Andreas Roth
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Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

– kunskap för en hållbar utveckling

Mapping losses of ecosystem services due to cropland reduction

-An attempt to model economic loss of reduced food production capacity

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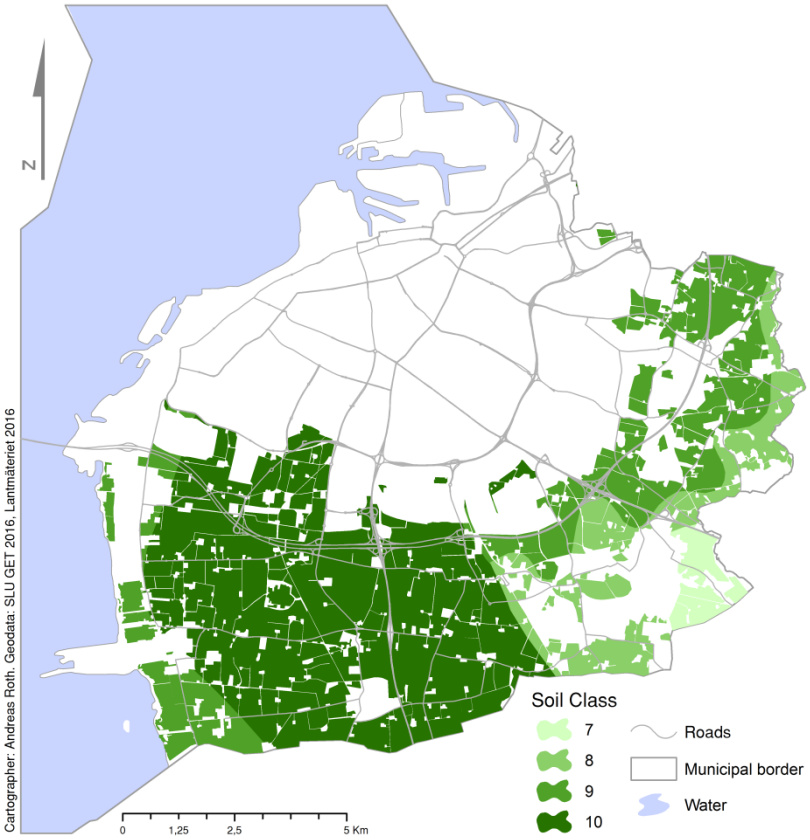
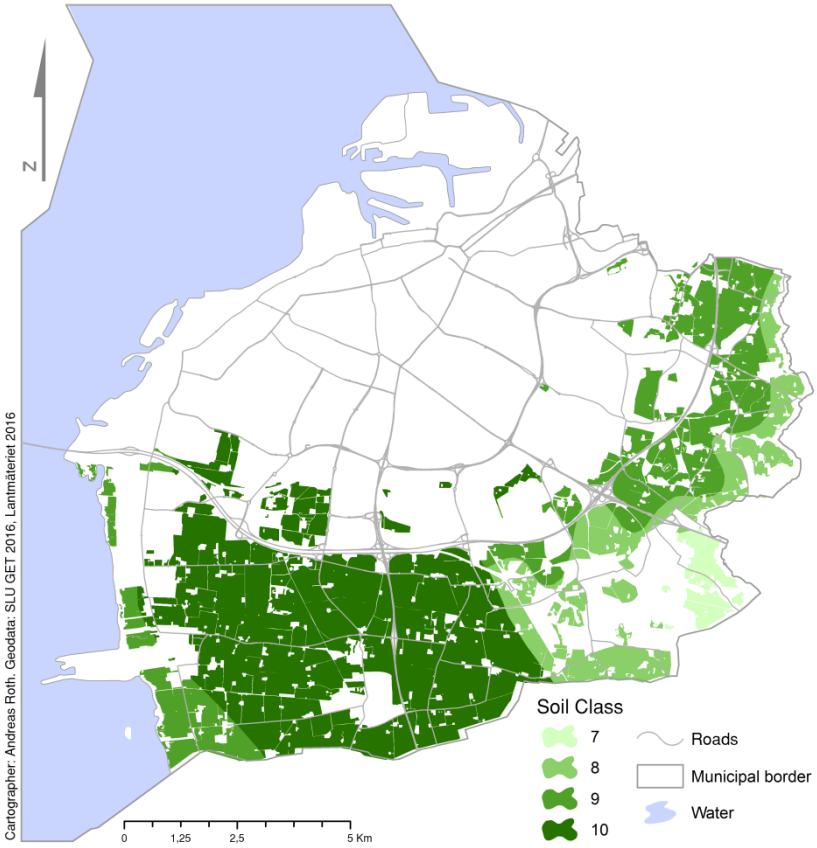
Background

The high development pace in Malmö for the past decades has led to an increased pressure to find land suitable for city expansion. Due to Malmös geographical position, this has often led to the exploitation of high quality cropland. To be able to accommodate the ever growing city, the municipality has continuously exploited the surrounding cropland to the point that more than 31 percent of high class cropland has disappeared between 1981 and 2014. In an attempt to reveal a contrast to the economic gains derived from the development of new neighborhoods and businesses, an ecosystem services (ESS) valuation approach is used. This approach makes it possible to assess the services provided to the society by different ecological functions, and to put them into the same monetary system that supports the socio-economic decisions of stakeholders.

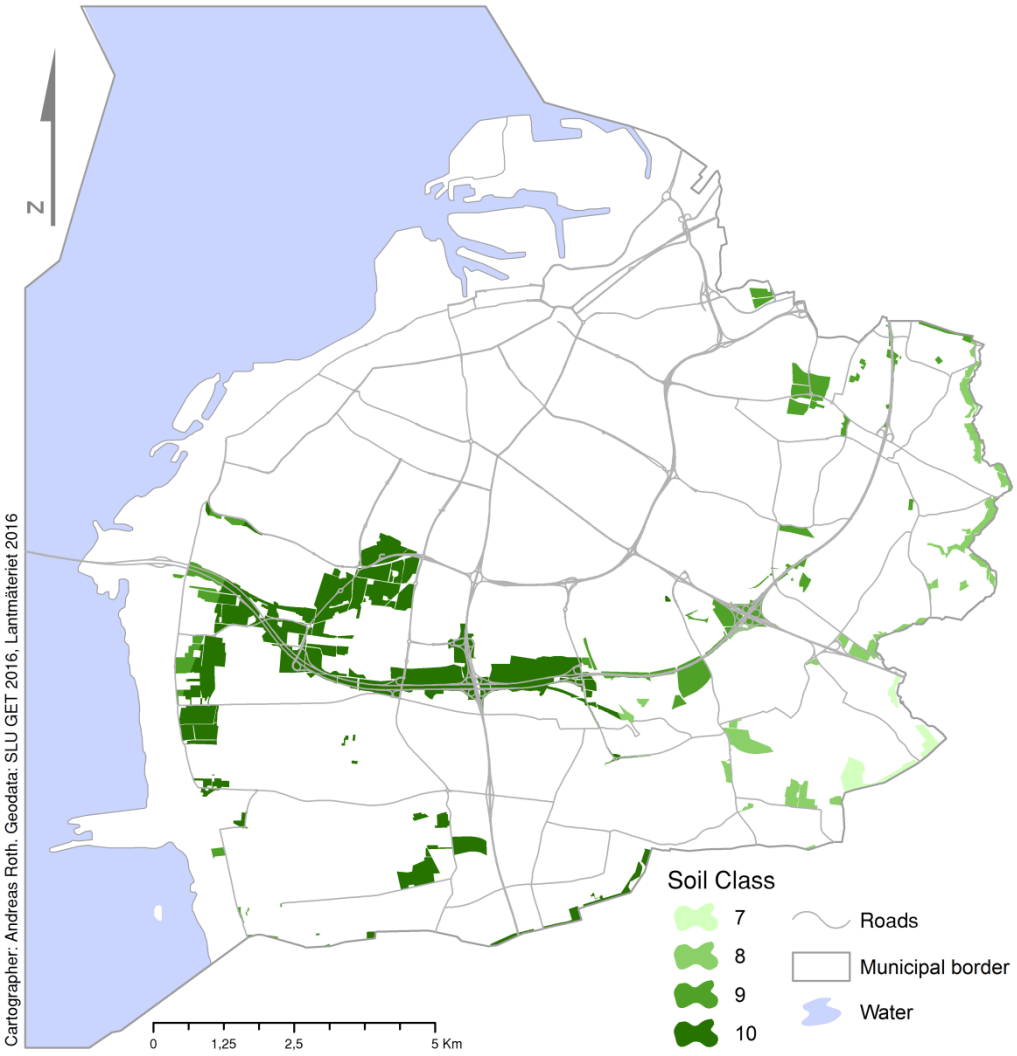
The first three maps depict the historical land development between 1998 and 2013. Areas marked in green are agricultural land categorized into soil quality classes depending on the soils crop producing capabilities. The last map of the series (map 3) shows the difference in cropland distribution, these are areas that have been exploited for other purposes and can no longer be used in food production.



Map 1: Agricultural soil classes and area 1998



Map 2: Agricultural soil classes and area 2013



Map 3: Area of agricultural land lost between 1998 and 2013, and its classification

Research question and delimitations

The study aims to explore the possibility to apply an ESS valuation method through a simple GIS model. It also tries to answer the question of how the future development of Malmö will impact the agricultural land surrounding the city, and what the potential economic losses could be through three different scenarios.

The delimitations of this study is quite extensive due to the complex field of ESS research and ecology. The valuation of agricultural land in this study only takes into consideration the provisioning service of food production, although cropland and agriculture is a host to many more ESS. For instance is the pollination service from bees and bumblebees valued between 100 million and 300 million Swedish kronor only in Skåne (Dänhardt et. al. 2013). This means that the total value of Malmös agricultural land, accounting for all ESS, is certain to be much higher than the valuation presented in this study.

Building the model

Mean cropland value in Sweden is estimated to 20 174 SEK per hectare and year (Jordbruksverket 2014; Jordbruksverket 2015). The classification of soil by food production capacity is divided into ten classes, 1 throgh 10, with 10 being the best soil class. The classes differs in food production capacity by a multiplier approximately from 0,8 for class 1 to 1,25 for class 10. For example, this gives class 10 soil a potential yearly food production value of 25 217 SEK per hectare, and class 7 soil a potential value of 22 191 SEK per hectare.

The percentage of average loss of land, stretching from 1981 to 2014, is used as the basis for the estimation of future loss of cropland. The statistics is also used to model a probable increase and decrease of development pace, and the economic losses that is expected due to the city expanding on cropland. In the modeling of future land use scenarios, consideration has been taken to account for areas that are marked as development areas for dwelling and business in Malmö's comprehensive plan (Malmö stad 2014).

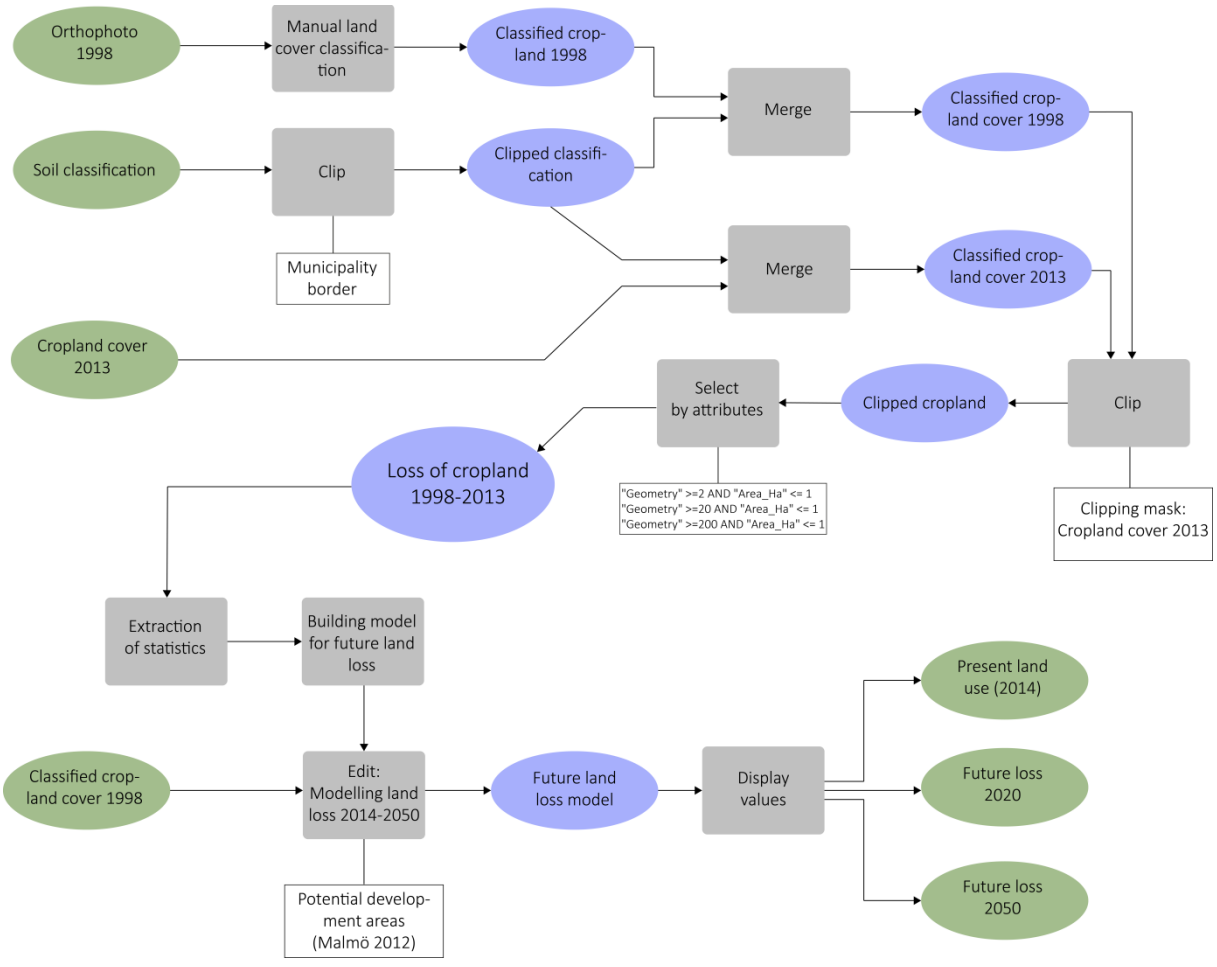
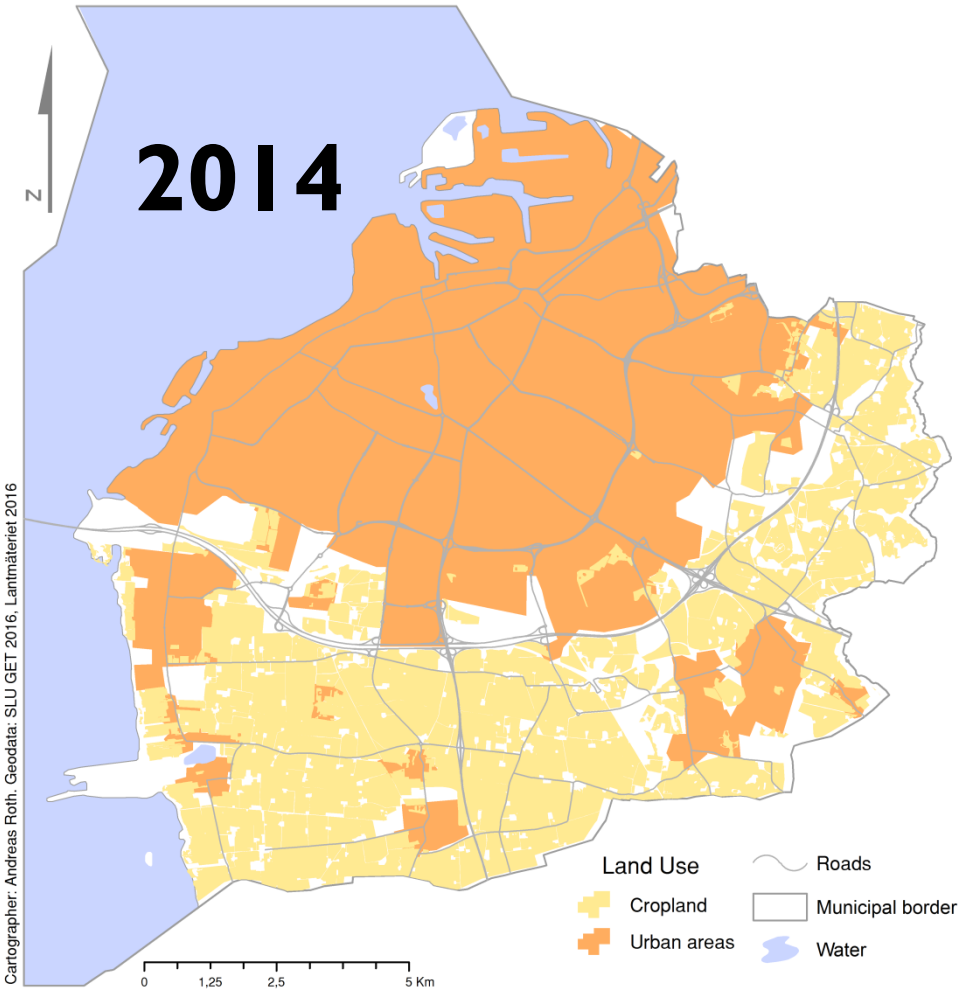


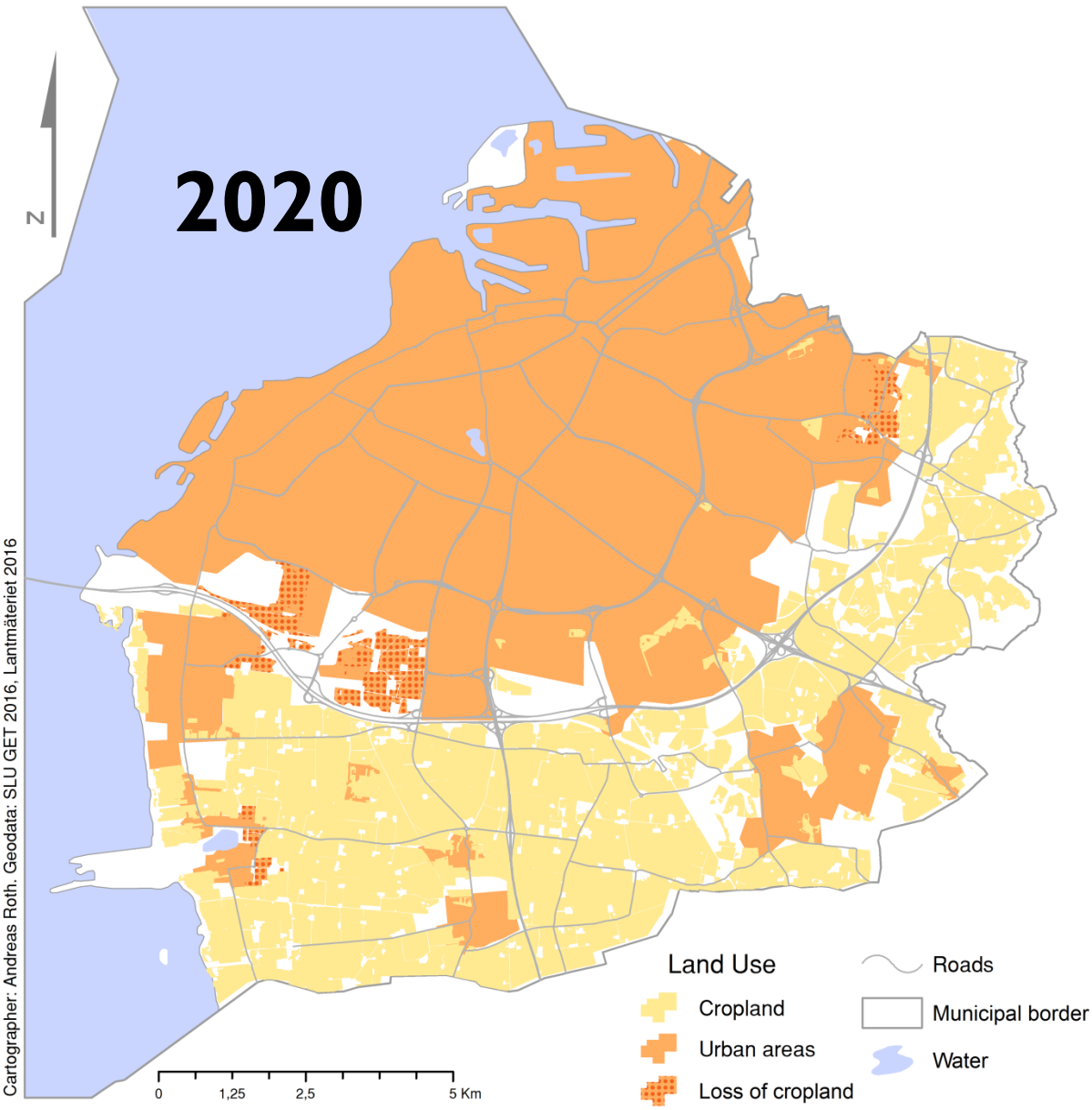
Figure 1: Flowchart of the model

Results

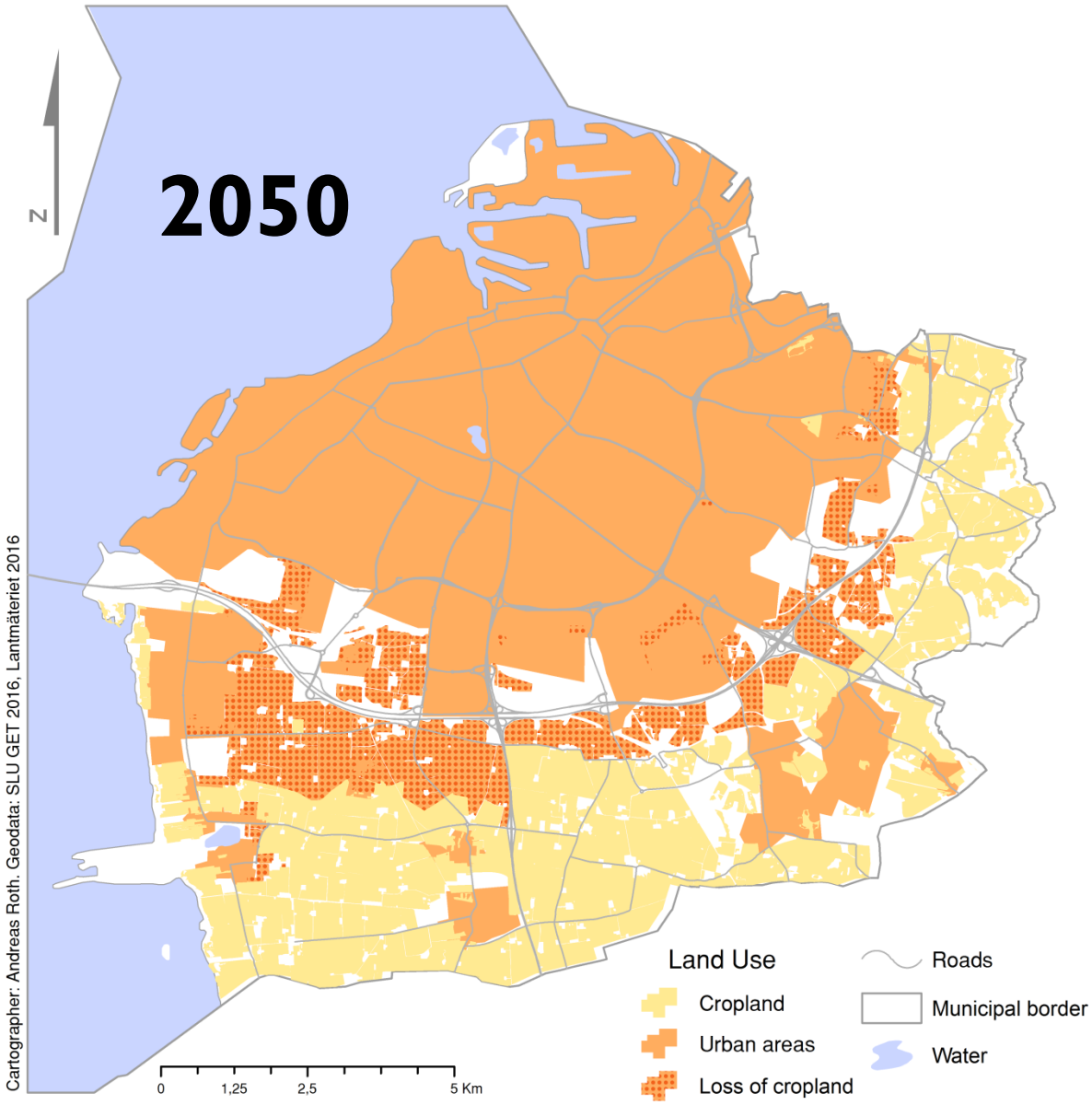
The results of the study shows that the economic loss from reduced food production, if the development pace stays the same (0,95 % of total cropland area), is estimated to be around 37 million SEK by 2050, yearly. The result is based on the calculation that around 1334 hectares of cropland is going to be exploited to accommodate the expanding city. If the development pace is to increase by 1,05 percent (from 0,95 % to 2 %) the economic loss from reduced food production is estimated to be around 65 million SEK by 2050 based on the models result that shows a total loss of cropland of 2371 hectares. Even if the exploitation decreases from 0,95 % to 0,5 %, the economic loss will be around 19 million SEK by 2050, with a loss of cropland the size of 700 hectares or around 1400 football fields.



Map 4: Present land use (2014)



Map 5: Land use in the year 2020 with current development pace (0,95 %)



Map 6: Land use in the year 2050 with current development pace (0,95 %)

Discussion

The model that was created in this study could be considered to be relatively accurate. Although the input data is generalized to allow quantification, the statistics used is still the most accurate that is openly available. The model uses weights, or value multipliers, to valuate the land classes that are derived from an extensive classification of Sweden's agricultural soil quality. In addition, the statistics that regulate the land use changes in the model derives from Malmö municipality's published statistics, which could be considered a very reliable source. The weakness of the model created in this study is its simplification of the use of the ESS concept and the exclusion of other, potentially more valuable ESS. The result of a study like this also has the risk of undermine the value of the ESS that can´t be sold on the open market. It is much easier to valuate products that are being sold in an economic system than to valuate the feeling of serenity that an open agricultural landscape gives to its visitors. All things considered, the study shows a

development that is sure to have both a substantial negative impact on both local food production, its yearly earnings, and the other ESS that is being provided by organisms and natural processes resided in the affected areas.

Sources

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Geodata: Lantmäteriet 2016 (orthophoto over Malmö), Länsstyrelsen 2016 (soil quality classification)