 1-200 (0.2-20.000) | ●● | ● | ● | ●●● | ● | ●● | ●● | ●● | ●● | ● | ● | ● |
| Aeroplane | 600-20.000 (100-20.000) | ●● | ●● | ● | ●●● | ●● | ●● | ● | ● | ●● | ●● | ●● | ● |
| Helicopter | 10-500 (0-3000) | ●●● | ●●● | ●●● | ● | ● | ●● | ●●● | ●● | ●● | ●● | ●● | ●● |
| Airship | 300-2000 (50-20.000) | ● | ● | ● | ●● | ? | ● | ●● | ●● | ●● | ●● | ●● | ●● |
| Cable car | 0.3-10 (0.3-50) | ● | ● | ● | ●● | ● | ● | ● | ● | ●● | ● | ● | ● |
| PRT | 1-100 (0.3-500) | ●● | ●● | ● | ●●● | ●● | ●●● | ●● | ●● | ? | ●●● | ● | ●● |
| Elevator / Lift | 0.1-0.5 (0.02-0.5) | ●● | ●●● | ●● | ●●● | ●●● | ●● | ● | ● | ●● | ● | ●●● | ●● |
| Escalator | 0.1-0.5 (0.02-1) | ●● | ●●● | ●● | ●●● | ●●● | ●●● | ● | ● | ●● | ● | ●●● | ● |

***Figure 2.7.*** *Different means of transport and their characteristics, data from [Sunter et al., 2014]*

## 2.5 Summary of research

As it was introduced in the previous sections, demographics is one of the key factors in assessing the rural depopulation trends based on several indicators that can provide an overview of the process such as: total number of people, average age, percentage of children, number of internationals and so on. Real estate is also an approach that should provide interesting results as inside cities it is expected to have more expensive properties than in the country side. On top of that, by emphasizing the public transport opportunities, it can be discovered if there is any correlation between them and the population growth. The last aspect which is likely to have a big impact is the landscape because it is assumed that people are more likely to live in beautiful areas, like close to forests, lakes or with water views and will not choose to move in a particular place in case it is located, for example, close to a power plant or windmill fields.

There should also be identified anomalies from what is to be expected, as in this way more knowledge will be gained, by finding the reasons behind the changes that are occurring.

After introducing the aspects which are considered to be relevant for the project work, the following topics will be taken in consideration as potential research topics for further studies:

- general statistics of demographics;
- economic approach for population trends;
- landscape analysis;
- public transport accessibility analysis.

# Problem statement 3

After having the introduction and an overview on the factors that can bring a strong contribution to the process, the problem statement can be properly formulated:

**How can prognoses be made for depopulation?**

The questions listed below will be answered during the next chapters and will help the student in finding solutions for the main problem. The questions are:

- Based on the previous research, how can the results be divided in order to be used for further analysis?
- Which tools can be used or combined in order to obtain even more precise visualisations of the areas that are likely to suffer from rural depopulation?
- What kind of statistics using demographics are relevant for studying rural depopulation?
- What is the influence that foreign citizens have on demographics?
- How are housing prices affecting depopulation?
- Can there be considered a time frame where the housing prices are significantly changing when taking in consideration the drive time out from a city center?
- Is the landscape contributing or influencing people's decision of moving in a certain area?
- Are public transport facilities important when living in rural areas?
- How are evaluated the initial assumptions/scenarios? Is there a better way for building them?

For being able to answer the questions, the project was structured as presented in Section 1.4.

Unlike the previous research that was made in this direction, which had a broader formulation, the facing study is intended to have a more detailed approach which resulted after discovering the importance of using the factors mentioned in Chapter 2.

# Planning the process 4

This chapter has the purpose of introducing the project objectives which have to follow the academical requirements of a thesis. For all the future subjects that will be detailed, there will be presented previous researches made in the specific directions, in this way having a better understanding of what each of the approaches implies. After that will be introduced the initial assumptions of the research, along with the reasons behind choosing Nordfyn municipality as a working area. The chapter will end with presenting the acquisition of data and the tools used for post processing it.

## 4.1 Project objectives

The working problem is built for the Danish context but it is also relevant for other countries as the whole world is becoming an urban place, rather than a rural one as it used to be. For this concern are made some empirical investigations supported by theoretical framework and the process is conducted for creating solutions integrated in a trustworthy report.

The process is meant to improve the professional skills of the writer in assessing rural depopulation and to develop new competences in this direction, by integrating spatial data theories in real life problems along with analysing and evaluating other methods for providing an outcome that can be easily understood by both professionals and non-specialists through tables, diagrams and maps.

At the end of the report will be suggested solutions and improvements of the process for possible future studies in this direction. There is a strong relevance of the chosen problem to the education undertaken because of the cross disciplinary subject that is used for implementing solutions coming from various fields, in this way creating interactive maps with intuitive visual comparison which are based on several indicators, providing an overview on the existing trends.

The importance of the investigation method to the validity of the result is given by the fact that when working at small scale such as in the facing example, any error can have a big influence on the outcome. This is the reason why it is important to produce clear maps that can illustrate the analysis and that facilitate the vision behind it. The products will have a descriptive role because they present the current situation and can offer a better understanding for individual decisions of the public.

The back bone of the analysis will start with assigning different roles for the settlements of Nordfyn and then continues with combining these assumptions with demographics for

supporting the idea that the areas that are hard to access, are the first ones that will suffer from rural depopulation.

For this report, GIS is used to emphasize the potentials regarding transport facilities and how real estate prices are changing as going out from the cities. It is important to combine the analysis with the existing opportunities regarding landscape and public transport because especially for people living in rural areas they can be a large impediment to get to places with amenities such as schools or grocery shops, or it is not desirable to live close to buildings used for different types of industries.

## 4.2 Existing solutions

This section has the purpose to introduce some of the national and international projects made in the same concern. They will be briefly presented and divided according to the topic that they are following. Some of the solutions are valid just for specific study areas, while others concern nationwide.

### 4.2.1 Demographics and transport

**Luminocity3D**: is an online platform targeted towards the dynamics of Great Britain cities. It uses a large range of parameters including: population, housing prices, transport opportunities, employment and others. In order to have a standardized framework, the whole country was divided in one square kilometer grid which has also a 3D dimension that gives the heights of the indicators represented, in this way obtaining a 3D cartogram. By visualizing the map in this manner, it is easy to make visual comparisons between the different patterns of the areas.

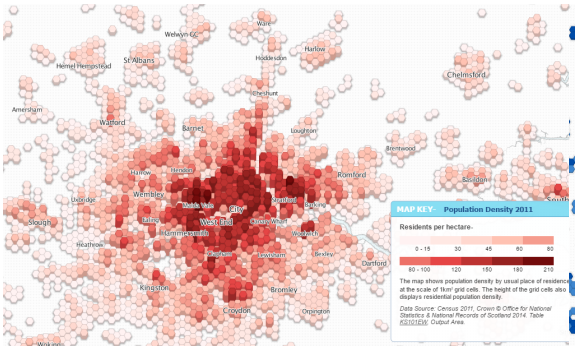


***Figure 4.1.*** *Public transport journey to work: trip destinations in London area, [Smith, 2014c]*

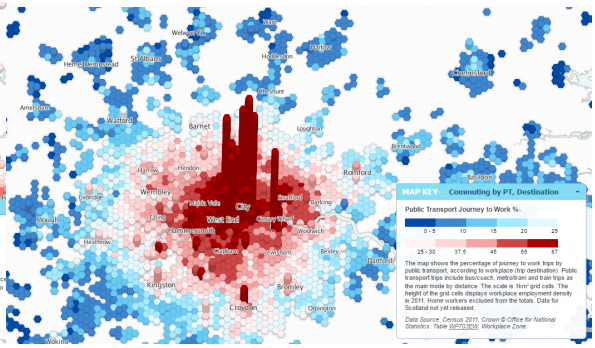


***Figure 4.2.*** *Population density 2011 in London area, [Smith, 2014c]*

In Figure 4.1 and Figure 4.2 are given two of their maps. The first one is showing the journeys to work made by public transport, according to workplace. The second one represents the population density of London in year 2011 and demonstrates how big this conurbation is. Each of the cells contains the corresponding information, which can be viewed by clicking it. These approaches can be used in urban researches for discovering

the patterns and behaviour of each zone. More explanation about each map can be found in their legends and in [Smith, 2014c].

**Copenhagen and Hong Kong: Mapping Global Leaders in Green Transport**: is a project that points out the importance of successful planning that combines the land-use with the public transport opportunities. It is a comparison of the available rail and metro network in Hong Kong and in Copenhagen. On top of that is added a 3D population density surface, which has information about the density of jobs and residents at each station, in this way demonstrating that population is clustered along the main transport nodes, [CityGeographics, 2012]. Figure 4.3 shows the map made for the case of Copenhagen.

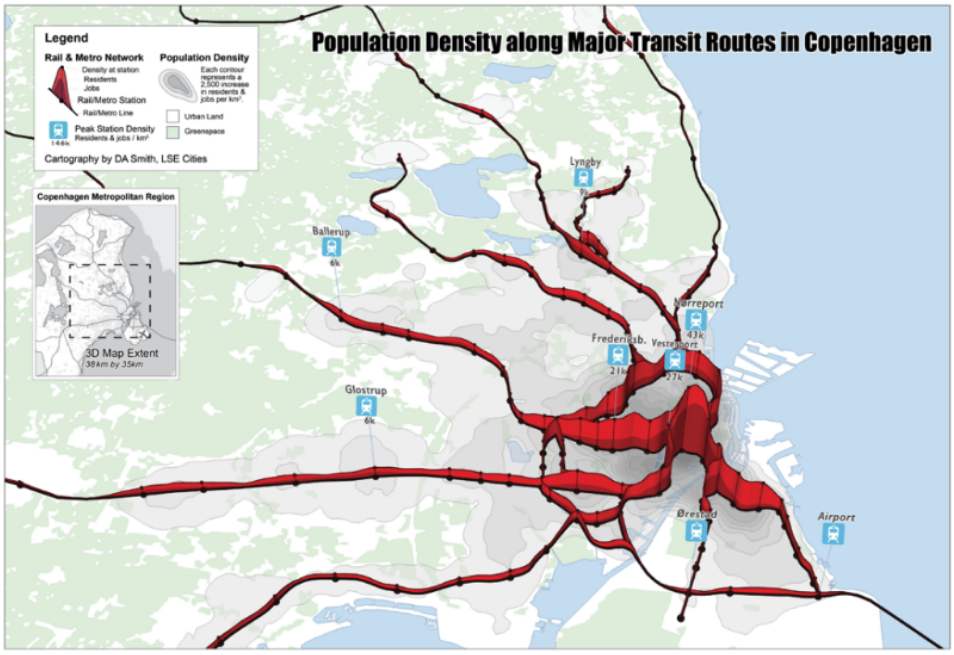


***Figure 4.3.*** *Population density along major transit routes in Copenhagen, [CityGeographics, 2012]*

### 4.2.2 Real estate

**Funen - access and accessibility**: an article that brings knowledge regarding the changes that are occurring in the urban and rural areas and is linking aspects such as income with education, or job market with infrastructure, [Byregioner, 2016], in understanding why some places suffer from large store closures, while others get richer. Figure 4.4 illustrates with green color the zones where the household income has been growing for Funen (part of South Denmark), in the interval of 2003-2013. All the exiting numbers from the legend can be used by the authorities for making strategic analysis of the urban planning development.

**Finans**: a financial online newspaper that has made a map for the whole country emphasizing the average housing prices per municipality as displayed in Figure 4.5. The student considers that it is unrealistic because some municipalities contain very large cities

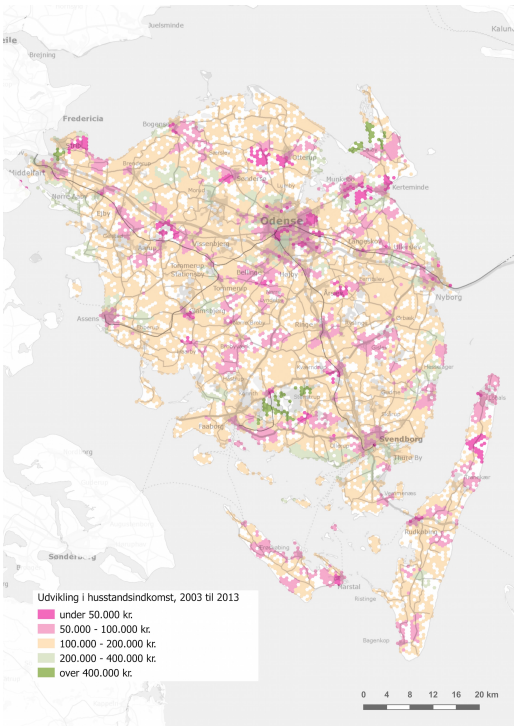


***Figure 4.4.*** *Development in the household income, 2003 to 2013 for Funen, [Byregioner, 2016]*

which have a big influence on the average price. The method that will be described in the facing report is using the prices per each house and they will have different shades of color assigned based on the differentiated values, so that the user can easily visualize in more detail which are the price variations rather than considering the big picture.

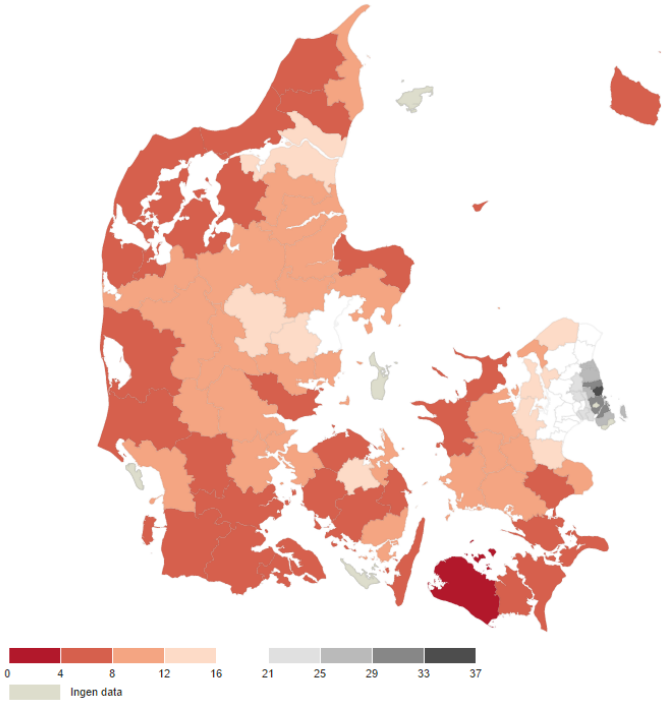


***Figure 4.5.*** *Average square meter prices per municipality, [Somonsen, 2016]*

**A Dynamic Model of Housing Demand**: is a master thesis made by one of the students from Aarhus University in year 2012 and it uses the hedonic price method described in Section 2.2 for identifying key points in the willingness to pay of Danish citizens when buying a property. This gives an idea of the demographics and their economic information by tracking households over time. There will be summarized the conclusions that he managed to make by using data from years 1992 to 2005 from IDA and BBR for demographic and socio-economic information of the houses, but also data from AFG which contains all the convictions from Denmark, [Hviid, 2012]. It was discovered that in general people tend to pay for six non-traded amenities included in the housing price. Some of them are detailed below along with his findings:

- people are willing to pay 43.000 dkk for increasing the fraction of ethnic Danes with 1%. This occurs due to the wish of living in areas with neighbours of same cultural background;
- households will pay 800 dkk to decrease the number of property criminals per 1000 inhabitants by one;
- citizens with low wealth are paying much more to avoid non ethnic Danes, whereas the ones with high wealth do not seem to be disturbed by this aspect;
- people with home living children are willing to pay more for school quality and for avoiding violent crimes. Also 20.000 dkk is the price for increasing the percentage of ethnic Danes with 1%. The effect of other types of crimes, such as sexual offences, is negative but they do not take place very often;
- for additional toilet, households will be increased in value with more than 300.000 dkk;
- additional square meter has the value of more than 6,000 dkk;
- the price is decreasing in areas occupied just with ethnic Danes;
- prices increase when getting closer to larger cities.

### 4.2.3 Landscape

**De Små landsbyer i den danske landdistriktsudvikling**, or in English: The small villages in the Danish rural development, is a research that contains one of the approaches that was not further investigated but it could be the base point in a future study as it consists among others in identifying if there is any relation between the distance to the coast and the development of the settlement. The hypnotises was that it can have a positive impact especially to the small communities, but the conclusion gained proved that the closer to the coast, the bigger decrease in the number of population. The two possible explanations might be given by the fact that these areas have higher prices compared to regular households and especially for families with children this is a big impediment. On the other hand, it is probable that municipalities are not giving permits for new settlements in the immediate coast distance, but more information can be found in [Møller and Staunstrup, 2015].

## 4.3 Discussion. Scenarios

As a basis of the research, it was chosen to work with several indicators that can provide an idea about the areas that are likely to suffer from rural depopulation:

- From OpenStreetMap were extracted the amenities of each settlement: schools, hospitals and grocery shops. City centres were not considered the ones provided by the municipalities, but were redefined by identifying a central location with a lot of interest points in each city;
- They were divided in two categories: the first ones have more than 2000 inhabitants and the other category are the ones with more than 100 inhabitants which have several interest points (as there are places which despite their big population, do not have shopping opportunities or schools);
- The above identified central places were used as starting points for computing isochrones in QGIS. These isochrones were calculated for 5 and 10 minutes, and were meant to provide an understanding of which are the areas that can be reached in certain amount of time from specific location, in this way being able to point the parts of the municipality that beside their small size and lack of places that can fulfil people's needs, have also hard access because of their poor infrastructure.

The two divisions made before can be seen in Figure 4.6, where blue represents the large cities, green is used for the small ones, and the remaining parts are the zones unreachable within an acceptable period of time. This explanation can also be found in the legend.

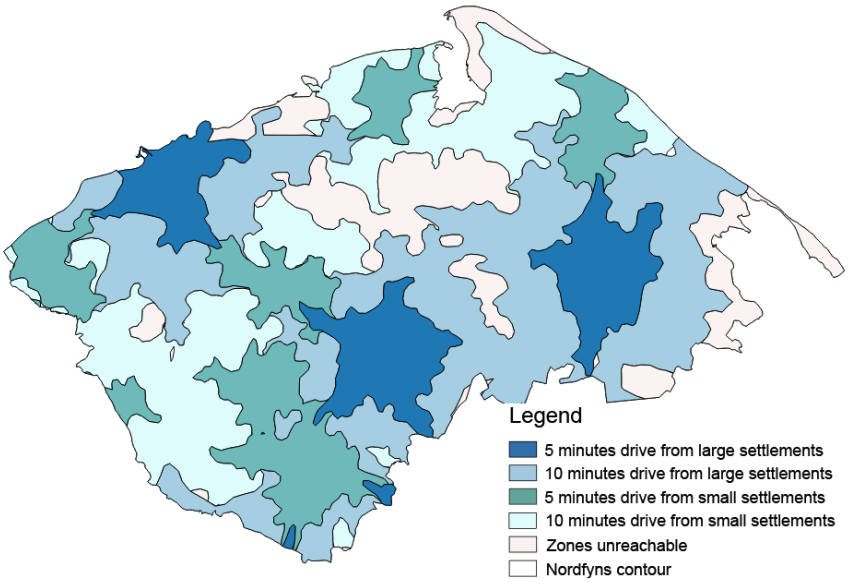


***Figure 4.6.*** *Areas reachable in 5 and 10 minutes drive depending on the size of the settlement*

The shapes represented in the picture are built on todays' existing situations and it is assumed that the present characteristics will be possessed in the future as well. This leads to the idea that the decisions made now are valid also in the future. But different scenarios have been introduced in order to emphasize the fact that the current status of a household is subject of several changes during the years. Based on the number of inhabitants of each city, there will be represented two assumptions of future scenarios. The first one is

likely to happen soon due to the lack of proper infrastructure in some cases. The second scenario is considered the worst case where some other cities will slowly suffer from rural depopulation. It is important to point out that the scenarios are built on the idea that there will not be built major means of transport in the following years.

During the whole report will be used just the existing situation for doing more investigations as will be described in the next chapters, by adding different types of data on top of the isochrones. But the other two can be found in Appendix B and in Appendix C with their corresponding calculations in the CD attached, which has a content description in Chapter 12.

## 4.4 Working area

The research is part of a project that Urland company is having in process and it consists in a strategic plan made for Nordfyn municipality. It is an assignment that will have as outcome different proposals that are meant to emphasize the opportunities that each area is holding, and to come with ideas regarding the spaces that need further investment for bringing to light their potentials.

It is made in several stages. The first one was designed for understanding the capabilities regarding the infrastructure, in the way that it can be an important asset in deciding where to move. The next steps will be taken for formulating a more precise conclusion when it comes to depopulation, in this part the student contributing with professional skills and knowledge. After that, the employees will formulate differentiated strategies based on the understanding gained after the facing research.

## 4.5 Data

Because of the different types of approaches that were applied, the required data was quite broad and the providers were vast. For being able to operate with demographics and real estate data, the partners working together with Urland for the strategic plan have ensured the required data to the company, and thus to the student.

When making the landscape analysis, several sources were needed:

- Kortforsyningen: which is the national agency for data supply. From here were extracted some of the GIS layers such as: forests, lakes, municipal border.
- Jordbrugsanalyser: is a website provided by the Environment and Food Ministry, containing GIS information regarding environmental protected areas, the livestocks of animals from the whole country, organic fields and much more. From here were extracted the points corresponding to existing farms from the municipality.
- Nordfyn municipality: as the project is conducted at public level, the members of the GIS department of the municipality were also able to help the company with the layers that were found as being interesting for the analysis, but were not identified in the previous mentioned sources.

In the situation where the public transport isochrones were computed, it was needed the updated schedule of buses and trains and for this purpose was made an agreement with Rejseplanen, which is the official travel plan website in Denmark. In this way, it was possible to obtain in real time data about means of transport with their itineraries and existing connections between the lines, without having to make individual searches for each location.

## 4.6 Tools used for processing the data

The various sources and types of data are needed to be processed with different tools. As the research is GIS-oriented, the program that was used the most is QGIS. It is a free open source that is useful for making, editing, visualizing and analysing geospatial information, [QGIS, 2015a]. The version used is 2.10.1 and in addition can be downloaded different plug-ins depending on the required tasks. The main purpose of using QGIS was for building reachability analysis through its plug-in made by OpenRouteService, which is called OSM route, being the abbreviation for OpenStreetMap. It contains information about street types, speed regulations or other traffic rules that are built-in and called online when the user is making a specific request. For this purpose it has to be inserted a starting point, the amount of minutes reached by the last polygon and the intervals between the isochrones. The results are temporary shape files that need to be saved separately for future post process.

Beside the isochrones computed for making the scenarios described in Section 4.3, the software was used for importing the GIS layers required for doing the landscape analysis and for computing the public transport isochrones. For the last purpose is handled also Python with QGIS capabilities, this facilitating the programming part of the Rejseplanen data and creating an outcome in the shape of maps.

For handling the statistical and real estate data, was used Excel which holds a lot of features apart from just computing tables: develops a wide range of calculations, sorts the elements based on different criteria, and can compute charts for facilitating the understating of the results.

# Analysis of demographics 5

This chapter is meant to provide a comprehensive visualization in terms of demographics between the different performances given in large and small sized settlements but also in the areas outside them. For being able to accomplish this, it has been worked with the division explained in Section 4.3. It is used a functional approach, as the areas of study were divided based on different travel times and sizes of cities. All the tables and diagrams that will be presented are made just for the first scenario. In order to understand the letters that will be used in the analysis, they will be shortly explained:

- SC1_A: scenario 1, zone A, which is the one represented with dark blue (5 minutes drive time from the large settlements);
- SC1_B: scenario 1, zone B, which is the one represented with dark green (5 minutes drive time from the small settlements);
- SC1_C: scenario 1, zone C, which is the one represented with light blue (10 minutes drive time from the large settlements);
- SC1_D: scenario 1, zone D, which is the one represented with light green (10 minutes drive time from the small settlements);
- SC1_E: scenario 1, zone E, which is the one left uncoloured (areas unreachable within 5 or 10 minutes drive).

In Appendix B and in Appendix C are given the next two assumptions of the future travel times areas in case there will not be made any other changes regarding the infrastructure. There can be found a brief description and their corresponding calculations are made available in the CD attached.

The data used is provided by the partners that Urland has in the project and it is taken from Statistics Denmark, which is the national database. The numbers are for each of the zones introduced before but the information for the inhabitants is not having geographical reference because of the laws regarding privacy, which means that the points cannot be placed on a map. It is describing the current status of the people living in Nordfyns in the given areas and the calculations are made for each zone at a time. It does not have historical data, and because of this reason it cannot be performed an assumption of the past trends regarding demographics.

## 5.1 Discussion

According to Statistics Denmark, in year 2013 it was a boom in the number of immigrants coming in the whole country. This happened due to the big amount of people arriving for

study and working purposes. From 2015, large groups of migrants (especially from Syria, Afghanistan and Iraq, as stated in [Wikipedia, 2016a]) started coming in Denmark to seek asylum. This movement is known as European migrant crisis or European refugee crisis and it began because of the existing conflicts in the above mentioned nations. As more and more foreigner are establishing in Denmark each year, it is important to understand how they influence the demographics, especially the refugees as they are concentrated in big numbers in the same place so that they can be in their own communities. As they can be close to main cities, they will have a large impact on the Danish environment in terms of demographics.

For having a better understanding of the changes that they bring on demographics, the calculations will be made for all the inhabitants in each zone and then they will be separated into native Danes and foreign citizens in order to discover each of the trends that might appear.

## 5.2 Basic statistics on demographics

This section gives a broader image of the basic statistics for inhabitants living in each zone, as presented in Figure 5.1, afterwards being performed the same calculations when handling just the data about ethnic Danes (Figure 5.2).

| | SC1_A | SC1_B | SC1_C | SC1_D | SC1_E |
|---|---|---|---|---|---|
| Number of people | 13820 | 6196 | 6251 | 2329 | 521 |
| Percentage of people from the total amount of the municipality | 47,46% | 21,28% | 21,47% | 8,00% | 1,79% |
| Areas | 62,709 | 73,33 | 157,84 | 99,246 | 54,503 |
| Percentage covered by the zones from the total area | 14,01% | 16,38% | 35,26% | 22,17% | 12,18% |
| Average age for each zone | 45,179 | 41,171 | 41,367 | 40,592 | 42,004 |
| Average age for adults | 53,855 | 50,836 | 50,169 | 48,85 | 49,671 |
| Minimum age | 0 | 0 | 0 | 0 | 0 |
| Maximum age | 103 | 102 | 97 | 96 | 86 |
| People under 18 years old | 2701 | 1443 | 1332 | 487 | 99 |
| Percentage of people under 18 from the total amount | 19,54% | 23,29% | 21,31% | 20,91% | 19,00% |
| People over 18 years' old | 11119 | 4753 | 4919 | 1842 | 422 |
| Percentage of people over 18 from the total amount | 80,46% | 76,71% | 78,69% | 79,09% | 81,00% |
| People with kids | 8571 | 3714 | 3703 | 1334 | 295 |
| Percentage of people with kids from the total amount | 62,02% | 59,94% | 59,24% | 57,28% | 56,62% |
| People without kids | 5249 | 2482 | 2548 | 995 | 226 |
| Percentage of people without kids from the total amount | 37,98% | 40,06% | 40,76% | 42,72% | 43,38% |
| Average number of kids for the ones who have kids | 2,2119 | 2,2246 | 2,2258 | 2,2766 | 2,2441 |
| Number of men | 7150 | 2990 | 2921 | 1060 | 244 |
| Number of women | 6670 | 3206 | 3330 | 1269 | 277 |

***Figure 5.1.*** *Basic statistics for all the inhabitants per zone*

For these types of calculations, even performing or not the division, the conclusions are the same:

- there are large differences in percentage of people living in each zone, A having the biggest concentration and then dropping at more than half in the next one and progressively decreasing in the others;
- average age has lower values as moving further from the settlements, except for zone E where it rises again. The reasons behind this will be more detailed in Section 5.3;

| | SC1_A | SC1_B | SC1_C | SC1_D | SC1_E |
|---|---|---|---|---|---|
| Number of people | 12873 | 5925 | 5966 | 2187 | 484 |
| Percentage of people from the total amount | 46,92% | 21,60% | 21,75% | 7,97% | 1,76% |
| Areas | 62,709 | 73,33 | 157,841 | 99,246 | 54,503 |
| Percentage covered by the zones from the total area | 14,01% | 16,38% | 35,26% | 22,17% | 12,18% |
| Average age for each zone | 46,15 | 41,56 | 41,8352 | 41,153 | 43,31 |
| Average age for adults | 54,886 | 51,386 | 50,9125 | 49,781 | 50,354 |
| Minimum age | 0 | 0 | 0 | 0 | 0 |
| Maximum age | 103 | 102 | 97 | 96 | 86 |
| People under 18 years old | 2482 | 1386 | 1290 | 467 | 98 |
| Percentage of people under 18 from the total amount | 19,28% | 23,39% | 21,62% | 21,35% | 20,25% |
| People over 18 years old | 10391 | 4539 | 4676 | 1720 | 398 |
| Percentage of people over 18 from the total amount | 80,72% | 76,61% | 78,38% | 78,65% | 82,23% |
| People with kids | 8224 | 3607 | 3604 | 1297 | 289 |
| Percentage of people with kids from the total amount | 63,89% | 60,88% | 60,41% | 59,30% | 59,71% |
| People without kids | 4649 | 2318 | 2362 | 890 | 195 |
| Percentage of people without kids from the total amount | 36,11% | 39,12% | 39,59% | 40,70% | 40,29% |
| Average number of kids for the ones who have kids | 2,2125 | 2,2307 | 2,23807 | 2,2884 | 2,2491 |
| Number of men | 6694 | 2856 | 2799 | 987 | 233 |
| Number of women | 6179 | 3069 | 3167 | 1200 | 263 |

***Figure 5.2.*** *Basic statistics for Danish inhabitants per zone*

- the maximum age is identified in zone A;
- more people under 18 years old are living in small-sized settlements rather than in the big ones. Even so, zone E holds the biggest percentage of adults compared to the total number of inhabitants from each zone;
- the percentage of people with kids is the highest in zone A. However, here is the lowest average number of kids;
- highest percentage of people without kids in zone E;
- more men in zone A, while there are more women in all the other zones.

## 5.3 More detalied statistics using age

It was expected that the areas located around large towns are holding the highest percentage of young people, but this is not happening based on the previous findings. Because of the high average age of people living in zone A, it was desired to identify exactly which are the age categories to which inhabitants residing here are included. This is the reason why population was divided in age intervals of 10 years, as it can be seen in Figure 5.3 for all the inhabitants and in Figure 5.4 for Danes.

The overall picture is not very clear and it cannot be taken any conclusion about the reasons behind the low percentage of people between 21 and 30 years old and the high percentage for the ones with ages between 61 and 70.

For providing a more precise overview of the ages of Nordfyns residents, it was made another division based on the different activities that they can have: attending various types of education, being active workers or being pensioners. These different ages are identified on the X axis from Figure 5.5 and Figure 5.6. The two diagrams are made for the Danish citizens from zone A and E and are represented at the same scale for being able to identify the existing differences between the zones.

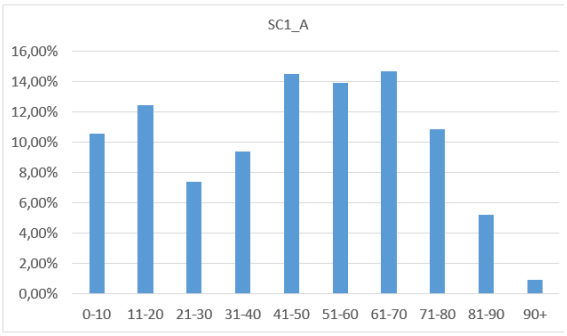


***Figure 5.3.*** *Intervals of ages for all the inhabitants*

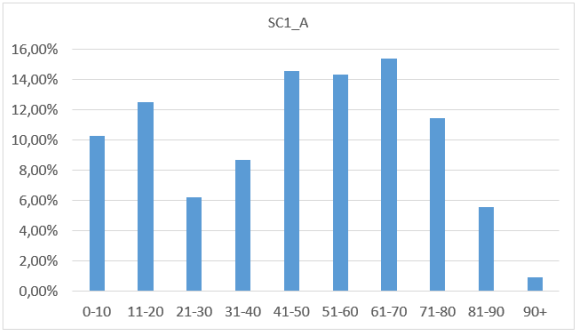


***Figure 5.4.*** *Intervals of ages just for Danish inhabitants*

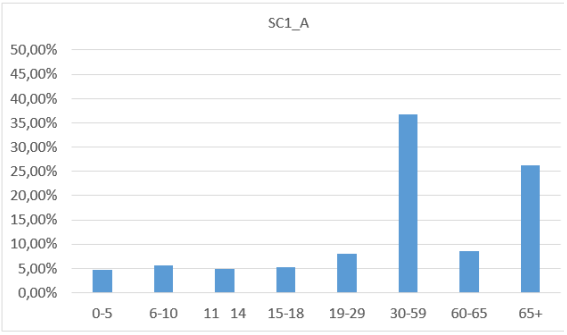


***Figure 5.5.*** *Division of ages for Danish inhabitants from A zone*

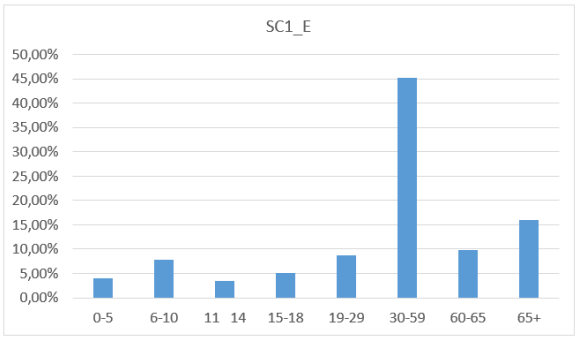


***Figure 5.6.*** *Division of ages for Danish inhabitants from E zone*

The large concentration of people being more than 65 years old from zone A, might be in relation with the placement of nursing and retirement homes in major cities. The explanation of the low number of children can also be in connection with the fact that old people from large urban communities might be financially strong, being a well-established generation living in same houses for many years, in this case putting pressure on young families because they have to move outside towns.

As mentioned in the beginning of the chapter, there was made a separate distinction for the foreign inhabitants. Figure 5.7 and Figure 5.8 provide very explicit views on the number of internationals in the first and last zone. In the first one are identified most of the total amount of young population of different categories, while section E corresponds to the highest percentage of people aged between 30 and 65.

On the CD can be found all the diagrams made for the rest of the zones using the approaches described above.

## 5.4 Moving dates

The facing section has the purpose of emphasizing the moving dates for the inhabitants that are now living in Nordfyn municipality, and presenting the reasons of the changes that have occurred over time.

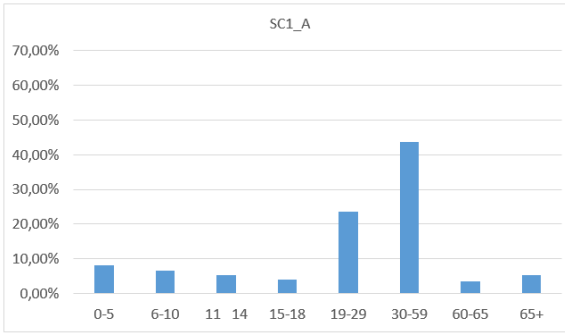


***Figure 5.7.*** *Division of ages for foreign inhabitants from A zone*

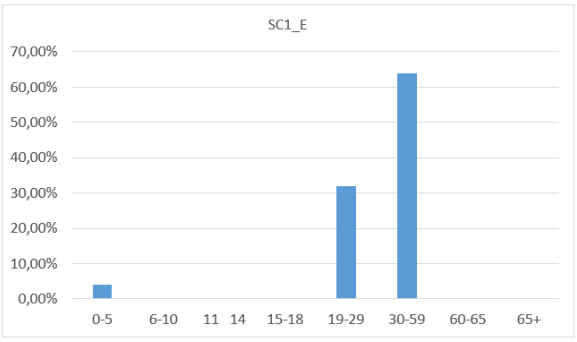


***Figure 5.8.*** *Division of ages for foreign inhabitants from E zone*

In case of considering just the Danish inhabitants when making the calculation, it can be seen from Figure 5.9 that some of the existing registered population has moved there even from 1910's. The increase in the percentages corresponding to 1970's is related to the grown in the sizes of the suburbs, process that took place around the whole country.

The intervals of 10 years in the analysis is changed starting with year 2008 due to the effects of the financial crisis. The division will be from this year to 2010 as the crisis has ended then. Even though it began in 2007 with a drop of property prices, as described in Section 2.2, the significant decrease in terms of moving to Nordfyn and perhaps buying a property there, can be easily noticed just from 2008 when the percentages have reduced considerable compared to the previous interval.

The next division is in connection with the fact that the diagrams are presented in parallel with the international people that have moved in Denmark mainly from 2013, as described in the beginning of the chapter. That is why the last two intervals are from 2010 to 2013, and then from 2013 to present. In the last period, the situation for ethic Danes starts to stabilize after the big changes that were identified in the last periods.

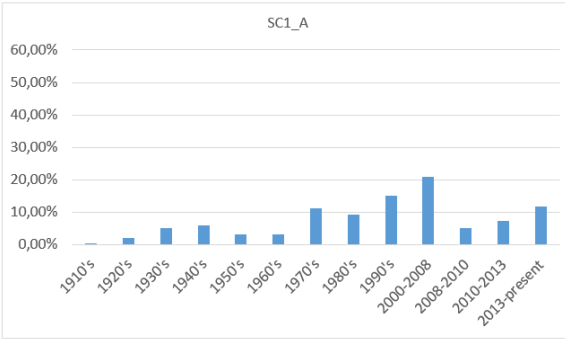


***Figure 5.9.*** *Intervals of ages for the dates when Danes moved in zone A*

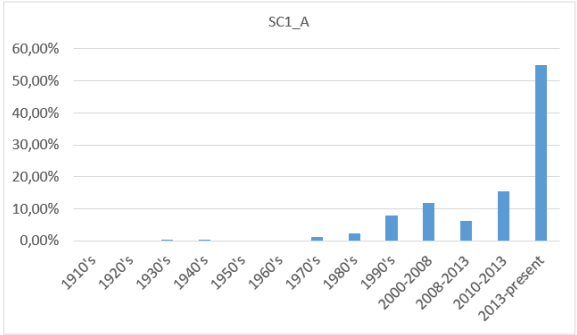


***Figure 5.10.*** *Intervals of ages for the dates when internationals moved in zone A*

In Figure 5.10 are presented the percentages for foreign citizens where are very few inhabitants that have moved in the study area until 1970's and from there the numbers are increasing until the shift given as a result of the financial crisis and from 2010 population is growing again with the highest percentage being in the present due to the European migrant crisis and due to the internationals coming for work or study related purposes.

## 5.5 Municipalities

The aim of this section is to present the calculations that can be made when having available the information regarding the municipality from where people have moved. From Figure 5.11 can be seen that more than half of the inhabitants have come from other municipalities and around 70% of the people who have not changed municipality are Danes who have lived in Nordfyn their entire lives. From this number 50% it represented by people under 18 years old.

| | SC1_A | SC1_B | SC1_C | SC1_D | SC1_E |
|---|---|---|---|---|---|
| Number of people | 13820 | 6196 | 6251 | 2329 | 521 |
| Number of people from other municipalities | 7951 | 3930 | 3768 | 1495 | 303 |
| Number of people who haven't changed municipality | 5869 | 2266 | 2483 | 834 | 218 |
| Number of Danes who haven't changed municipality | 5187 | 2110 | 2301 | 745 | 203 |
| Number of adult Danes who haven't changed municipality | 3461 | 1225 | 1333 | 410 | 125 |
| Number of municipalities from where people have moved | 97 | 92 | 92 | 82 | 49 |
| Number of foreign people | 947 | 244 | 285 | 142 | 25 |
| Percentage of foreign people from the total amount of people | 6,85% | 3,94% | 4,56% | 6,10% | 4,80% |

***Figure 5.11.*** *Demographics focused on municipalities and foreign citizens*

There are also given the numbers of municipalities from where people have moved and it can be noticed that in the 5 minutes drive time area around the large settlements are living people coming from all the other 97 municipalities, while zone E does not seem to attract many citizens from outside Nordfyn.

Below are the first 5 municipalities per each zone, from where most of the people are relocating to the interest area, along with the number of citizens that have moved from these places.

- Zone A: Odense (4607), Assens (389), Middelfart (375), Faaborg-Midtfyn (253), Kerteminde (175);
- Zone B: Odense (2122), Middelfart (291), Assens (272), Faaborg-Midtfyn (126), København (82);
- Zone C: Odense (2102), Middelfart (236), Assens (203), Faaborg-Midtfyn (145), Kerteminde (100);
- Zone D: Odense (682), Assens (155), Middelfart (127), Faaborg-Midtfyn (62), Kerteminde (48);
- Zone E: Odense (168), Middelfart (16), Assens (15), Faaborg-Midtfyn (13), Vejle (6).

The results for zone A can be visualized better in Figure 5.12. All the municipalities given in this diagram are placed in Funen, where Nordfyn is also included and it is a part of the Region of Southern Denmark. This leads to the conclusion that the main reason for settling in Nordfyn might be given by the closeness to the location from where inhabitants have moved.

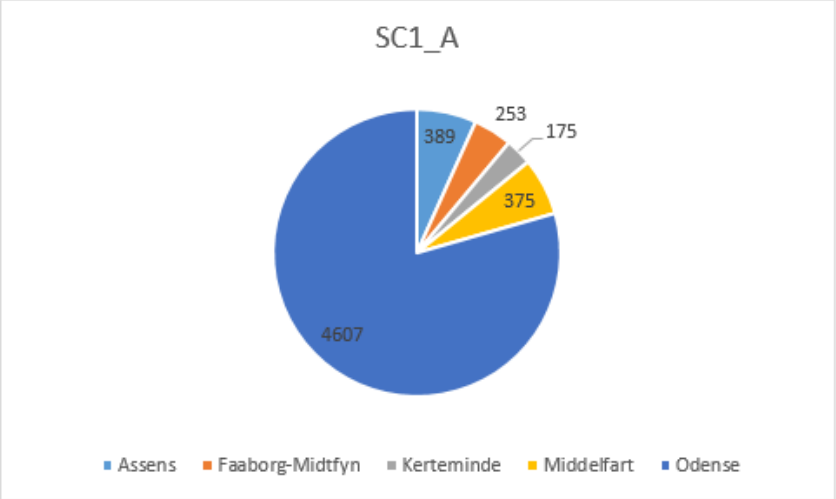


***Figure 5.12.*** *First 5 municipalities from where most of the people are moving to zone A in Nordfyn*

## 5.6 Foreign citizens

In order to understand which are the largest contributors from where migrants are coming from, it was chosen to put in diagrams just the countries from where have arrived more than 10 people in a specific zone. In Figure 5.13 is represented the situation in zone A where the biggest number is given by Syrian citizens. The explanation behind it is related to the existing conflicts from this place, which resulted in the European refugee crisis, described in Section 5.1.

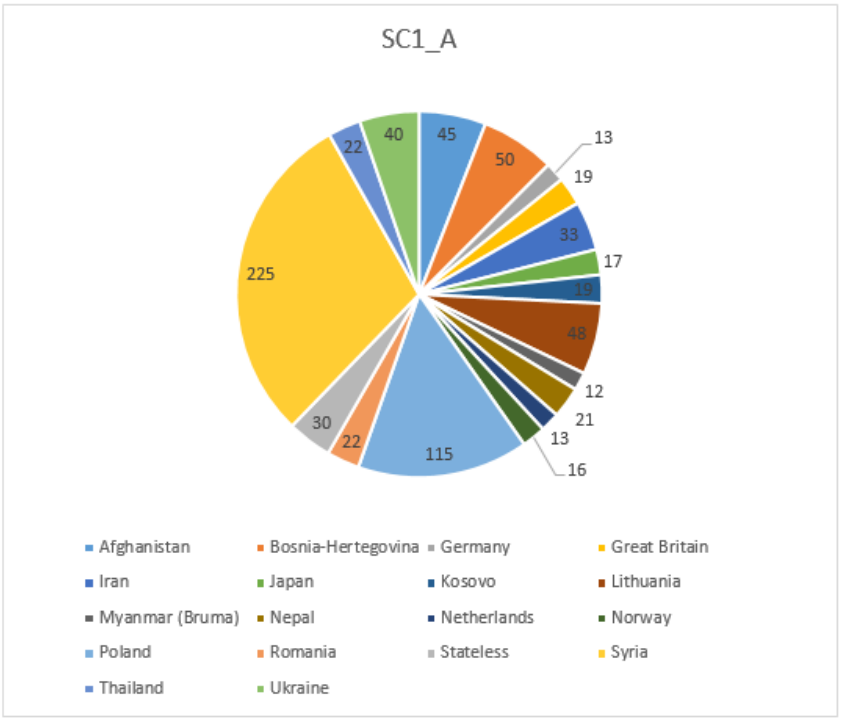


***Figure 5.13.*** *Countries from where most of the internationals are coming in zone A*

From the total amount, some of the people that came in the municipality are now well-integrated in the Danish community being active workers or students. But for making a clear distinction, there should be added more information in this regard such as employment status or income.

The diagrams made for the other zones can be seen in the CD, except for zone E because there is no country from where came more than 10 people. Also it is important to point out that in this zone are no inhabitants from Syria.

In order to have an overview of how many countries are the origins for the foreigners of Nordfyn, there are given the corresponding numbers below:

- Zone A: 53 countries;
- Zone B: 45 countries;
- Zone C: 39 countries;
- Zone D: 26 countries;
- Zone E: 10 countries.

# Real estate analysis 6

The paper will try to determine if the individual housing prices can be used when making an assessment of the population growth or decline, as the approaches built around the economic value are very important for evaluating the sociological-based structures.

The results will take shapes of tables, diagrams and maps which will have the purpose of providing comprehensive outcomes even for non-trained people.

## 6.1 Discussion and calculations

The data used for housing prices covers all the properties sold within year 2012 and beginning of 2016. It contains details such as: selling price, date of transaction, type of property and others. From the provided information, it was chosen to handle just the ones about villas, apartments and townhouses (in Danish: Rækkehus), which are traditional row houses of identical or mirror-image houses that share side walls, [Wikipedia, 2016b]. The reason for handling only these categories is because it was desired to make a realistic calculation of average prices, and in case it would have been selected also the farms, they would have given different results as the price for this kind of property can be strongly influenced by the existing big constructions or by the large areas of land.

The real estate data had to be double-checked in Google Maps as there are cases where the prices are very high or the total area is a lot larger compared to normal properties of the selected types. When searching them, they are actually large farms which were misclassified.

The remaining assets are differentiated in the zones described in Chapter 5, and for each one of them was calculated the average square meter price as can be seen in Figure 6.1, made for all the zones of the existing scenario.

The prices are changing from a medium value of around 16000 in Zone A, to less than 6000 dkk in zone B, slowly decreasing and then rising again in zone E, which is a very interesting finding, as there was expected to find the cheapest properties. The explanation for the downward trend of the prices might be given by the different facilities that small settlements can offer compared to the large ones. Also, there is a significant change in the number of transactions, as zone A has 621 in the described interval, while zone E holds a number of 11. The low number of houses sold in the rural areas is explained on one hand by the fact that the number of people from those specific parts is significantly lower compared to the main settlements and on the other hand by the categories of buildings

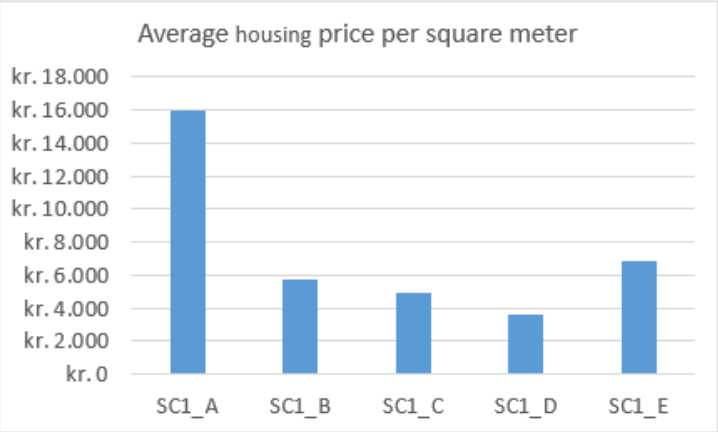


***Figure 6.1.*** *Average house per square meter in all the zones of the first scenario*

that were taken in consideration, removing the farms, which usually constitute the most common and important parts of small towns.

## 6.2 Housing prices for Nordfyn

In order to be able to have a visual outcome of all the housing prices that were available, Urland team has chosen to insert the points in QGIS and using its tools it was desired to provide an outcome that can facilitate the understanding of the different numbers along Nordfyn.

For this purpose was worked with IDW method, which stands for inverse distance weighted interpolation. This type of analysis is used for modelling the housing prices for the whole municipality and it consists in estimating values for those points that do not have any information, by assigning weights to the known location (the vector points) in such way that 'the influence of one point relative to another declines with distance from the unknown point that is to be created' [QGIS, 2015b], by this being built a raster surface which is including the entire area. The result computed using this method can be found in Figure 6.2.

It is noticed that actually in Morud (located in the southern part of Nordfyn) are the highest prices, marked with green and located at the border with Odense municipality. These are higher values than in the cities marked in zone A, but because of the fact that this settlement is combined in the calculation with others of the same type, the average prices get lower than for the ones calculated for the three main towns. The possible reasons for having more expensive properties in Morud, is given in Section 9.3.

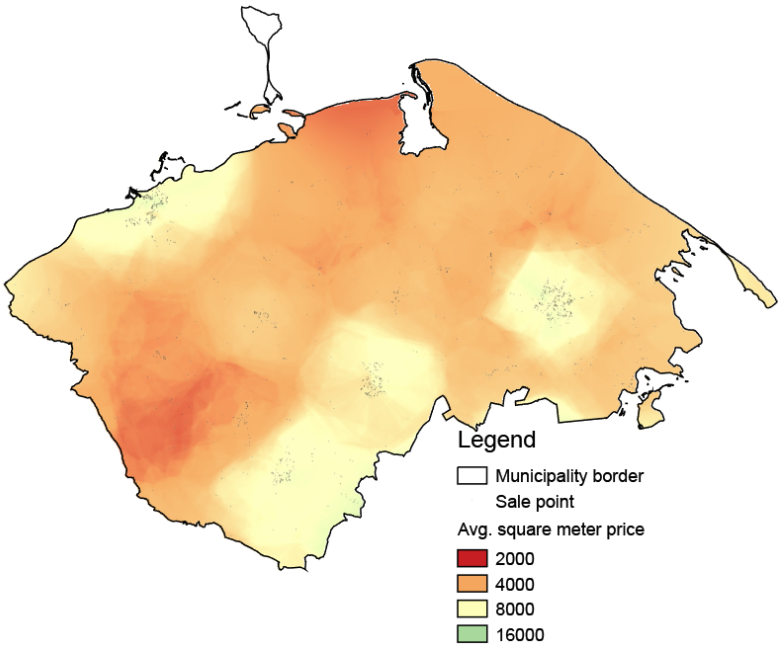


***Figure 6.2.*** *Average housing prices map computed by using IDW*

## 6.3 Precise identification of areas where housing prices are considerably changing

It was discovered that in zone E the prices start rising and it was desired to find out exactly in which time interval are the numbers from housing prices shifting, decreasing or increasing considerably. For this purpose were computed isochrones in QGIS for each minute until reaching the travel time of 15 minutes and then extracting all the existing properties according to the time frame where they are located. There were chosen isolated settlements around the whole country as starting points of the calculations, which can help taking some conclusions. The reason for picking isolated ones is to minimize the influence that the prices can have in case that the reachability zones are interfering with others that can start from cities of the same category, in this way the housing prices being affected. For a better understanding, it can be given the example of Otterup and Søndersø where their isochrones are overlapping even before 10 minutes drive and they also meet the travel maps made from Odense, and this closeness to the city is likely to have a big impact on the prices for the locations outside these two cities, but situated near Odense.

For Nordfyns was chosen Bogense as an isolated settlement as it is not located close to any city of similar sizes. For identifying if there is an existing trend were picked just towns with inhabitants between 3000 and 7500 and were computed the average square meter prices, as in Figure 6.3.

It was calculated an average for all these cities and the result is put in a diagram that looks like Figure 6.4.

From this figure can be noticed that the prices find their peak in a 2 minutes drive time from the city center, slowly decreasing until reaching 5 minutes and then meeting a severe

| Cities | Minutes | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| Bogense | kr. 11.824,55 | kr. 8.524,41 | kr. 8.004,83 | kr. 8.095,60 | kr. 7.386,50 | kr. 3.473,75 | kr. 4.052,20 | kr. 3.351,33 | kr. 1.553,75 | kr. 5.468,49 | kr. 4.848,05 | kr. 3.690,38 | kr. 3.726,13 | kr. 3.428,35 | kr. 3.162,50 |
| Løgumkolster | kr. 4.450,38 | kr. 4.400,21 | kr. 7.190,25 | kr. 3.798,92 | kr. 5.793,00 | kr. 7.762,86 | kr. 4.458,25 | kr. 3.278,67 | kr. 2.200,50 | kr. 3.104,33 | kr. 2.968,93 | kr. 3.814,67 | kr. 4.055,77 | kr. 4.173,45 | kr. 4.630,40 |
| Skærbæk | kr. 4.807,17 | kr. 5.378,78 | kr. 4.806,95 | kr. 7.898,64 | kr. 2.912,75 | kr. 3.894,09 | kr. 3.725,53 | kr. 5.514,11 | kr. 1.609,50 | kr. 3.007,69 | kr. 3.485,50 | kr. 2.332,40 | kr. 3.868,13 | kr. 4.743,38 | kr. 4.032,88 |
| Toflund | kr. 6.483,58 | kr. 5.555,15 | kr. 4.425,14 | kr. 2.545,00 | kr. 5.078,67 | kr. 3.834,71 | kr. 4.940,50 | kr. 4.621,92 | kr. 3.540,57 | kr. 3.504,65 | kr. 3.346,18 | kr. 4.339,41 | kr. 4.801,30 | kr. 3.980,35 | kr. 3.871,45 |
| Faaborg | kr. 8.187,28 | kr. 11.561,19 | kr. 8.994,95 | kr. 12.024,46 | kr. 11.736,13 | kr. 10.284,96 | kr. 4.296,05 | kr. 3.929,00 | kr. 5.460,60 | kr. 8.063,82 | kr. 6.136,78 | kr. 6.007,57 | kr. 5.469,81 | kr. 7.310,63 | kr. 5.088,86 |
| Rudkøbing | kr. 7.792,13 | kr. 10.328,56 | kr. 8.039,03 | kr. 5.709,36 | kr. 4.215,74 | kr. 7.463,75 | kr. 4.387,69 | kr. 3.766,97 | kr. 4.998,72 | kr. 3.630,79 | kr. 3.531,23 | kr. 2.604,64 | kr. 3.653,67 | kr. 4.624,75 | kr. 3.352,93 |
| Ølgod | kr. 4.873,00 | kr. 5.836,25 | kr. 6.213,18 | kr. 7.707,22 | kr. 6.626,50 | kr. 3.501,50 | kr. 3.954,50 | kr. 1.274,25 | kr. 6.327,00 | kr. 2.758,36 | kr. 5.232,92 | kr. 4.318,38 | kr. 5.733,13 | kr. 3.888,86 | kr. 4.675,48 |
| Videbæk | kr. 6.699,33 | kr. 6.550,49 | kr. 7.351,14 | kr. 7.728,06 | kr. 9.525,83 | kr. 5.015,78 | kr. 3.998,89 | kr. 4.580,14 | kr. 4.680,54 | kr. 6.005,56 | kr. 6.432,71 | kr. 3.556,48 | kr. 4.511,90 | kr. 4.730,68 | kr. 5.737,83 |
| *Average* | kr. 6.889,68 | kr. 7.266,88 | kr. 6.878,19 | kr. 6.938,41 | kr. 6.659,39 | kr. 5.653,92 | kr. 4.226,70 | kr. 3.789,55 | kr. 3.796,40 | kr. 4.442,96 | kr. 4.497,79 | kr. 3.832,99 | kr. 4.477,48 | kr. 4.610,06 | kr. 4.319,04 |

***Figure 6.3.*** *Average square meter prices for properties located in one minute interval isochrones up to 15 minutes, computed for cities with 3000-7500 inhabitants*

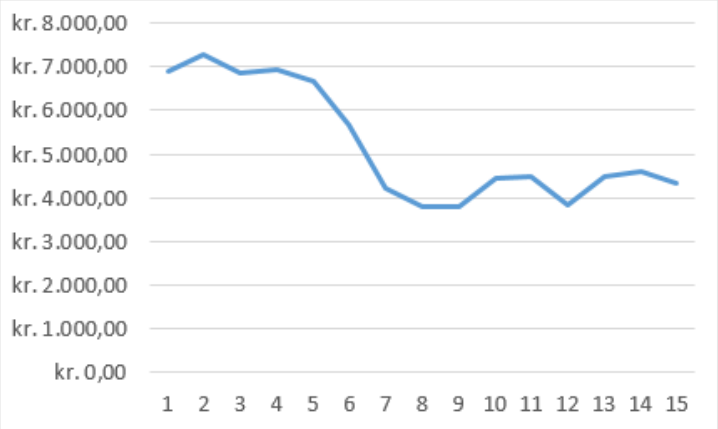


***Figure 6.4.*** *Average square meter prices calculated for all the settlements mentioned before*

drop that continues up to the areas located between 9 and 10 minutes. Starting from here the prices are changing again, having larger average values. The explanation might be that in case of looking at the isochrones on the map, it can be identified that this is the time frame where the isochrones meet the ones corresponding to a neighbour settlement of same category or an even larger one, which has a strong contribution on the overall value of a property.

## 6.4 Housing demand

As it was presented when introducing the theory, it is desired to find out what are the trends regarding housing demand for Nordfyn in the last years, and how do they differ compared to the values given in Table 2.2. For being able to formulate a conclusion after this comparison, it is introduced the existing situation of the municipality in Figure 6.5.

Apparently the average size of villas is increasing compared to the available data for 2008, and also increasing as moving further away from cities. This might happen because it is cheaper to buy in these zones. When looking at the way the numbers are changing for apartments, the demand is bigger in zone A, and it decreases in zone B and in all the other

parts there were no properties sold within 2012 and 2016. In the case of townhouses, the requirements for average size are higher in smaller settlements.

| | SC1_A | SC1_B | SC1_C | SC1_D | SC1_E |
|---|---|---|---|---|---|
| Apartment - average size | 80,323 | 74,000 | - | - | - |
| Villa - average size | 143,568 | 147,496 | 152,450 | 153,470 | 159,545 |
| Townhouse - average size | 97,365 | 103,000 | 127,000 | - | - |

***Figure 6.5.*** *Housing demand for Nordfyns in 2012-2016, divided in the zones of the existing scenario*

# Landscape analysis 7

Another tool that can contribute to the understanding of the municipality's demographic challenges is performing the landscape analysis that can provide an image regarding the connection between the number of inhabitants and the features contained in the area.

It is used for emphasizing the potentials and for identifying the places that can be considered less attractive when deciding where to move. Its benefits can be seen when working with planning purposes, such as strategic plans.

With the previously two chapters was drawn an initial assessment regarding the rural depopulation movement and consequences, by building processes around transport times and adding other indicators on top. When taking in consideration also the key characteristics of the environment, it can be formulated a premise for a trustworthy outcome that can be used in the overall development of the communities.

For this purpose are used the QGIS performances given by the layers that are providing a back-bone in a comprehensive understanding of the capabilities of the landscape, offering a visual evaluation. The data used is described in Section 4.5. There are identified as many key elements as possible and later is formulated their impact.

It is worked with two types of approaches: the first one is related to the resources of the settlement's environment and the second one focuses on the areas that are man made and are considered negative factors in the municipality. When talking about the existing potentials, one can refer at the natural resources, historical land-use or cultural information. These are indicators that can attract people because they give a sense of beauty or of possible leisure activities which can be undertaken, for example, in areas with: forests, lakes or at the coast lines, the last one being an important attraction for people living in Nordfyn. In Figure 7.1 are inserted all these environmental layers in order to have a clear image about the opportunities that exist.

Beside the elements mentioned before, there are a range of places that are not desirable to live close by and they have an influence in a downward development of demographics of the municipality because of their effects on health and well-being of the population. These are made artificially and have been divided in different categories as seen in Figure 7.2.

Windmills are being built more and more, which is good for the country's economy but bad for people living close to them because of their side-effects seen in the amount of noise that they produce, the threat that they can bring to the wildlife or the visual impact which is very often not considered as being a pleasant one. It is the same situation in case of being near big factories of industrial areas.

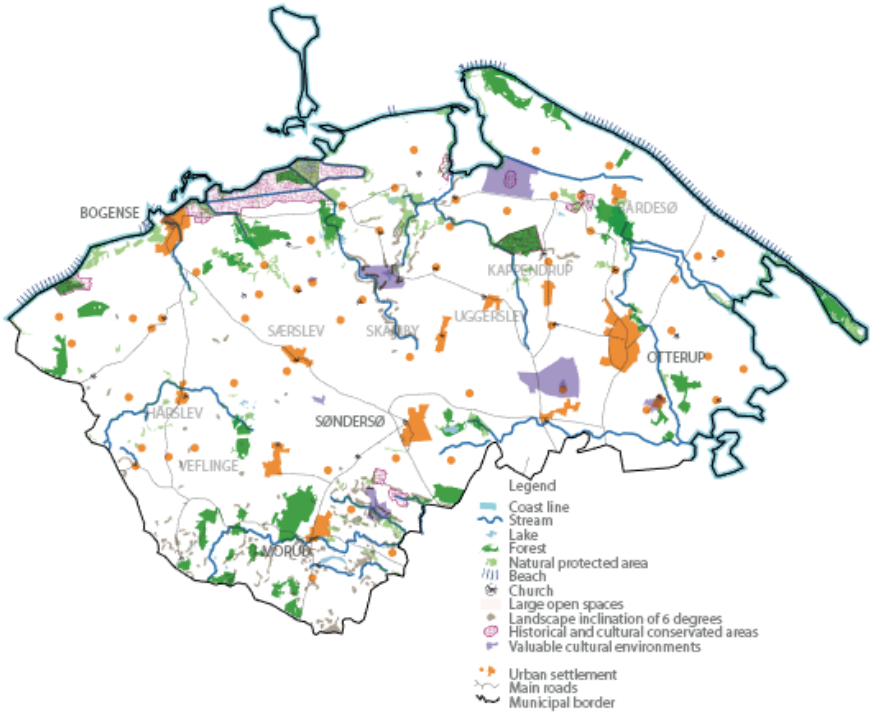


***Figure 7.1.*** *Positive features in Nordfyns environment*

Another types of places which might bring a certain vulnerability in case of moving to Nordfyn are the presence of farms. They were divided in two parts based on their size which was taken from Jordbrugsanalyser and measured in Animal Units or AU. The term has the purpose of creating a common definition in 'calculating the relative grazing impact of different kinds and classes of livestock', [McCarthy, 2003].

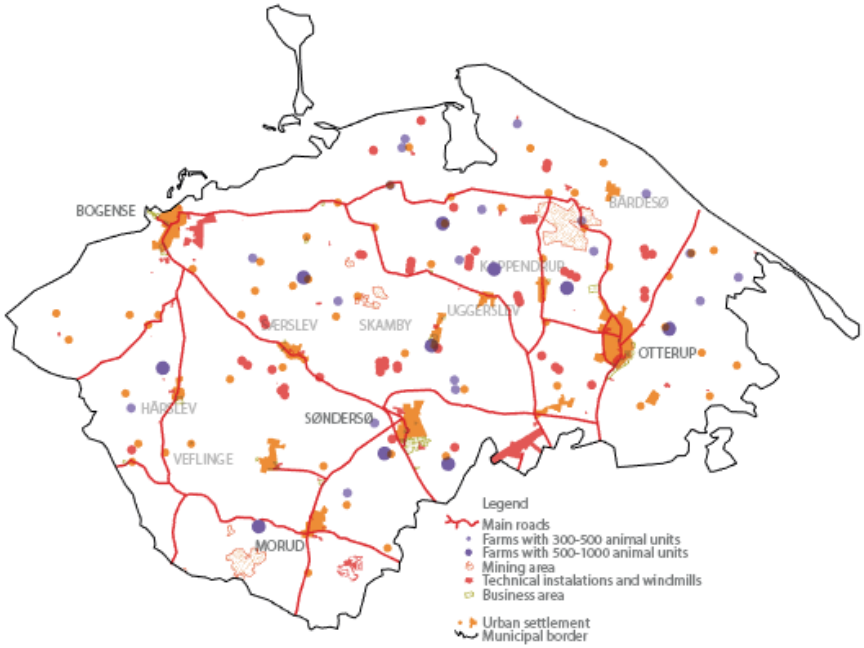


***Figure 7.2.*** *The elements that can constitute impediments when moving to Nordfyn*

There are three elements identified on both maps: the municipal border, main roads and the urban settlements. They are represented in order to make a better distinction and to localize more precise the layers introduced. Roads can constitute on one side a positive aspect as they assure facile access, but on the other hand can be a negative one because of the noise and pollution. One of the important aspects to be mentioned is that the municipality is located in the vicinity of the motorway that joints the Eastern with the Western part of the country (known as the Big H), in this way being easy to travel further out from Nordfyn.

This landscape analysis will be an approach that will later explore more its usability when thinking about ways of building new scenarios for better identifying the rural depopulation movement.

At the end of the report, in Appendix D and in Appendix E the reader can find the previous figures at scale 1:200000 where it is easier to visualize them and to identify their details on the maps.

# Public transport implication 8

Cars are nowadays the first choice in terms of using means of transport, but in order to have an environmentally sustainable system it is important to be more aware of the capabilities that public transport is holding. In this regard are used the benefits given by information systems, which help in understanding the existing situation and can contribute as a decision-support for future improvements that might occur.

It has been discovered that due to a reform in the school system, pupils have to stay longer at school, so it is needed to ensure that the available regional founded routes are reflecting the current demands and that they are also dependent on the frequent hours when people have to arrive or to leave their working places.

In order to supplement the current facilities, there have been introduced different options such as Flexitur, where a person can book a place and a car will be assigned to him or her along with other passengers and it runs just in Southern Jutland, which means that the existing routes might not be sufficient or optimal.

This chapter is made in order to identify which are the areas where is more appropriate to use public transport rather than cars and to identify if there is a lack of transport possibilities to the main cities of the municipality. Urland team has contributed in the research, also by providing their map of public transport, so that the student can discover which are the parts with low level of service and if there is any connection between this type of infrastructure and the changes in the number of inhabitants.

Their process has started with a collaboration with the owners of the data for the whole country, which are called Rejseplanen, who offered an open API (application program interface) and a shapefile with the coordinates for all the stops in Denmark. By using them was made a Python script which holds QGIS capacities where were inserted the central points for the main cities: Bogense, Otterup and Søndersø. The script reads the file with the stops, takes the location of the origins that were previously introduced and calculates the travel time from each origin to all the stops by making a request to the open API. In this way is explored the topology at stops, which means that is taken real time information regarding the time journey, the period required for transferring from one mean of transport to another, but also the waiting time involved. In the facing calculations is considered as stating time 8 o' clock in the morning on 1st of June 2016, assuming that in a working day the demand for public transport is higher than in the weekends and that there are multiple options available. After doing so, it is received an answer with the period required for getting from the starting point to each of the stations. From here

are picked the fastest routes corresponding to each travel option and then are computed the isochrones for 10, 15, 20, 25 and 30 minutes intervals, as seen in Figure 8.1. Because timetables are changed usually once a week, the stops might no longer be valid, that is why is important to mention for which time frame was made the process.

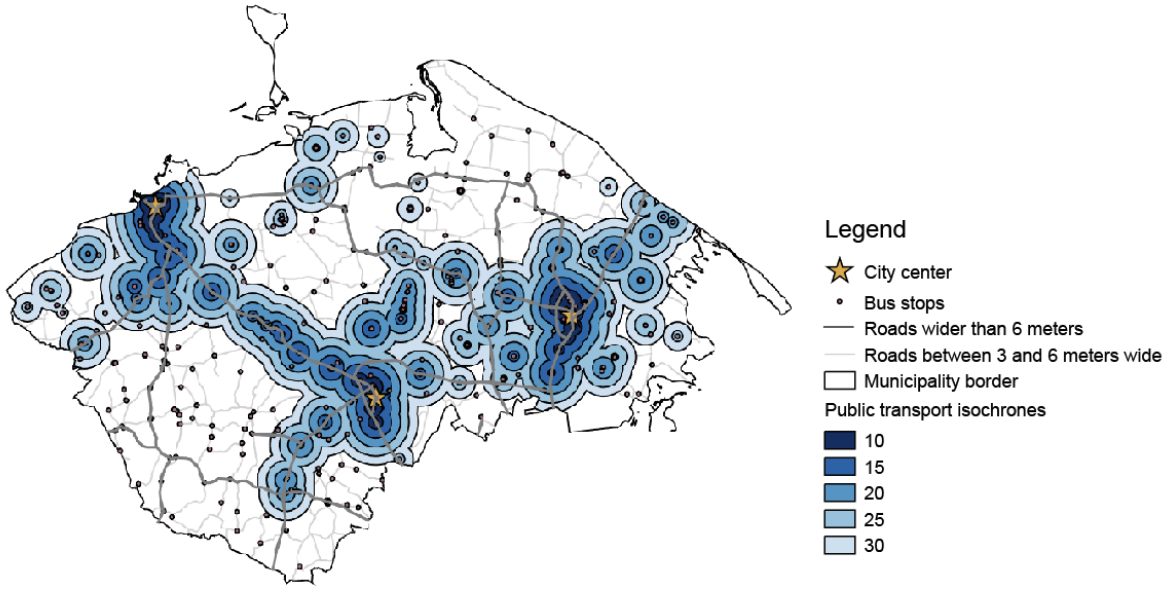


***Figure 8.1.*** *Public transport isochrones computed for Bogense, Otterup and Søndersø*

The circles that can be identified in the picture are corresponding to the walking distance required in order to achieve the 30 minutes inserted. They are isolated because a person cannot get off between the stations. They are represented in such way that, for example, in case that a bus has a journey of 27 minutes, the rest of 3 minutes are indicated by circles with a radius of 3*80 around the stop, where 80 is the distance in meters that a person can walk per minute. In the same manner are made the other circles around the final stations, and these areas get smaller the further away they are from the origin, because there is less time remained for walking away from the station as it is taking longer to arrive in that point.

By making this availability analysis can be identified the infrastructural isolated zones in relation with the most important cities of the municipality, and because of the fact that they cover large areas, there should be taken some decisions where the public transport can have priority over cars or big trucks, by having dedicated lanes or priority at intersections.

Even if taking public transport is more time consuming than cars, it is more cost-efficient and more environmental friendly. In case the number of people choosing buses will increase, the number of cars will decrease, the traffic being less dense and also the available infrastructure in this direction is likely to improve, providing in this way shorter periods of time needed for going for one place to another.

# Final discussion 9

This chapter will present the closing remarks of the report, with the most important aspects that were gained, combining the different results in order to identify the connection between the outcomes given by using different types of data and then explaining the way are built new scenarios for future investigations.

## 9.1 Significant findings

This part will summarize all the important aspects that were found in the process analysis. There were found also some deviations from what was expected to achieve, but this was a good way to gain more knowledge and understanding of the changes that the municipality is facing.

### 9.1.1 Demographics

It was found out that international citizens have a big contribution in the way the numbers are changing because especially after year 2010 came a lot of foreigners for working or studying reasons and after 2015 the whole Europe has known the process of European refugee crisis. The migrants are usually living together in large number, in this manner keeping their cultural identity. For this reason, it was decided to divide all the calculations in the ones corresponding just to data about ethnic Danes and the ones for international people. The conclusions gained after introducing the basic statistics on demographics were introduced in Section 5.2.

In case of looking at the percentages of people of different ages it is noticed that there is a significant number of old Danish inhabitants in zone A, this possibly finding its reasons in the fact that it is the area with nursing and retirement houses, but another explanation can be also that this category holds the financially strongest inhabitants, forcing younger people to move outside cities. When analysing the same numbers for migrants, this percentage is significantly lower, but instead is a large concentration of population that might be of active workers or students.

Most of the Danes have moved in Nordfyn between 2000-2008 because of the boom in the real estate market. It was analysed also the data regarding the municipalities from where people have moved, and in zone A are individuals coming from all the municipalities of the country, while zone E corresponds just to half of them. All the first five municipalities from where are relocating the biggest percentages of population, are situated in Funen which

means that in this case the closeness might be the main reason for choosing Nordfyn. From the residents that have not changed municipality, 70% are Danes.

It was discovered that in the areas located around the main towns, are citizens coming from 53 countries and the biggest contribution is from Syria, Poland, Bosnia-Herzegovina and Lithuania.

### 9.1.2 Housing market

Regarding the real estate trends, it should be pointed out that it was assumed that the real estate market is a perfect one, considering just the selling prices, but other significant costs are added as fees needed for the realtor. The average square meters prices are the highest ones in zone A and this is happening due to the different available facilities that larger towns are having. Afterwards they are decreasing at around half value in B and having lower and lower numbers until reaching zone E where they are rising again, maybe because of the add-ons given by the landscape characteristics. But it is important to mention that in zone A have been 621 transactions in the period of 2012 and beginning of 2016, while in E are just 11.

There has been made an investigation concerning the time frames where housing prices are changing significantly and it was found out that at 5 minutes they are considerably dropping and continue decreasing until reaching 10 minutes out of the cities and then they start rising again most probably because of the influence that other settlements are bringing.

Regarding the housing demand was concluded that average sizes of villas and townhouses are increasing compared to previous years, and also increasing as moving further away from the cities, perhaps because of the fact that prices get lower and lower as being far out the main towns. The process is reverse for apartments.

### 9.1.3 Landscape characteristics

The combination of forest, lake, coast or in general beautiful resources can be an advantage for Nordfyn in case of deciding where to move. Also it is located close to the highway that is joining the Eastern with the Western part of the country, which is a very important aspect in terms of mobility from one place to another. Even if there are infrastructural isolated places, they are still big attractions in terms of holiday destinations given also by the presence of the summer houses.

It is occurring what is known by planners as doughnut effect which implies that the areas located just outside the settlements are more beautiful due to the characteristics given by nature, while the city centres are less attractive. This is proved by the fact that the peak in average housing prices has been identified at two minuted drive time from the central locations.

### 9.1.4 Public transport availability

When overlapping the public transport isochrones with the ones made for cars, it can be seen that the ones for public transport cover less areas, or the same areas in longer period of time. This happens due to the numerous stops that buses or trains have to make, without being a continuous or uninterrupted journey.

## 9.2 Combining the results

In case of combining the results of the different outcomes, can be identified important aspects of the municipality. The separate maps that were merged are the ones for: isochrones from the first scenario with housing prices, the same isochrones with housing prices and the public transport travel times with real estate map.

### 9.2.1 Isochrones and housing prices

The first combination of maps is between the isochrones computed for cars and the housing market trends. By using this is identified that there have been sold just few houses in the area left uncoloured, which corresponds to zone E, as seen in Figure 9.1. In the light green areas are cheaper properties, while as getting closer to dark blue area, the prices are rising. This was to be expected because of the different level of development, existing infrastructure and amenities in the zones. But the most surprising aspect is that in the southern part of Nordfyn, in Morud, are the highest housing prices of the municipality, even if the settlement is medium sized.

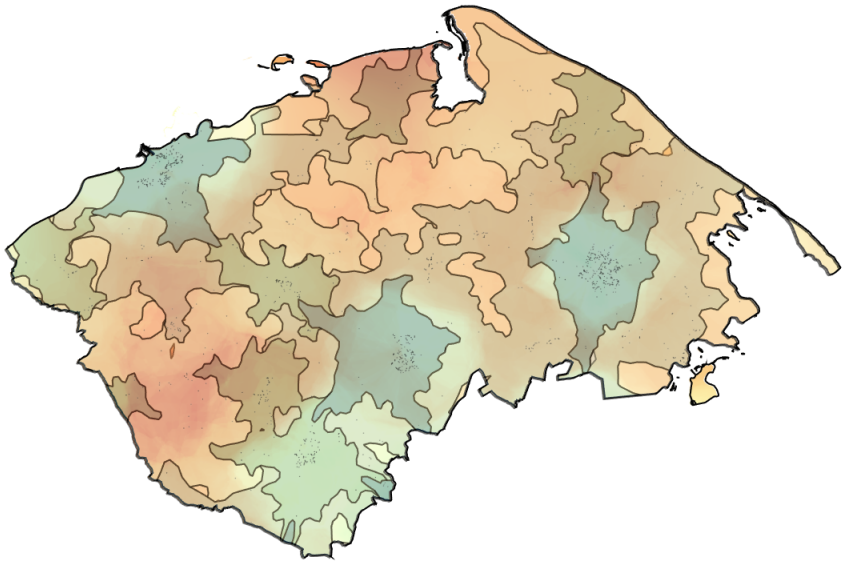

***Figure 9.1.*** *Isochrones overlapped on housing prices*

### 9.2.2 Isochrones and landscape characteristics

Figure 9.2 reveals that the most significant amount of points considered as being potentials for the municipality, are located in areas of 5 and 10 minutes drive from the large settlements. The interesting aspect is finding the large concentration of positive factors around Morud.

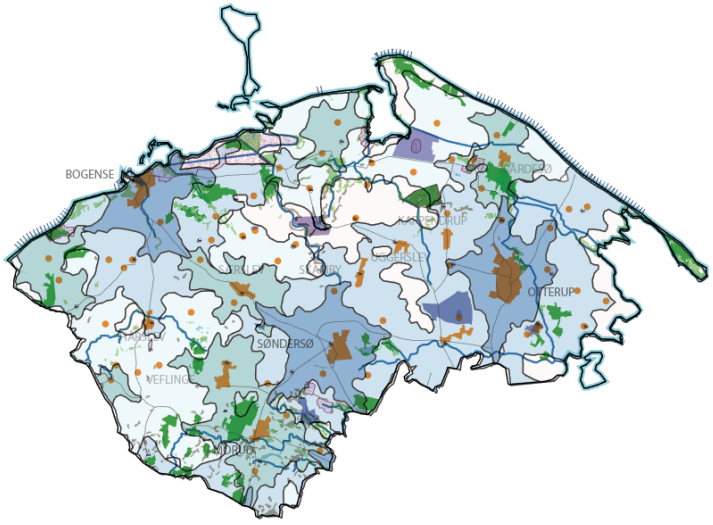


***Figure 9.2.*** *Isochrones overlapped with the landscape potentials of the municipality*

Unlike the previous map, in Figure 9.3 are identified the areas with the landscape barriers overlapped with the isochrones. Apparently there are a lot of farms and technical installations in the areas left uncoloured, these being mostly located in the central part of the municipality. Significant numbers from these categories are in the northern part as well, where are the travel times corresponding to small settlements. Also in these areas are not as many potential places as in the other zones.

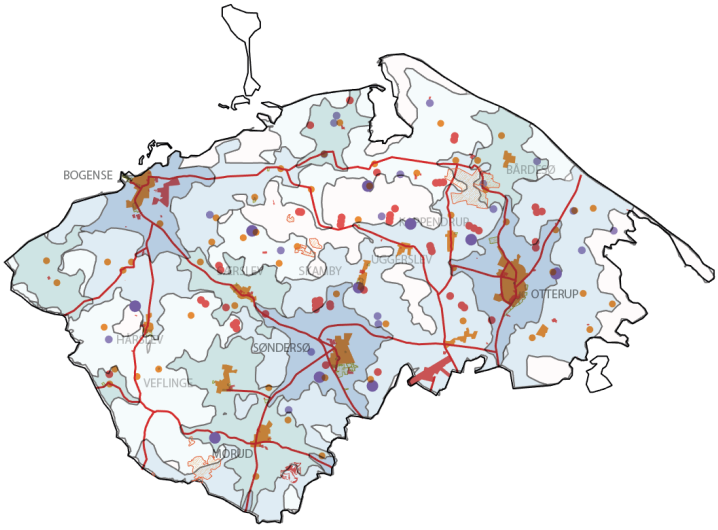


***Figure 9.3.*** *Isochrones overlapped with the landscape barriers of the municipality*

### 9.2.3 Public transport isochrones and housing prices

The areas from around the three main cities that have easy access to any type of transit coverage, such as buses or trains, are the ones where the housing prices are the highest. The parts represented by orange or red, which correspond to low values of the average square meter prices, are also hard to access by public transport, as in Figure 9.4. The only exception is Morud and the potentials of this city are discussed in more details in the next section.

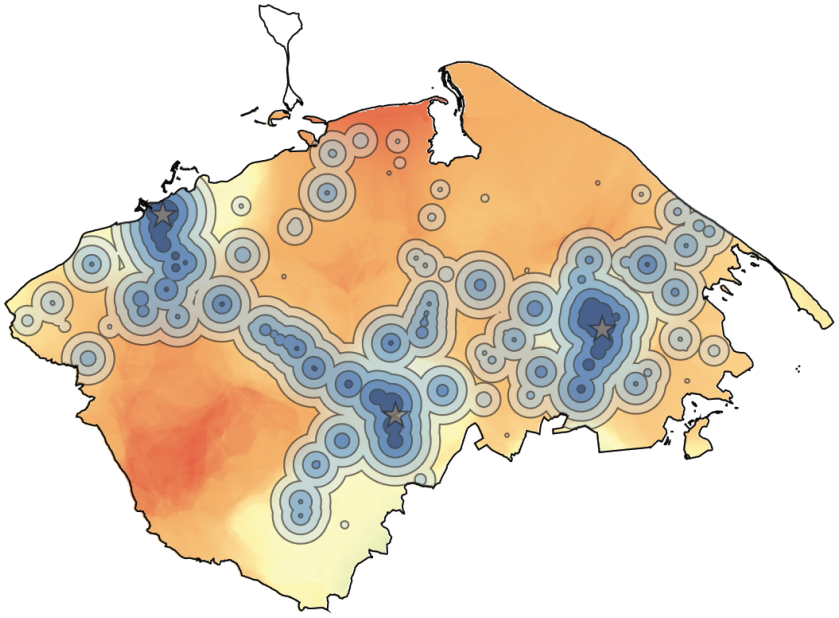

***Figure 9.4.*** *Public transport isochrones overlapped on housing prices*

## 9.3 Importance of Morud

The southern part of the municipality is having results which are not as expected after building the scenarios, because its position has a strong influence on the housing prices as it is relatively close to Odense and Fredericia where are located several job opportunities. In order to visualize the travelling distances from these cities to Morud, there have been computed isochrones from 5 to 5 minutes up to 30 minutes, as in Figure 9.5, where are represented just the curves that intersect the municipality. For a better understanding, these have been combined in Figure 9.6, where is easier to see the closeness to both cities.

On top of this, the area holds a lot of potential because of the large number of positive aspects given by the landscape analysis. This will be one of the elements used for building new assumptions regarding the focus zones.

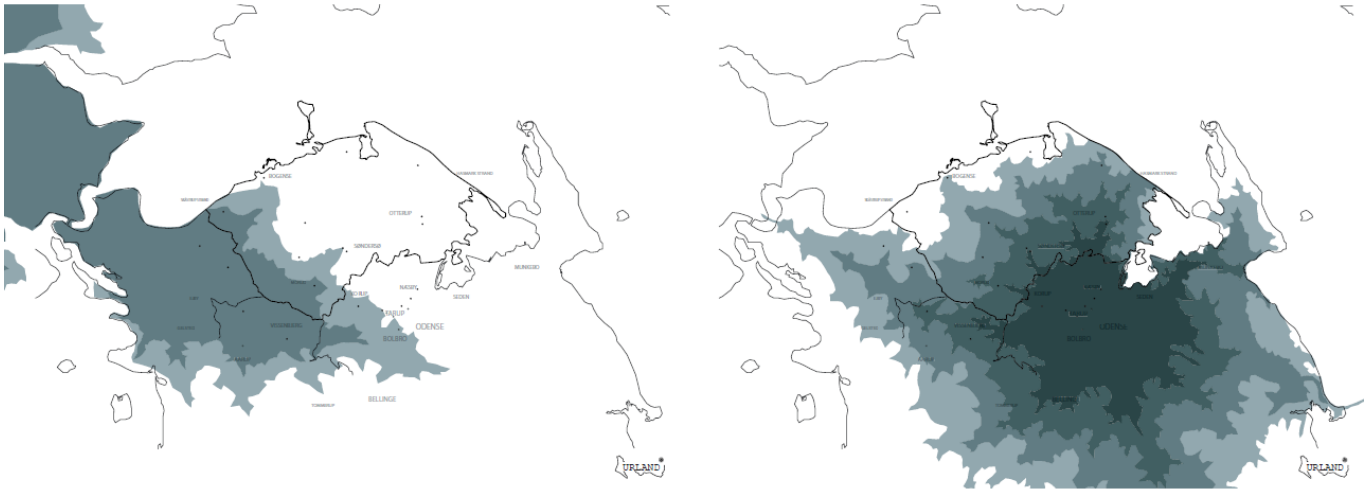


***Figure 9.5.*** *Isochrones from Fredericia in the left and Odense in the right*

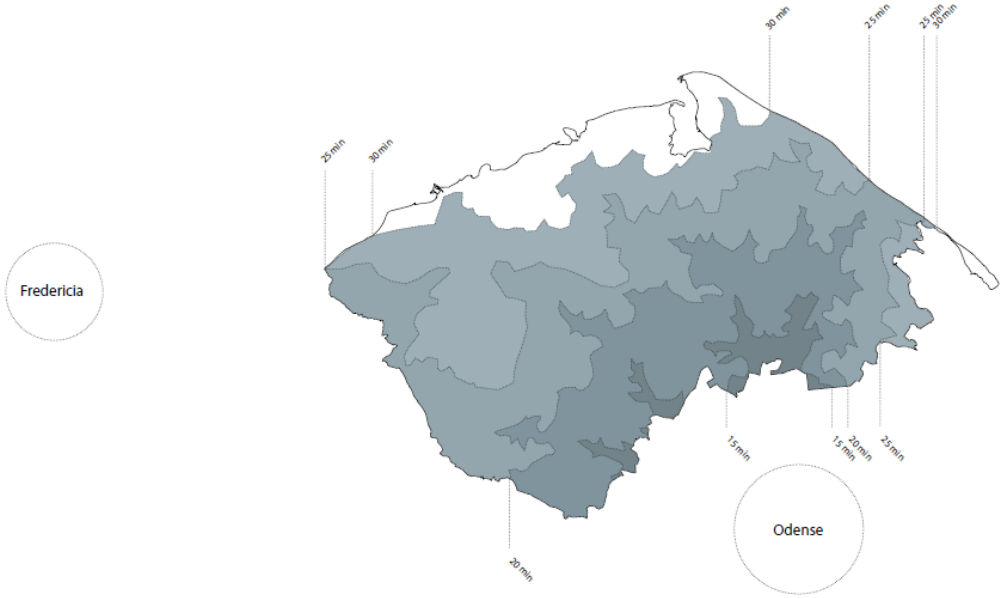


***Figure 9.6.*** *Combined isochrones for Fredericia and Odense*

## 9.4 Setting new scenarios

The existing scenarios are a little bit too broad being built just on the travelling distances and number of inhabitants, while all the analysis of the report reveal very specific aspects for certain areas. After covering all the research and the post process, there have been identified and measured relationships between various features, this leading to what is called as being regression analysis.

Some of the variations were unexpected, and because of this reason are combined the previous outcomes in redefining the zones, having as a basis especially the housing prices and the potentials of the landscape. The key particularities of each of zone are presented in Figure 9.7 and they provide a clear distinction on the existing capabilities and demands

of the inhabitants and they will be further analysed and developed by the Urland planners.

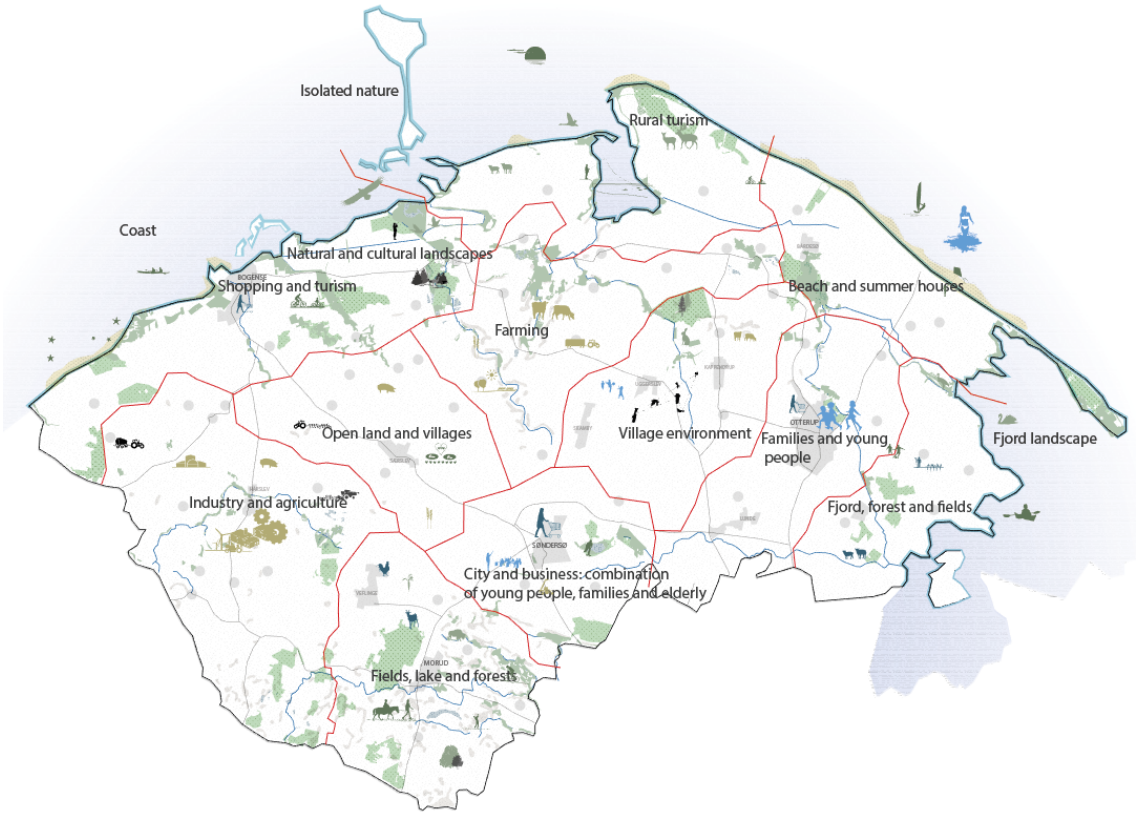


***Figure 9.7.*** *Potentials of each new zone*

It can be seen that now the areas of influence of Bogense, Otterup, Søndersø and Morud are divided separately. There is also the summer house area in the eastern part of the municipality, then the north less developed part, the central zone where is hard to get access, and other parts that have their specific characteristics.

The new 11 zones were made using on a combination of factors:

- the local and regional infrastructure availability
- demographic data of the previous set zones
- housing prices map (see Figure 6.2)
- interviews with local people around the municipality. These were made by the partners that Urland has in making the final strategic plans and the purpose of the interviews was to find out which are the potentials that rely in the areas, and their corresponding opportunities that cannot be identified by making the previous analysis. Also it was a good way for identifying the internal relationships between one city to another in order to assure a good cohabitation in case of combining several settlements in one future zone with distinguished characteristics. Visiting towns and having interviews with people that live and or have a job there, was a good way for the working teams to discover the needs of the inhabitants.

# Conclusion 10

The aim of this report was to create a detailed research that can fulfil all the scientific requirements of a thesis and that can provide a reflection of the student areas of interest and focus, being passionate about all the changes that are occurring nowadays at rural level.

It resulted as representing an important tool for gaining more knowledge regarding rural depopulation, helped in developing new GIS skills and in assimilating ways of handling different types of data for the project purpose. There were found new ways of introducing the outcomes, which are diagrams and tables beside the computed maps. Their importance is seen in providing understanding to non-specialist but they can also be used as decision-support tools in public or private sectors.

The five scenarios introduced at the beginning of the paper are used in order to find the way demographics and housing prices differ depending on the closeness to the three biggest cities of the municipality: Bogense, Otterup and Søndersø. It was demonstrated that the existing travel time areas are suitable for supporting some of the assumptions, but it is recommended to combine the results in order to come with better solutions. The infrastructural facilities that Nordfyn has, are providing a consistent understanding on its potential. Even if it can be noticed a great improvement in the knowledge concerning this subject, there are still some features that are worth considering in case of a new research within this topic, such as developing the calculations for the new scenarios introduced, which are presented in Section 9.4.

Future trends cannot be predicted because of the lack in history data, which means that there can be made just assumptions on what is likely to happen. It is important to point out that all the calculations are based on the existing situation of the municipality.

In order to be able to read about more detailed findings of the process, they can be identified in Chapter 9. In the facing chapter are presented brief conclusions on each topic, that are structured in such a way that they can answer the questions from the problem statement which were given in Chapter 3, as it follows:

*Based on the previous research, how can the results be divided in order to be used for further analysis?* Based on the isochrones computed before, there have been introduced scenarios regarding which will be the areas that will suffer from rural depopulation. The outcomes given in the paper are presenting the nowadays' situation with its corresponding division of five zones covering 5 and 10 minutes reachability areas from the small and large cities, with the 5th zone being the areas where is hard to get access in these amount of minutes.

*Which tools can be used or combined in order to obtain even more precise visualisations*

*of the areas that are likely to suffer from rural depopulation?* According to the theory and the solutions that exist in the whole world in this concern, it was identified that the tools required for assessing better the rural depopulation movements are: statistics using demographics, housing market data, landscape analysis and isochrones made for public transport.

*What kind of statistics using demographics are relevant for studying rural depopulation?* There have been made different kind of statistics using demographics of each zone, where some provided expected results, while others produces surprising outcomes. The calculations were made concerning: total number of people, average age, number of kids that each family has, number of people under 18 years old, number of old inhabitants, number of people who haven't changed municipality, number of foreign citizens and a lot more.

*What is the influence that foreign citizens have on demographics?* After determining the results of the basic statistics, it was discovered that the foreign citizen have a strong influence on the calculations, especially because they are in large number coming from countries like Syria or Afghanistan, due to the existing conflicts in those places. This is not a situation that exists just in Denmark, because it is recognized at European level as being the migrant crisis, where people are moving to other states in order to seek asylum. Due to their influence, it was decided to divide the process on one hand for internationals and on the other hand for Danish citizens.

*How are housing prices affecting depopulation?* Using the same zones, it was intended to see how the housing prices differ and was found out that zone A holds the most expensive properties, and the prices are decreasing at more than half when moving further away from the main cities. Because the areas located outside towns are having lower square meter prices, means that more people are affording to live in these places, but perhaps the real estate data is not sufficient in demonstrating the rural depopulation, being more significant when adding also other factors on top of this approach.

*Can there be considered a time frame where the housing prices are significantly changing when taking in consideration the drive time out from a city center?* It was discovered that at some point there is a fluctuation in the housing prices. Because of this reason, came the will of finding the limit where is the maximum drop in the prices, and the precise time interval where they start rising again based on the fact that the isochrones meet another cities. For this purpose were chosen isolated cities around the country, with 3000-7500 inhabitants, and were computed isochrones for each minute from 1 to 15 minutes in order to find if there is a trend in the housing prices for whole Denmark depending on the distance from the city centres. Apparently the biggest decrease occurs at 5 minutes drive time, with prices getting lower and lower and from 10 minutes their values increase again.

*Is the landscape contributing or influencing people's decision of moving in a certain area?* The paper was used for understanding the potentials regarding the landscape and for visualizing the locations where are places that can have a negative influence when deciding where to move. These aspects might be of great significance, as it is expected that people are more likely to live in areas where they can benefit from the beautiful features provided by the nature, and are not interested in the locations situated close to factories or other

technical installations.

*Are public transport facilities important when living in rural areas?* In case of living in the country side, there are a lot of aspects that are important to be taken in consideration. Among them is the closeness to interest points such as: schools, supermarkets and hospitals, but also to working places. This distance cannot be an impediment when having a proper public transport infrastructure that can provide quick access between different locations, in this way avoiding the need of being dependent on cars. The isochrones computed for identifying the areas that correspond to various travel times, show that the coverage of the existing facilities is smaller than the one for cars, but in case more and more people will start using the public transport, there is likely to have some improvements in the system and also the numbers of cars will decrease, having less busy traffic.

*How are evaluated the initial scenarios? Is there a better way for building them?* The scenario that was used for all the processes is based on the existing situation of the municipality and it was demonstrated that it provided important results. After processing the statistical data on demographics for the two possible future scenarios, it was found out that the results cannot be considered relevant as they are based on future assumptions, but all types of data are most probably going to change by the time next calculations will be made. This means that the actual data cannot be used for a realistic prediction of the future trends but in case historical data would have been available it would have been interesting to discover which were the past movements of the population.

A better way of building new scenarios is by combining the outcomes gained after the various approached, and modelling the zones accordingly. In Section 9.4 was presented a short description of this method.

# Perspectives 11

There can be given several ideas in case of making a future research in this direction. Maybe the most important one will be to develop the calculations of the new scenario and to discover if they provide better outcome regarding the potentials that each zone has. The calculations should be done for both demographics and real estate, as it is already taken in consideration the landscape analysis and the transport to the three main cities of the municipality. It might be a good idea to compute the public transport isochrones also for Morud.

Different outcomes will be provided if combining the statistics of the age of population with the size of the houses where they live in. This can make a lot of sense as when people get older, they might not be capable of managing a large house and they are most probably choosing to live in smaller places.

A combination of the selling price and the valuation price of the properties will give an understanding of the wealth of individuals, because the difference between these two is providing an overview on the way housing market has changed over time.

By making an online platform or a website that can contain information in all the cells of the represented municipality, it is easier to see the maps and to click from one to another in order to identify the characteristics and benefits of each one of the approaches.

# CD content 12

The CD attached contains:

| Description | Name of the files |
|---|---|
| Different potentials that settlements can have | Appendix A |
| Scenario 2 | Appendix B |
| Scenario 3 | Appendix C |
| Potentials of the settlement | Appendix D |
| Barriers of the settlement | Appendix E |

***Table 12.1.*** *Appendices*

These appendices are also found at the end of the report. In addition, the CD includes:

1. A PDF copy of the report
2. Files for the statistics on demographics:
    - 01:calculations
3. Files for the real estate process:
    - 01:gis layer
    - 02:excel files
4. Files for computing the landscape analysis
    - 01:landskab
5. Maps

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