

Agricultural land use changes in Eiderstedt: historic developments and future plans

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Abstract

The Eiderstedt peninsula in Schleswig-Holstein (Germany) has a long tradition as agricultural land. In the past, the landscape has been generally dominated by extensively used grassland. These grassland areas are home to many bird species, so that Eiderstedt can be considered to be one of the most important bird habitats in Schleswig-Holstein. Ongoing changes in the structure of the regional agriculture towards an intensified dairy production and the growth of biofuels call for a conversion of large shares of grassland to arable farm land. However, these plans are fiercely debated because a strong decline in grassland area is likely to have a considerable ecological impact on domestic meadowbird species. In this study, these problems accompanying an extensive land use change on Eiderstedt are explored. Three possible scenarios of transformations of agricultural land are developed which can be applied to determine the possible impacts of such conversions.

1 Ecological implications of land use choices on Eiderstedt

The peninsula Eiderstedt at the West coast of Schleswig-Holstein is a region that is traditionally mainly used agriculturally. The dominant agricultural land use options are extensive management of grassland and the production of crops on arable farm land. Historically, there have been distinct shifts in the shares of these two land use options, each altering the characteristics of the landscape of Eiderstedt considerably. In times when the focus of agricultural activities on Eiderstedt was on the export of cattle as was the case in the late 19th century (Hammerich 1984), practically all agricultural land on Eiderstedt was used as grassland (LVermA-SH 2007a). But there were also periods in which more than half of the land was arable farm land.

These shifts in land use have ecological implications as Eiderstedt is considered to be one of the prime habitats for meadowbirds in Germany (Hötker *et al.* 2005) breeding in the large grassland and wetland areas adjacent to the North Sea. In addition, vast amounts of migrating birds pass through Eiderstedt in spring on their way from wintering grounds in the South to Scandinavia as well as on their way back in fall. The Naturschutzbund Deutschland (NABU) classifies Eiderstedt as wetland region of international importance based on the Ramsar convention (NABU 2005). Most of the bird species breeding on Eiderstedt prefer

extensively used grassland or wetlands as breeding habitat, while arable farm land is much less suitable for the rearing of offspring.

Currently, approximately three quarters of the agricultural land on Eiderstedt is used as grassland (Stat A Nord 2004). However, plans to increase the share of arable farm land drastically in order to adapt to changes in agricultural production patterns are discussed. Altered boundary conditions brought about by changes in European agricultural policy often necessitate the switch from outdoor dairy production to maintaining the cattle stocks in stables (Nehls 2002). This means that crops with higher energy content have to be fed, which must grow on arable farm land in the vicinity. These kinds of land use change are generally irreversible as arable farm land on Eiderstedt needs to be artificially drained so that the original ponds that are characteristic for the landscape in this region are destroyed during the conversion process. According to the local farmers union, two thirds of the agricultural land on Eiderstedt are supposed to be converted to arable farm land within the next couple of decades (NABU 2004). Such a change would not only distinctly alter the appearance of Eiderstedt, but would also mean the loss of valuable bird habitats and possibly a reduction of the recreational attractiveness of the landscape to visitors.

This study will look at possible scenarios of land use development on the Eiderstedt peninsula. After a brief historic overview of past agricultural land use changes in this region, the controversy between farmers and environmentalists about the future development of the local agriculture is presented. Using a geographic information system (G/S), scenarios of a future conversion of grassland to arable farm land on Eiderstedt are developed and described. These scenarios can be used in further assessments to quantify the ecological impacts of each development path.

2 Historic development of agricultural land use in Eiderstedt

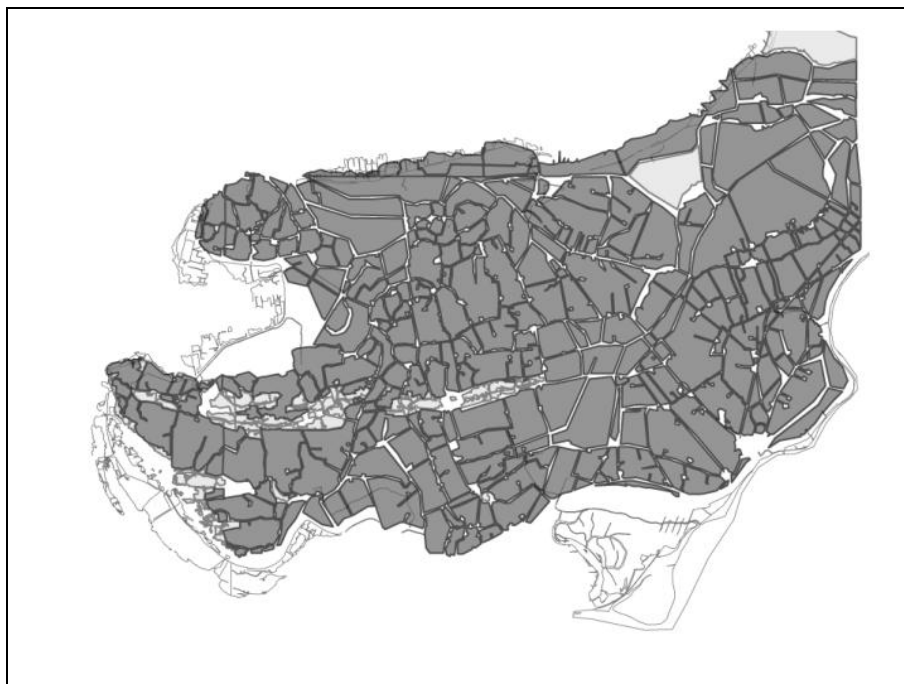


Figure 1: Agricultural land use on the Eiderstedt peninsula in 1878, grassland is shown in dark grey and arable farm land in light grey (based on LVermA-SH 2007a).

Eiderstedt is a peninsula at the West coast of Schleswig-Holstein that extends into the North Sea. It is located between the river Eider in the South and the town of Husum in the Northeast. Back in the 11th century, Eiderstedt consisted of several geest islands, but started to grow together as a consequence of the first coastal protection measures being erected at that time (Meier 2001). Initially, transportation was only possible by boat as settlements were exclusively accessible from the North Sea. These waterways remained in operation for several centuries and its underlying pattern is still recognizable. Today, almost the entire peninsula is enclosed by dikes built to withstand severe storm floods. This makes it necessary to artificially drain the land area. Parallel passing drills (in German: *Gruppen*) have been constructed that have become a typical feature of the Eiderstedt landscape (Fischer 1997).

The soil quality of the marshland is quite high (Feddersen 1853; InfoNet Umwelt 2007). In the early 19th century crop production was of great importance on Eiderstedt (Hammerich 1984) and the share of arable farm land was quite high. In some years close to half of the agricultural land was used to grow crops. In the middle of that century cattle farming became the prime means of agricultural production as exports of cattle to the United Kingdom via the harbors of Tönning and Husum were very profitable. Consequently, meadows and grassland with ponds and drainage drills running through became the dominant type of agricultural land on Eiderstedt. When detailed maps of Germany were drawn up by the Prussian government in the late 1870s, almost 93% of the agricultural land consisted of grassland (LVermA-SH 2007a). Arable farm land was hardly found (Fig. 1): crop production took place only in the vicinity of the town of Garding and in the Northeast of Eiderstedt.

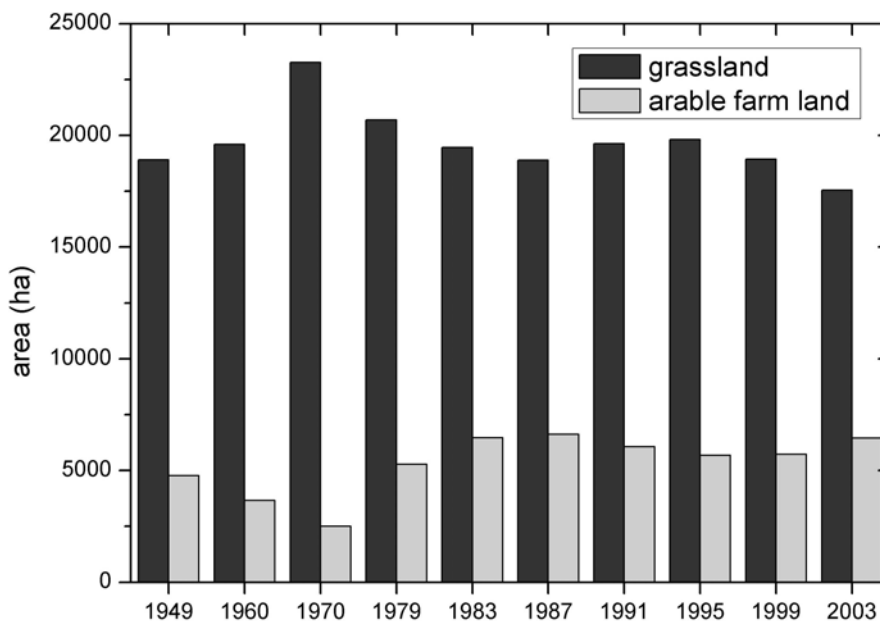


Figure 2: Distribution of agricultural land on Eiderstedt: grassland and arable farm land (based on Stat A Nord 1950-2004).

During the first half of the 20th century, there were only little changes in the distribution of agricultural land (Hammerich 1984) with the share of grassland always exceeding 80%. After World War II the dairy production became dominant on Eiderstedt, which led to a further reduction of arable farm land until 1970 (Stat A Nord 1950-2004). Figure 2 shows that arable farm land started to increase afterwards, which was mainly due to an expansion of crop production on polders that were secured by dikes in the 1960s. Until 2003 the share of arable farm land remained stable at about one quarter of the total agricultural land. The distribution

of the two dominant agricultural land uses in 2002 is illustrated in Figure 3, in which the three bird sanctuaries on Eiderstedt (Westerhever, Poppenbüll, and Kotzenbüll) are particularly marked. Even though crops are grown in all regions of Eiderstedt, there are vast areas of contiguous grassland, particularly in central Eiderstedt (LVermA-SH 2007b). These are of great ornithological significance.



Figure 3: Agricultural land use on the Eiderstedt peninsula in 2002, grassland is shown in dark grey and arable farm land in light grey (based on LVermA-SH 2007b).

In recent years, however, altered political boundary conditions have caused farmers to switch from dairy production with the extensive grassland use to higher intensity cattle farming and biofuels production. As intensive cattle farming involves permanent housing of the cattle, it is essential to grow the high energy forage crops. The increased demand for these crops and for those used in biofuel production necessitates an expansion of the share of arable farm land at the expense of grassland and meadows.

3 The controversy about plans for future land use change

Meadows and grassland are habitats with the potentially highest biodiversity in central Europe (Nehls 2002). They are threatened by an intensive agricultural use involving the application of large amounts of fertilizers, the conversion to arable farm land, and dehydration by improving drainage. A conversion of grassland to arable farm land destroys the diverse flora and fauna and cause a deterioration of the quality of the entire ecosystem. The expansion of grassland in other regions to offset the losses is inadequate as newly seeded grassland is ecologically worthless for a long period of time. Consequently, the plan to convert a significant share of the grassland on Eiderstedt to arable farm land is strictly opposed by environmental interest groups led by the *NABU*.

Farmers argue that protection plans proposed by *NABU* are far too restrictive and do not fare well with the economic necessities of the region. Their interest group *Pro-Eiderstedt* proposes contractual nature conservation, as conservation measures can only be realized in consent with the local farmers. Many such contracts were established in the late 1980s but

their number declined in the 1990s when fundamental enforcement rules changed. In 2001, approximately 1 000 ha of agricultural land were managed by contractual conservation. According to the Ministry of Agriculture in Schleswig-Holstein, that area increased to about 3 000 ha in 2006 (MLUR 2006). Extensively used grassland managed by contractual conservation may not be converted to arable farm land, drainage may not be intensified, and the application of pesticides and fertilizers is prohibited. *Pro-Eiderstedt* has developed a concept to manage approximately 10 000 ha of agricultural land by contractual conservation, however, the plan calls for only limited enforcement of the specified rules.

Critics of contractual nature conservation state that it has proved to be not too effective in the past (Nehls 2002). Contracts with strict rules are hardly attractive to farmers and are therefore very often rejected, even though only one third of such contracts in Germany contain special obligations regarding environmental protection while the largest share of them contains only general rules for extensive land use.

Advocates of strict rules to protect the grassland areas propose to strengthen the extensive grassland use without increasing incentives of a more intensified management. The *NABU* calls for a special premium for the farmers who extensively manage their grassland (NABU 2004) to offset the economic disadvantages of grassland farming in comparison to crop production. An important aspect of this plan is to grant premiums for arable farm land and for grassland separately and with particular reference to the location. Additionally, the premiums must be revoked in case of a conversion of the land. However, the enforcement of such a premium system would be quite complicated and subject to a large number of exceptions.

In addition to economic stimulation, environmental interest groups endorse direct measures to protect ecologically valuable land. The European directive Natura 2000 requires the members of the EU to identify protected sites according to the European Conservation of Wild Birds Directive. The former environmental minister of Schleswig-Holstein, Klaus Müller of the Green Party, proposed to declare 24 648 ha of Eiderstedt, which is practically the whole area of the peninsula except for the settlements, as sanctuary. This caused fierce opposition as this plan exceeded the minimum requirements of the directive (SH-Landtag 2004). Farmers feared that the declaration of a large protected area would bring them economic disadvantages as new investments and expansions of agricultural activities would be severely regulated.

Instead, three separate bird sanctuaries on Eiderstedt have been declared: one around the town of Westerhever in the Northwestern corner of Eiderstedt and two others in central Eiderstedt near Poppenbüll and Kotzenbüll (Fig. 3). The goal of declaring these sanctuaries was to maintain these sites as habitats for migrating and breeding bird species (MLUR 2006) by preserving the many ponds and drainage drills by limiting the extent of agricultural use. Farmers criticize even this declaration arguing that the EU Conservation of Wild Birds Declaration is only valid for natural and not for cultivated land and does not apply to Eiderstedt as the whole landscape is anthropogenically cultivated in its entirety already for centuries.

Currently, no agreement between the different interest groups appears to be in reach. In case no additional sites are declared as sanctuaries in the future, the remainder of the agricultural land on Eiderstedt may be subject to conversion in the near future. This would alter the appearance of the landscape on Eiderstedt such that arable farm land would become the dominant form of land use for the first time in more than one and a half centuries.

4 Scenarios of land use development in the next decades

In order to be able to assess the possible ecological consequences of such land use change, different scenarios are developed. The scenarios are based on the assumption that the plan to drastically increase the amount of arable farm land on Eiderstedt to two thirds of the entire agricultural land area is actually realized within the next couple of decades. Due to the lack of information in the propositions on which areas are to be converted, three different patterns of land use change are compared in the following. The agricultural land use patterns in the course and after the completion of the planned conversion are identified for all scenarios. They differ quite substantially, depending on the development path applied.

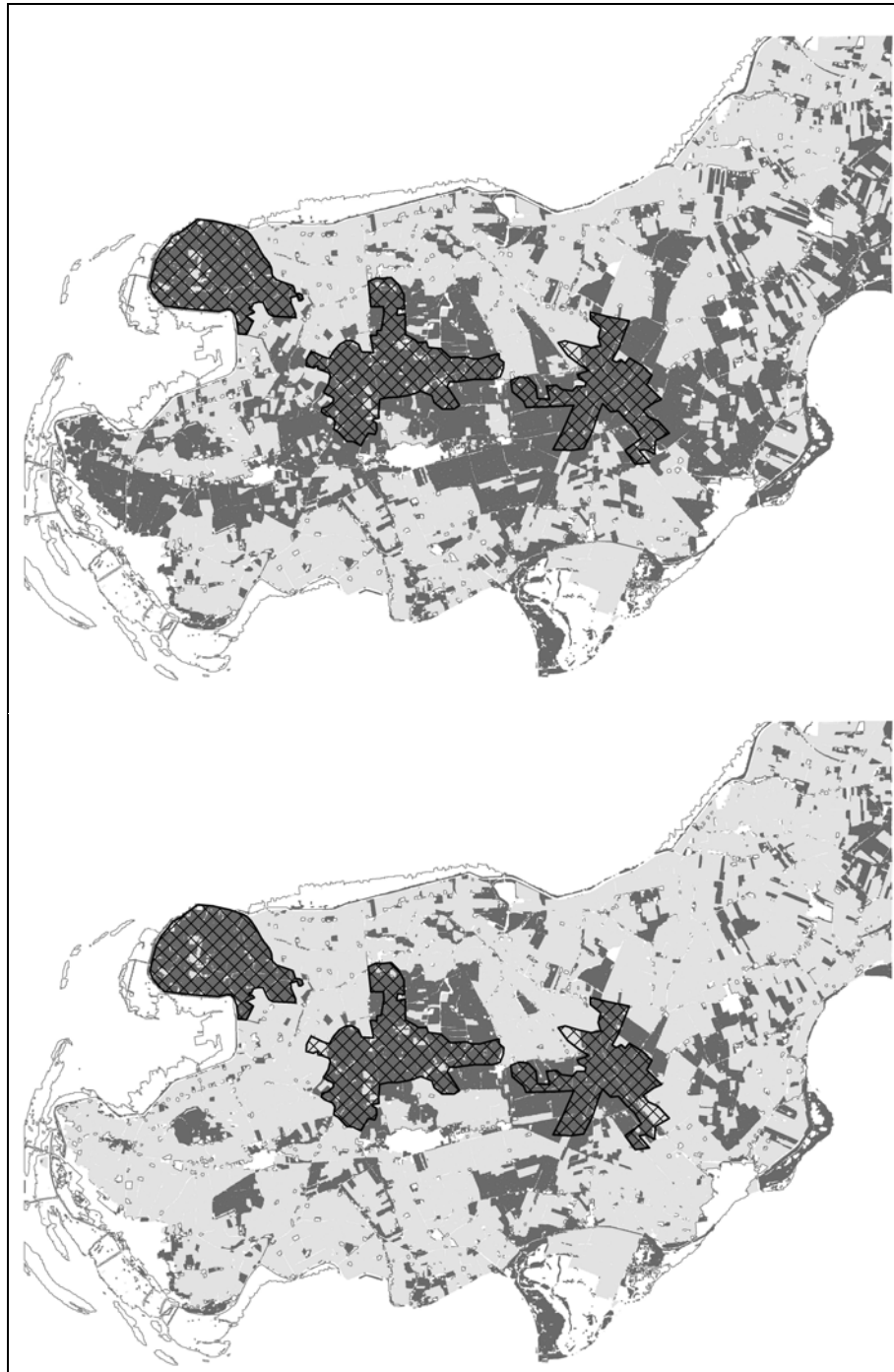


Figure 4: Agricultural land use on the Eiderstedt peninsula in 2015 (top panel) and 2025 (bottom panel), if land use change originates along the main roads across Eiderstedt.

The first scenario considers a pattern of land use change, in which land is primarily converted along the main roads through Eiderstedt and in only recently diked marshland (Fig. 4). Such a development is particularly likely if a lot of biofuels are to be grown on Eiderstedt in the future. Because these crops would need to be transported to the power plants from where they are grown, producing them as closely as possible to already existing infrastructure makes this task significantly easier.

If the land use change originates from the main roads through Eiderstedt, the landscape becomes very patchy during the conversion process. Halfway through the conversion process, uniform areas of grassland can only be found in the three declared bird sanctuaries and in their vicinity in central Eiderstedt (Fig. 4). The Eastern part of Eiderstedt consists of a mix of many small areas of both land uses. It has to be noted that in the early phase of the conversion process land closer to the coastal areas of Eiderstedt are more likely to be converted than the more central parts of the peninsula.

At the end of the conversion process, only some patches of grassland remain scattered throughout Eiderstedt (Fig. 4). These are generally quite fragmented, except for the areas around the three bird sanctuaries, in which larger uniform areas of grassland remain intact. These areas would have to serve as primary breeding grounds for the remaining meadowbirds. In all scenarios, the region around Westerhever only remains a uniform grassland area because it is a declared bird sanctuary. If it had not been declared a protected site, the Northwestern tip of Eiderstedt would also have been converted into arable farm land to a large extent.

The second pattern is based on the assumption that it is best to grow crops on large continuous patches of land. Therefore, in this pattern land is primarily converted in areas around already existing arable farm land (Fig. 5). In this case the conversion process is more coherent and produces a less fragmented land use pattern.

During this conversion process, a large region of grassland remains in central Eiderstedt. It does not only encompass the two bird sanctuaries but also substantial areas in their vicinity (Fig. 5). The large size of this uniform grassland area increases its ecological value as breeding habitat for meadowbirds. Similar to the previous scenario, the arable farm land is mainly located in the regions close to the coast but it is combined into larger units so that crop production can be more efficient in this scenario than in the previous one.

The distribution of the remaining grassland in 2025 in this scenario (Fig. 5) is similar to the one considered earlier, except for the region North of St. Peter-Ording, which remains grassland, and the area in central Eiderstedt, where less land is converted in the vicinity of the two bird sanctuaries. In contrast, patches converted to arable farm land are less fragmented, so that the degree of land use change appears to be even higher than in the previous scenario, even though this is not the case.

The third pattern of conversion follows the premise that the less remote an area of land is, the more useful it is to be used for crop production. Since the Eiderstedt peninsula is connected to the rest of Schleswig-Holstein only in the East, this pattern of land use change converts grassland to arable farm land from East to West (Fig. 6).

By applying such a conversion pattern, it is ensured that the area of arable farm land used for crop production is more or less coherent, while the remaining grassland also consists of large patches as long as possible (Fig. 6). In the early phase of land use change, conversions are more likely to occur in the Southern part of Eiderstedt than in the North.

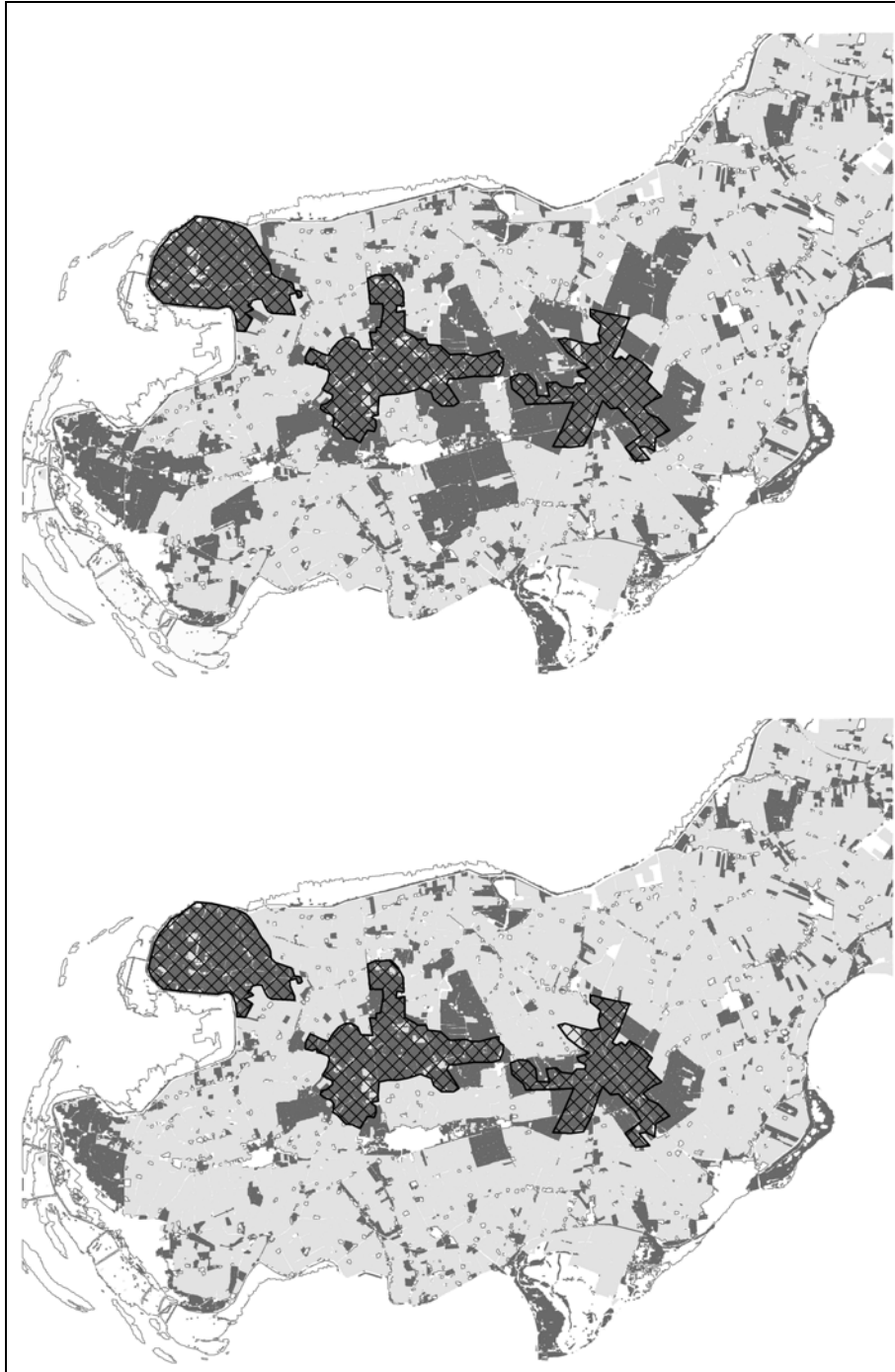


Figure 5: Agricultural land use on the Eiderstedt peninsula in 2015 (top panel) and 2025 (bottom panel), if land use change extends outward from already existing patches of arable farm land.

If two thirds of the agricultural land have been converted to arable farm land from East to West, practically all of the remaining grassland is confined to the area West of the town of Garding. Eastwards only bird sanctuary of Kotzenbüll remains more or less intact. However, there is even some land use change within the two bird sanctuaries in central Eiderstedt. This is likely to have an adverse influence on the overall ornithological habitat quality of these two special regions. Furthermore, large parts of the remaining grassland are in the vicinity of the towns of St. Peter-Ording and Tating, which are popular tourist destinations at the West coast of Schleswig-Holstein. This is likely to cause additional ecological difficulties due to increased stress imposed on the fauna caused by high anthropogenic frequentation.

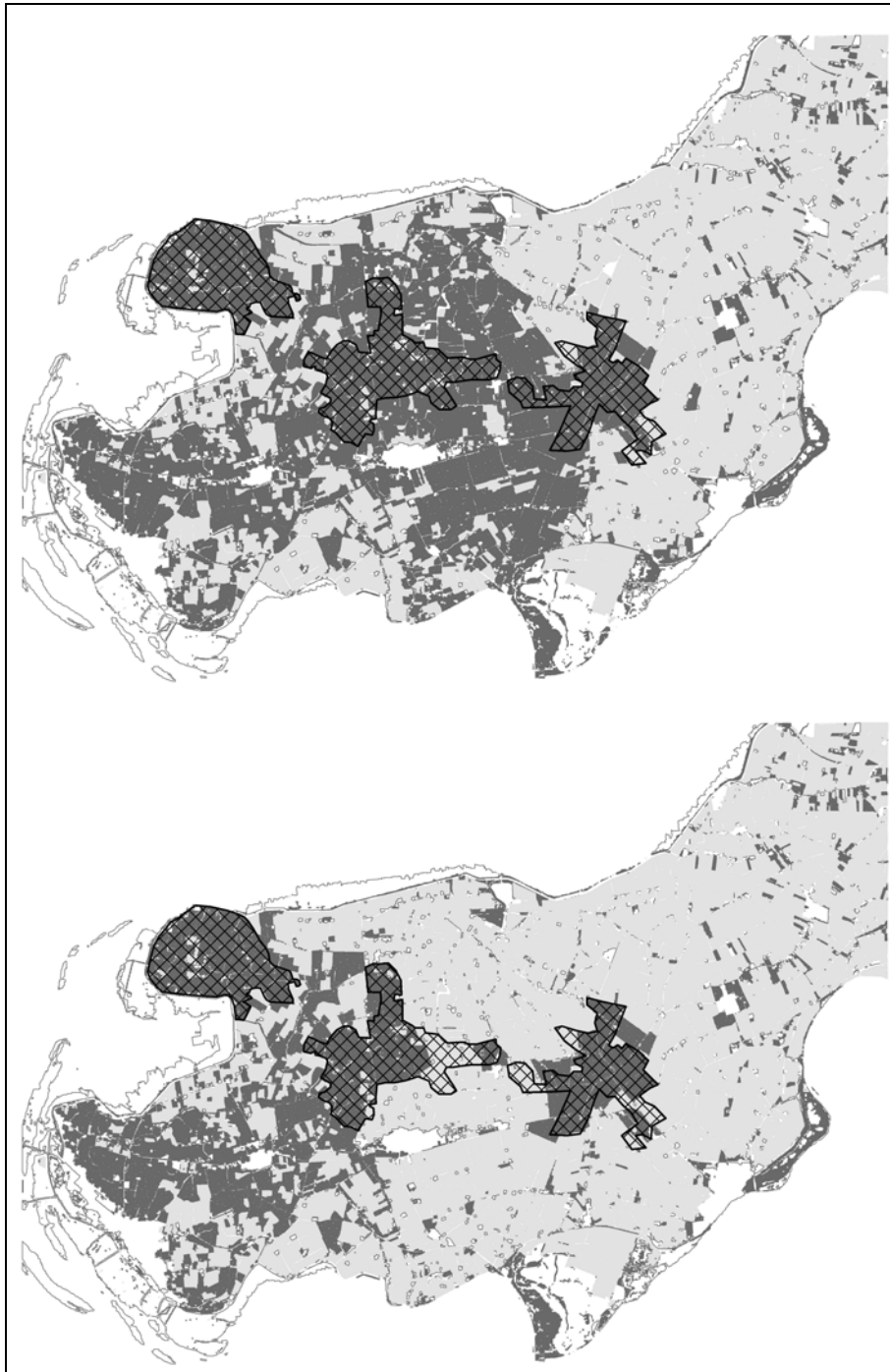


Figure 6: Agricultural land use on the Eiderstedt peninsula in 2015 (top panel) and 2025 (bottom panel), if land use change first occurs in the East and then progresses Westwards.

5 Possible implications of a conversion of grassland to arable farm land

A large scale conversion of grassland to arable farm land throughout the Eiderstedt peninsula will not only change the appearance of the entire landscape but also have an impact on the number of breeding pairs of meadowbirds supported by the habitats. The scenarios described above are applied in a *GIS* assessment to determine the altered carrying capacity of the Eiderstedt peninsula for key bird species (Schleupner & Link 2007).

The results indicate that the pattern of agricultural land use change has a profound influence on how the number of breeding pairs develops.

The three scenarios mainly differ in the location of the remaining grassland areas and in their degree of fragmentation. The fragmentation is highest if the conversion originates along the existing infrastructure on Eiderstedt, which worsens the quality of the grassland that is not converted to arable farm land. In contrast, the area of coherent regions of agricultural land use is largest if the conversion proceeds Westwards across Eiderstedt. However, since the remaining bird habitats in the bird sanctuary near Kotzenbüll become quite isolated and most of the other suitable breeding habitats are located in proximity to major tourist destinations, the bird density in those habitats is likely to decline over time, amplifying the pressure on the bird populations of Eiderstedt caused by the reduction in size of the suitable breeding habitats.

Overall, the quality of the Eiderstedt peninsula as breeding habitat for meadowbirds decreases substantially as a consequence of a large scale land use change. As the density of breeding pairs of four important species declines, the number of individuals supported by the habitats will be reduced at a disproportionately high rate (Schleupner & Link 2007). Even the declaration of the three bird sanctuaries on Eiderstedt will prove to be insufficient to counter this trend since the sanctuaries are also negatively influenced by changes in their vicinity whose influence carries over into the protected areas.

In addition to adverse ornithological impacts, a substantial land use change on Eiderstedt can have an influence on income generated by tourism. Eiderstedt is a famous destination due to its extensive grassland areas and the large numbers of breeding and migrating birds to be observed. The general appearance of Eiderstedt to visitors will change if large parts of grassland are replaced by arable farm land for crop production. How this would influence the tourist industry on the peninsula still needs to be determined separately. The controversy about land use development can only be solved if a compromise can be reached between the ecological demands of the ornithological fauna, the economic interests of farmers, and the aesthetic expectations of tourists visiting the Eiderstedt peninsula.

Acknowledgements

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