

A permanent agro-geographical division of Denmark?

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The yield of Danish crops has been rising through the years towards the west as well as towards the east. The geographical implications of the differences of soil quality have not changed.

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Keywords: *Agricultural geography, Denmark, barley, wheat, isodense map.*

The agro-geographical division of Denmark into seven soil fertility regions was presented in *Geografisk Tidsskrift* 1944 (1); in 1976 (2) after the administrative reorganisation of 1970 a simplification from the seven regions into three was proposed. The agro-geographical difference between East- and West-Denmark has turned out to be very stable in spite of prophecies of increasing homogeneity (3). By means of better strains of cultivated plants, increasing use of fertilizers and the growing control of weeds, plant diseases, and vermins by means of herbicides and pesticides agriculture has been made as effective as possible towards the east as well as towards the west.

It has been supposed that during the Middle Ages it was only possible to get round 8 hkg (hecto-kilogrammes) of grain per hectare, about the year 1900 it was round 17 hkg. From 1920 the yield has still been growing because of the increasing use of fertilizers; in 1979 the average yield of grain for the country as a whole was 42 hkg. A decisive condition has been the short distance between research and practice, the connecting link being an effective agricultural adviser-service in this country (4).

Even if a change of the agricultural structure has caused that there is now a greater amount of husbandry towards the west to produce manure, it has been compensated in the east by the increasing use of fertilizers. The yield has been growing in all Danish land, and if the amount of fertilizers in the future will be reduced on account of environmental considerations the soil will perhaps by and by approach its original fertility.

K.-E. Frandsen writes in his dissertation (5): »Af undersøgelsens mere generelle resultater skal . . . peges på, at den inddeling af Danmark, som Aa. H. Kampp har foret-

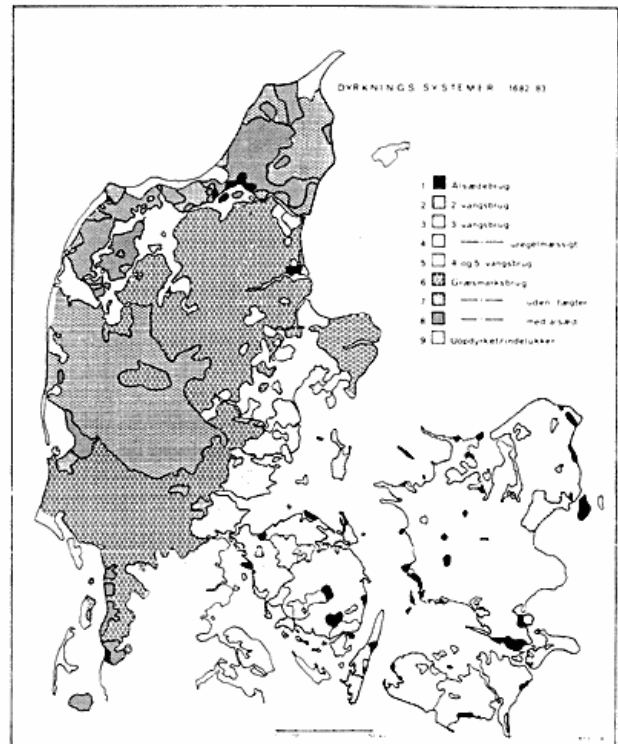


Fig. 1. Danish Field Systems 1682-83.

1. Sown permanently without systematic rest.
2. Two field system.
3. Three field system.
4. Three field system with irregular rotation.
5. 4- and 5- field system.
6. »Feldgrasswirtschaft« (ley-grass-farming).
7. »Feldgrasswirtschaft« without »tægt«.
8. »Feldgrasswirtschaft« with permanently sown fields without systematic rest.
9. Non arable land (K.-E. Frandsen (5)).

aget på grundlag af sognestatistik . . . viser mange fællestræk med fig. 51 (her fig. 1). Det danske landbrugs opdeling i en øst- og vestorienteret type . . . er således ikke alene et nutidigt fænomen, men var veludviklet allerede i 1600-tallet«. (Of the more general results from the research it turns out that the division of Denmark into agro-geographical regions, which Aa. H. Kampp has car-



Fig. 2. Barley. Dot= 300 hectares (Aa. H. K.).



Fig. 3. Wheat. Dot = 300 hectares. (Aa. H. K.)

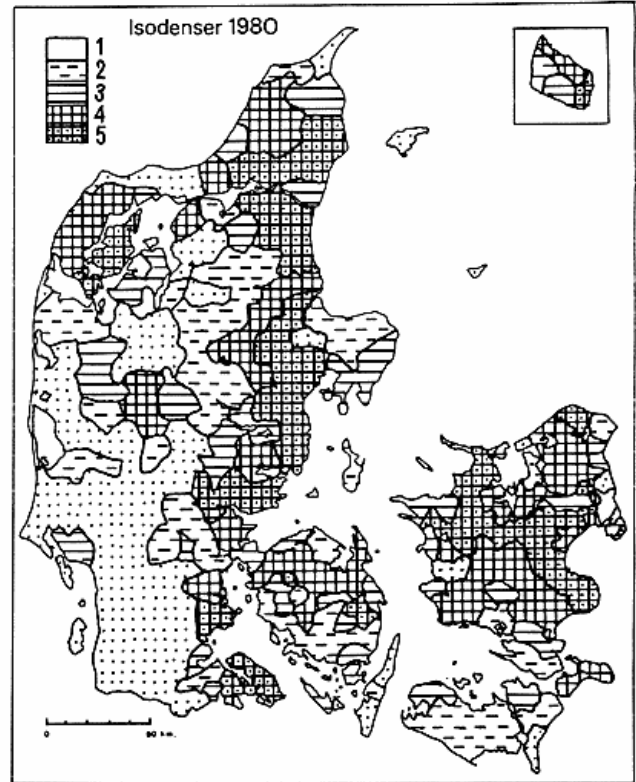


Fig. 4. Isodense map 1980 (Area of Wheat + Barley as a percentage of the ploughed area).

- 1: 61.0
- 2: 61.1-65.0
- 3: 65.1-68.5
- 4: 68.6-72.1
- 5: 72.2 (Aa. H. K.).

ried out based on parish statistics, shows many features in common with fig 51 (here fig. 1, Danish field systems 1682-1683). The division into an east- and west-oriented type is thus not only a contemporary phenomenon but was well-developed already in the 1600's).

Barley was in 1980 rather evenly distributed all over Denmark and amounted to 59 per cent of the total agricultural area (fig. 2), but it is doubtful how many years this great area will be possible. Cultivated land is usually a one-sided plant community; in one hectare of barley there are about three millions of barley plants, normally of the same strain, which gives the possibility of a rapid reproduction and spreading of pathogens. About one and a half millions of hectares in Denmark are sown with barley, and at least 80 per cent with the most popular strains, and accordingly for instance Mildew, Yellow Rust or Brown Rust may be spread with the wind from field to field and from province to province (6). After a prohibition of growing winter barley it is since 1979 again allowed if it has been treated against Mildew disease, and now this crop is again in progress.

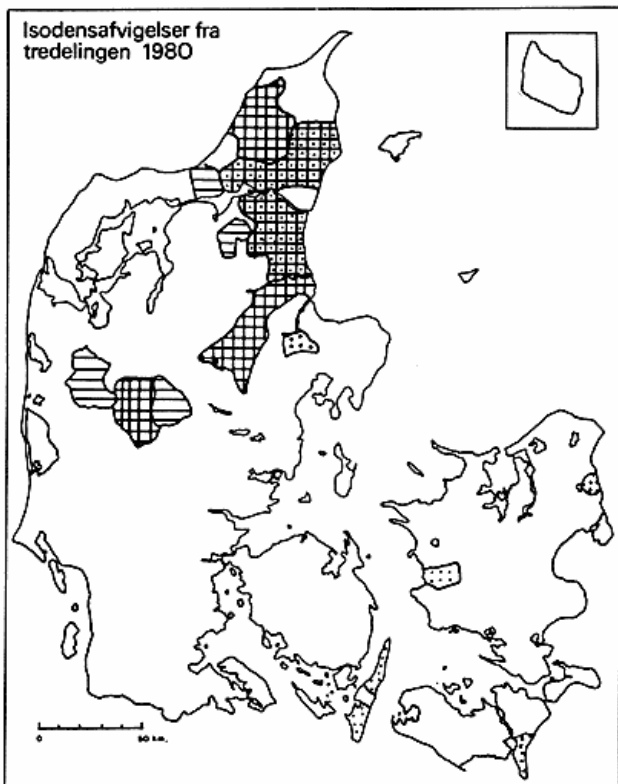


Fig. 5. Isodense deviations (Aa. H. K.)

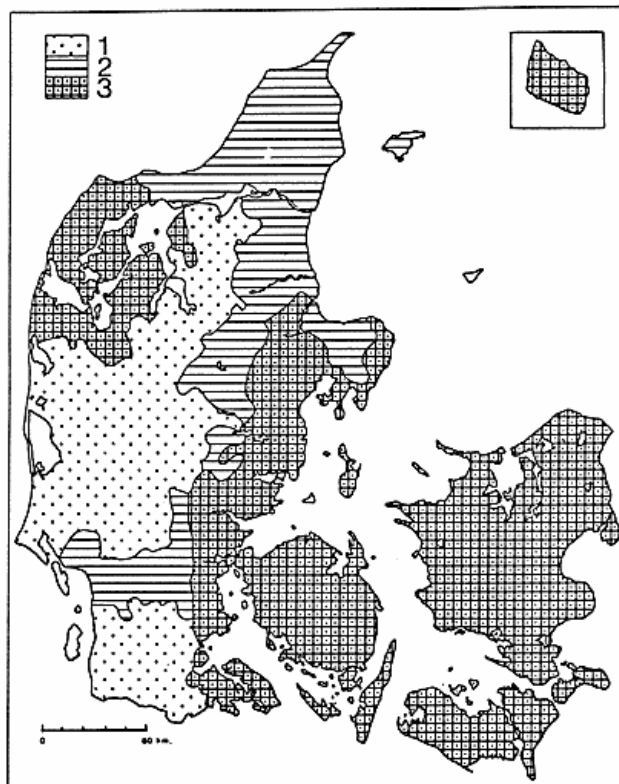


Fig. 7. The agro-geographical division. (Aa. H. K.)
Fig. 7. Den landbrugsgeografiske inddeling.

The wheat, on the other hand, has become more and more east-oriented (fig. 3 (10)), and the isodense map from 1980 (fig. 4) (areas of wheat plus barley as a percentage of the ploughed area) shows the same geographical distribution of the soil quality as the corresponding maps from 1907, 1937-39, 1946, 1951, 1962, and 1971. The agro-geographical difference between East- and West-Denmark

has appeared stable during centuries, manifesting itself in the 1600's in the different types of field systems, as well as in the distribution of village churches in the 13th century. The isodense deviations (fig. 5) are not more numerous than those of former years (1, 2).

It has not been possible to work out an isodone map (map showing the yield per hectare of the most important crops) for 1980, but most probably it would not differ very much from the one of 1971 (2); and from the research made by Aa. Walter Jørgensen (fig. 6 (9)) it is evident that the geographical divergences of the barley yield are not diminishing but even seem to grow. It is still possible to illustrate in a map the agricultural dependence on the soil conditions (fig. 7).

The classical model made by von Thünen (8) showing the intensive productions near the towns has been replaced by a pattern where the labour-demanding productions, say milk produce, is disappearing from those districts, while more extensive productions as grassgrowing to an increasing extent are found in holdings near towns. It might be expected that the higher prices of farmland here would impel to intensivate the production with the purpose to obtain the greatest possible yield per hectare. That the development is going in the opposite direction is due to the specific production conditions in the townnear territories, where especially must be pointed out a high

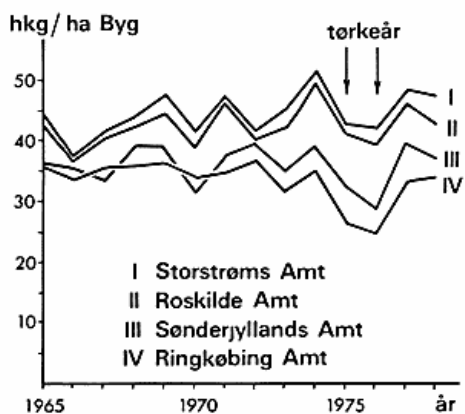


Fig. 6. The yield of barley in four Danish counties 1955-1978.
I-II: on the Islands.
III: South Jylland.
IV: West Jylland. (Aa. W. Jørgensen (6)).

Fig. 6. Høstudbyttet af byg i udvalgte amter 1955-1978.

level of expence, uncertainty of investment, and problems concerning the responsibility for protecting the environment for future generations (9).

The specialization has also been distributed geographically according to the possibilities of the various territories. The most characteristic feature is that the specialized cattle-farms continuously have been spreading towards the west. This is connected with as well the many grazing areas in the western and northern Jylland as that it is far more difficult for landowners in these districts to get supplementary paid work than for farmers who live nearer the industrial towns of East Jylland and the Isles. On the contrary most of the farms without any husbandry are to be found towards the east where the soil is better fitted for plant growing and where city activities may secure employment to many hands.

RESUMÉ

En permanent landbrugsgeografisk inddeling?

Byg er i dag den vigtigste kornart i landet og udgør 59% af det samlede landbrugsareal. Efter en årrækkes forbud er det fra 1979 igen tilladt at dyrke vinterbyg mod, at den behandles med mel-dug, og denne afgrøde er atter i fremgang.

Hveden derimod bliver mere og mere østorienteret, og den landbrugsgeografiske forskel mellem Øst- og Vestdanmark har vist sig stabil gennem århundreder, idet den manifesterede sig f.eks. i 1600-årene i udbredelsen af de forskellige dyrkningssystemer (fig. 1); den synes endog at øges en smule (fig. 6). Isodens-kortet fra 1980 (kort over hvede + byg i procent af det samlede omdriftsareal) viser påfaldende lighedspunkter med tilsvarende kort fra 1907, 1937-39, 1946, 1951, 1962 og 1971.

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Digital Analysis of Landsat Images for Land Use Mapping in Denmark

Vibeke Niels-Christiansen and Kjeld Rasmussen

Niels-Christiansen, Vibeke & Rasmussen, Kjeld: Digital Analysis of Landsat Images for Land Use Mapping in Denmark. Geografisk Tidsskrift 84: 89-92. Copenhagen. January 1984.

The applicability of Landsat-data for land use mapping in Denmark is analysed on the basis of a data set consisting of six super-imposed images from the growing season 1982. The temporal variation in spectral signatures of crops and land use classes have been studied, and it is shown that classification accuracies of 80% can be obtained using Landsat against a 90% accuracy when data with 20-m resolution become available.

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Keywords: *Land use mapping, crop-identification, Landsat, image processing, multitemporal analysis.*

The application of satellite images for the purpose of mapping land use has become a standard procedure in some countries, where conditions are favourable. In several European countries experiments have shown, however, that this methodology may not yet be well suited under the conditions encountered (see f.i. Wastenson et al. (1980), and Lichtenegger (1980)). The main limitations are: 1) the small size of the »typical« European field, 2) the high frequency of cloud cover, particularly in northern Europe, and 3) the complexity of the scene to be analysed, i.e. the great variety of crops and agricultural practices.

This paper intends to extract some important results from a study of the applicability of satellite images for land use mapping in Denmark. For full documentation of the study the reader is referred to the study reports (Rasmussen, 1982, Rasmussen & Niels-Christiansen, in press). The study has aimed at 1) identifying the optimal methodology to be applied and 2) the main limitations to the quality of the results.

The satellite images applied in this study have been 6 Landsat MSS scenes from the growing season 81/82 supplemented by 3 scenes from 80/81. It has been recognized from the beginning that attempts to base a semi- or fully operational land use mapping system on Landsat data are

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