



Agricultural change in Denmark between 1982 and 1989: the appearance of post-productivism in farming ?

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Abstract

Regional agricultural development in Denmark in the 1980s is analysed by using surrogate statistics for three bipolar development trends: 1) intensification-extensification, 2) concentration-dispersal and 3) specialisation-diversification. The scale of analysis is the municipality. The results show that agriculture in eastern Denmark has intensified and specialised, whereas central parts of Jutland have extensified and diversified mainly due to the introduction of more complex crop patterns and a decline in the number of dairy cows. An increase in concentration is evident for the whole country. Aggregation of the development trends show that only 16% of the municipalities developed in the direction of 'industrialisation', a result which conflicts with the conventional understanding of the main develop-

ment trends in Danish agriculture. However, part of this new interpretation may be related to the data and methodology employed in the analysis.

Keywords

Agricultural development, spatial differentiation, intensification, extensification, specialisation, productivist, post-productivist

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Agriculture in developed countries has, during the last four decades, undergone processes of change commonly known as 'industrialisation'. The characteristics of these changes are well known and include the creation of economies of scale at the farm level, increased reliance on purchased inputs (e.g. fertilisers, feed, agri-chemicals), resource substitution (i.e. capital for land and labour), the introduction of organisational features associated with the concept of the firm, specialisation of the labour function and the mechanisation of production processes (Bowler, 1992). A close alliance between governments and agricultural industries has contributed to this development (Winter, 1996). Moreover, the period has been characterised by a high degree of consensus about agricultural policy goals, namely increasing farm output and securing low consumer food prices (Marsden et al., 1993). These processes have, in combination, for most northwestern Europe, encouraged a productivist agriculture, including intensive high input-high output farming systems, with emphasis on food quantity (Ilbery et al., 1997).

Surplus production and associated budgetary problems, along with a growing criticism of the negative environmental impact of productivist agriculture, forced the EU Commission, from the mid-1980s, to develop new policy goals and instruments to meet these challenges, including changes in subsidies from market price support for production to

area-based, direct income support, a progressive withdrawal of state subsidies, and integration of agriculture within a broader range of rural economic and environmental objectives (Bowler, 1992, Ilbery et al., 1997). This shift in farming policy priorities has led some researchers to argue that agriculture has entered a new era since the early 1980s - a so-called 'post productivist phase' or a 'post-productivist transition' (PPT), indicating that the process is ongoing (Lowe et al., 1993, Shucksmith, 1993, Ilbery & Bowler, 1998, Marsden et al., 1992).

The new policy tendencies are expected to facilitate a more low input-low output farming system, with emphasis on sustainable farming systems and food quality (Ilbery et al., 1997). Several authors stress, however, that the productivist farming system, and its associated policy, will not be replaced by the post-productivist system, rather the two systems will coexist (Marsden et al., 1992, Ilbery & Bowler, 1998, Marsden et al., 1993). This co-existing of different development directions is forecast to lead to an increasing differentiation in agriculture, not only between countries, but also regions and farms (Ilbery & Bowler, 1998, Marsden, 1998).

Empirical evidence on the general structural development of agriculture during the post productivist transition exists at the level of large administrative areas within the European Union (Brouwer & Lowe, 1998, Bowler &

Ilbery, 1999). However, few analyses have been published on the small-scale, geographical composition of recent agricultural developments, including the underlying processes and trends of development. Such spatial analyses may be useful as a supplement to more general studies of agricultural changes and their economic and environmental consequences, with strong relevance for policy makers within the agricultural sector, who are dealing with more area-oriented policies, both regarding market support and environmental measures. In addition, small scale spatial studies may be useful in providing a framework for more detailed surveys of agricultural changes and associated landscape changes.

The aim of this paper is to explore the direction of agricultural development in Denmark between 1982 and 1989 and its geographical composition in a period of change in agricultural policy. This is done through a series of statistical analyses of the main development directions in Danish agriculture at the municipality level. Due to lack of more recent data, the analysis is limited to the time period 1982-1989.

Conditions for spatial differentiation - some reflections

In the introduction, some of the global processes and factors which are resulting in development and change in agriculture were described. It is well-known that such processes do not run uniformly and that they have diverging spatial consequences (Jansen & Hetsen, 1991, Meeus et al., 1990). Differences in spatial development have been explained variously over time and by different schools of thought. These explanations have been reviewed by e.g. Healey & Ilbery (1990) and Bowler (1996) and will not be discussed here, apart from some few general ideas.

Spatial differences have often been seen as a function of variations in the physical environment. However, this approach has been criticized for being too deterministic and insufficient in explaining spatial diversity. Economic, social and humanistic approaches have, therefore, dominated research on spatial differentiation in the last decades (Healey & Ilbery, 1990).

Economic and social-economic explanations about spatial differentiation can be obtained from the theoretical concepts of commercialization and commoditization theories (Ilbery & Bowler, 1998). The first school argues that factors such as distance from major urban-industrial concentrations, regional farm-size structure and the distribution of

natural resources can explain why the processes of commercialisation (i.e. the integration of agriculture into the market economy and the modernisation of agriculture) occur earlier and to a greater extent in some areas than in others.

Explanations of spatial differences in agricultural development derived from commoditization theory are based on the uneven penetration of the family farm system by external capital (i.e. capital exploits areas where the greatest financial returns can be obtained) (Marsden et al., 1987). This conceptualisation is difficult to substantiate empirically. It has been suggested by sympathizers of the theory, therefore, that family farms in general can survive and adapt to capitalism through different adjustment strategies or development pathways (e.g. redeploy farm resources into new agricultural products or services on the farm) (Bowler, 1992, Shucksmith, 1993, Marsden et al., 1992). By incorporating behavioural attributes, this school of thought approaches the ideas mentioned in the next section.

Behind both the commercialization and commoditization approaches lies the argument that development is determined by macro economic and social factors (Long & Ploeg, 1994, Ilbery & Bowler, 1998).

These approaches have been challenged by Pile (1991) and Long & Ploeg (1994), who claim that both theories overemphasize the power of international economic interests and the intervention of states in shaping agricultural development. Long and Ploeg (1994) argue that, 'it is theoretically unsatisfactory to base one's analysis on the concept of external determination. All forms of external intervention necessarily enter the existing life-worlds of the individuals and social groups affected and in this way are mediated and transformed by these same actors and local structures' (Long & Ploeg 1994:64).

The possible impact of local structures and resources in shaping agriculture makes these and other researchers advocate the existence of endogenously generated development patterns (Ploeg, 1992, Long & Ploeg, 1994, Murdoch et al., 1994, Bowler, 1999). The notion of endogenous development is not well described from a theoretical point of view, but argues that development to a certain degree is based on locally available resources, labour and knowledge and that 'endogenous development emerges as a 'self oriented' process of growth and a relatively large part of the total value generated by this type of development is re-allocated in the region itself' (Ploeg & Saccomandi, 1995:10).

Closely linked to the notion of endogenous development is the concept of 'farming styles', where it is argued that farming is not determined by market and/or technology;

Dimensions	Surrogate statistic
Intensification-extensification	Change in standard gross margin per hectare agricultural land 1982-89 = Δ SGM/AA
Concentration-dispersion	Change in average farm size 1982-89 = Δ AA/EA
Specialisation-diversification	Change in specialisation 1982-89 = Δ Hr

Source: Bowler and Ilbery (1997)

Table 1: Variables used in the analysis of changes between 1982 and 1989 (for more explanation see text).

rather farmers have different opportunities for positioning themselves along these two axes. The choice of position is the results of strategic reasoning by the farmer, evolved through a complex process of interaction between the farmer and other actors, and between farmers and institutions developing and implementing new technologies (Ploeg 1990, 1992, 1994).

It has not been the goal of this analysis to address these theorisations; rather the ideas are seen as a source of inspiration in relation to the interpretation of the results generated from the following analysis.

Method

The method employed in this study for analysing spatial trends in agricultural development is that developed in the work of Bowler (1987) and Bowler & Ilbery (1997). In these works the authors suggest that the complexity of agricultural change can be conceptualised according to three bipolar dimensions: (1) intensification - extensification, (2) concentration - dispersal and (3) specialisation - diversification.

The term 'intensification' includes the rising levels of purchased non-farm inputs in agriculture and the resulting increases in output per hectare farmland. 'Concentration' describes the process whereby the productive resources and the output of particular products, have become confined to fewer and larger farms and concentrated in to fewer regions. 'Specialisation' describes the proportion of the total output of a farm or region accounted for by a particular product (Gilg, 1996). The terms extensification, dispersion and diversification have the reverse meanings. It is argued by Ilbery & Bowler (1998) that the processes of intensification, concentration and specialisation may characterize the productivist agriculture, while the contrary processes promote the post-productivist agriculture.

Measurement of the three structural dimensions - intensification, concentration and specialisation - are, as suggested by Bowler and Ilbery (1997), based on three surrogate statistics: standard gross margin, farm size and the degree of specialisation in plant production. The calculations of the surrogate statistics are as follows: the standard gross margin (SGM) of all holdings in an area, expressed as a ratio of the agricultural area of all holdings (AA in hectares), is used to indicate the degree of intensification. SGM is measured as the difference between the standard production value and the standard size of the variable costs. It is a limitation of this surrogate that it, when used as an index, expresses both a profit relationship and a relative degree of intensification or extensification.

The agricultural area of all holdings (AA), divided by the number of farm in an area (EA), expresses the degree of concentration (ie. average farm size).

The degree of specialisation has been indicated by a calculated value (Hr) (Bowler and Ilbery, 1997), in the present case based on six land use classes: cereals, root crops, grass crops in rotation, seeds, horticulture products and permanent grass. The applied formula for the plant production specialisation is shown in Table 2. The formula is draw from 'entropy-maximizing models' and the idea of the formula is to measure the amount of uncertainty (entropy) in a probability distribution or a system subject to constraints (Johnston et al., 2000:211). The entropy measures the relationship between a macrostate (H) and the possible micro-state that corresponds to it, in the present case the land use classes expressed as the relative proportion of total farmland. Employment of other units than land use classes (e.g. the standard gross margin for individual types of production) would have made it possible to include both different classes of land use and animals, which may have improved the analysis. Lack of suitable data has made such an analysis impossible.

The data employed in the study are public data from the Sta-

tistical Department (Danmarks statistik) - agricultural statistics - from the year 1982 and 1989. A special dataset has been produced by the Statistical Department in order to harmonize the reference year for standard gross margins.

Table 2: Formula for calculating the level of regional specialisation, *Hr* (entropy).

Hr	= H/H_{max} [$0 < Hr < 1$]
Where:	
<i>H</i>	= $(IF \log_{10} IF)$.
H_{max}	= $K 1/K * \log_{10} * 1/K$.
<i>IF</i>	= land use (<i>I</i>) as a relative proportion of the farmland (<i>F</i>) in a region.
<i>K</i>	= number of land use classes

Source: Bowler and Ilbery (1997)

which is measured in ECU per hectare. The exchange rate applied is for the year 1980. The development in the three dimensions is calculated as an index of change between the two dates (i.e. $1989/1982 * 100$), when evidence of an emerging PPT might be expected.

The data included all municipalities in Denmark, except municipalities surrounding Copenhagen (255 regions). As data at the level of the municipality has not been collected by the Statistical Department since 1989, only data up to 1989 has been included in the analysis. From 1997, statistics at the municipality level have been published again, based on a new database compiled by the Ministry of Agriculture, Fisheries and Food in connection with the EU subsidy system (Det Generelle Landbrugsregister/Centrale Husdyrbrug Register, GLR/CHR). However, these statistics do not include data adequate for the present analysis.

To assist the interpretation of the results, correlation analyses (Pearson's product-moment correlation) have been carried out between the calculated indices, the individual surrogate statistics of the structural dimensions and individual agricultural variables. The employed agricultural statistics include the number of ha, cattle per hectare, pigs per hectare and their changes in the period 1982-1989, calculated as indices with 1982 as the reference year (see Table 3).

Reservations may be made about each variable and it may be argued that the variables used in the analysis are too simple. However, the variables are widely available and have been used in the literature to describe/characterise structural changes such as the ones dealt with here (Bowler, 1987, Bowler & Ilbery, 1997, Johnston et al., 2000).

Trends in agricultural development in Denmark 1982-1989

Institutional setting of the period

The most important institutional setting of the investigated period was related to changes in the Common Agricultural Policy and to the introduction of a national strategy for the protection of the aquatic environment in Denmark (Action Plan on the Aquatic Environment, 1987). The latter included obligations for livestock farmers to establish a storage capacity for animal manure, when stocking densities were greater than 30 animal units per farm and a demand of 65% crop cover for the cultivated area during wintertime. Both regulations were implemented, in the mid 1980s, but did not have to be completely fulfilled in the period (Ministry of the Environment 1994).

Important changes in the Common Agricultural Policy (CAP) in relation to Danish agriculture were the introduction of the milk quota system in 1984 and the co-responsibility levy on milk and cereals. None of the CAP measures introduced in 1985 and 1987 for extensification, afforestation, diversification or agri-environmental farming was implemented in Denmark in the study period (Primdahl, 1996).

The introduction of the milk quota reduced the number of dairy cows (Stryg, 1991) and seems likely (in the short run) to have slowed down farm size development on livestock farms (Wiborg & Rasmussen, 1997). The demand for winter cultivation and the levy on cereals have also impacted on the crop pattern. In the study period, cereals have been replaced by peas and seed for industrial use, as well as an extensive change from spring to winter-grown crops has taken place (Stryg, 1991, Reenberg, 1988).

Results

The spatial analyses of the changes in the structural dimensions between 1982 and 1989 are shown on maps in Figures 1, 2 and 3. The actual state of three bi-polar dimensions for 1982 and 1989 are not shown, but will be included in the discussion of the development trends.

From the intensification-extensification index, mapped in Figure 1, it appears that an agricultural extensification has occurred in many regions throughout the country in the period from 1982 to 1989. 61% of all regions have index values less than 100, indicating that extensification has been the most dominant trend. Less differentiated areas of extensification are located in the central part of Jutland;

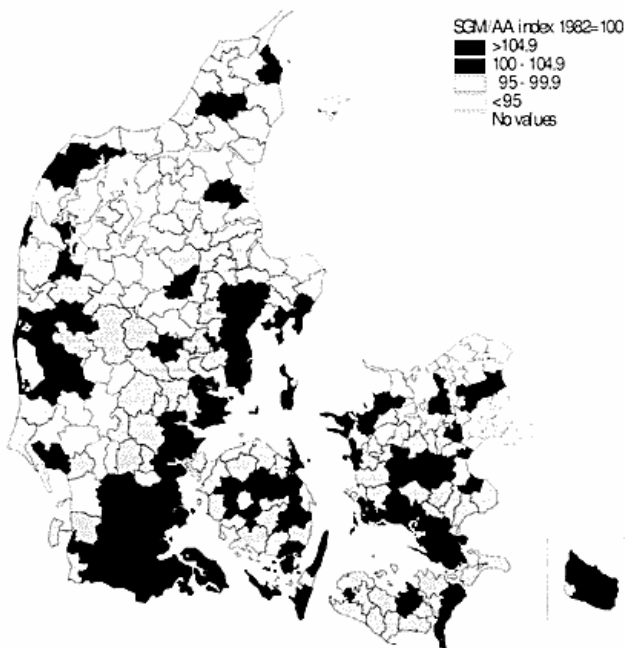


Figure 1: Change in intensification, measured by the Standard Gross Margin.

however, smaller coherent areas of extensification are also found in the crop dominated farming areas in eastern part of Denmark (e.g. north of Copenhagen). Strong increases in intensification have taken place in the south eastern part of

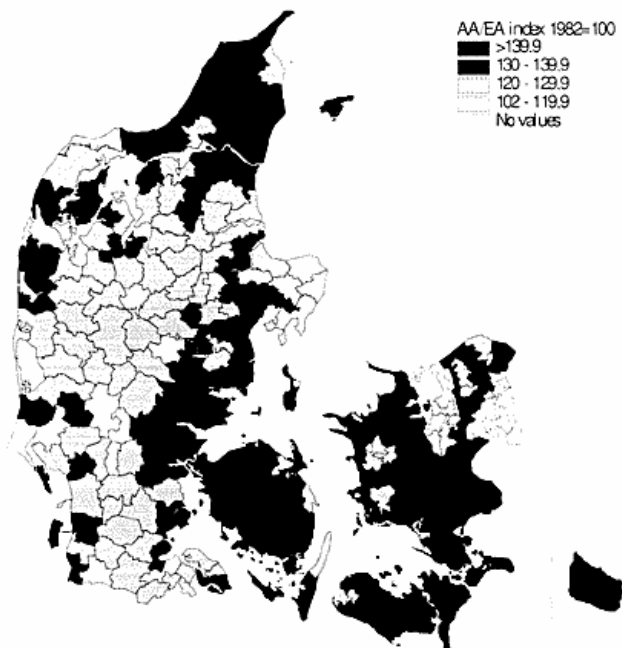


Figure 2: Change in concentration, measured by average farm size.

Jutland and in the central part of Funen.

The concentration-dispersal map (Figure 2) shows that concentration is an ongoing process in all parts of Denmark, but the degree of development varies, with the highest concentration increases in the east (the islands), especially Funen and Bornholm, along with the northern part of Denmark. Moderate increases in concentration are mainly found in central and southern Jutland, where the density of livestock farms is high.

The last index, illustrates the development of the specialisation-diversification dimension (Figure 3). Large areas of western Jutland have experienced diversification, whereas more mixed patterns of diversification and specialisation are visible in the eastern part of Jutland and on Zealand.

Figure 4 summarizes the pattern of the regional changes between 1982 and 1989 in the three bi-polar dimensions. For each municipality the developments have been recorded as declines or increases relative to the reference year 1982 and summed into 8 potential groups. As the concentration-dispersion dimension has increased all over the country, only four development classes have appeared.

The analysis shows that 41 of the 255 municipalities may be characterised as 'industrialising' (i.e. increases in all three dimensions). These municipalities are all located in the in the eastern part of the country - the eastern part of Jutland, the central part of Funen and Zealand and on Born-

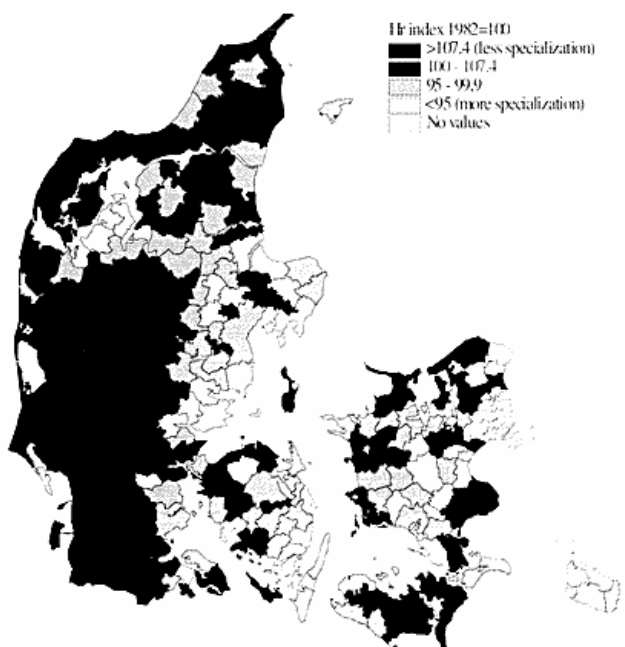


Figure 3: Change in specialisation, measured by an entropy index, including 6 land use classes.

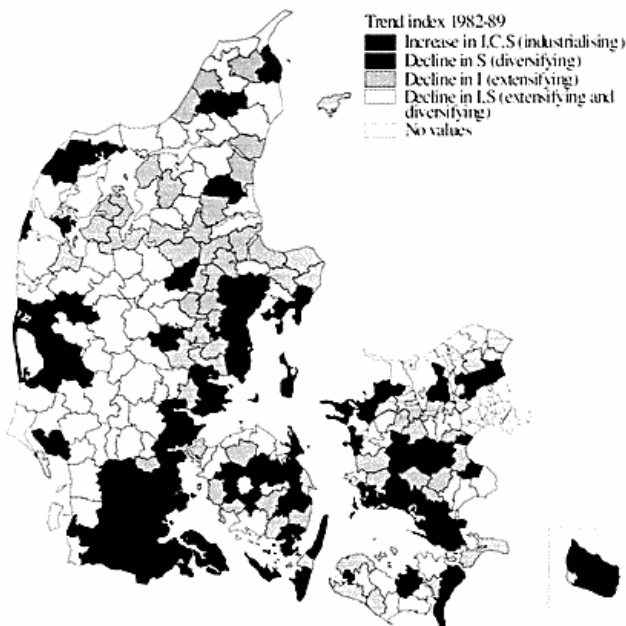


Figure 4: Development trends for the period 1982-1989, based on the intensification, the concentration and the specialisation index.

		1989									
		1	2	3	4	5	6	7	8		
1982	1	13		2						15	
	2	1	8		1			2	3	15	
	3	1		22	9		1	4		37	
	4		3	2	24				6	35	
	5	4	1			19	2	4		30	
	6	1	2			8	34		6	51	
	7		1	7	1	6		20	4	39	
	8			2	2		2	9	18	33	
		20	15	35	37	33	41	37	37	255	

Typology:		C	=	Concentration
1) C,I,S	5) I,S,Ds	Ds	=	Dispersion
2) C,I,Dv	6) I,Dv,Ds	I	=	Intensification
3) C,S,E	7) S,Ds,E	E	=	Extensification
4) C,Dv,E	8) Dv,Ds,E	S	=	Specialisation
		Dv	=	Diversification

Figure 5: Change in typology, based on the information from the transition matrix.

holm. The main areas of decline in the two dimensions of intensification and specialisation are located in central Jutland, whereas areas of decline just in specialisation are concentrated in southern Jutland and around Ringkøbing Fjord. Decline in intensification exclusively is seen only in the eastern and northern part of Denmark (never to the west of the main stationary line). Respectively, 88 municipalities have had a decline in the two dimensions of specialisation and intensification, while 126 have had a decline in one of them. The results indicate that 'industrialisation' of agriculture is far from the dominant development trend in the investigated period; however, concentration has taken place all over the country.

Figure 5 summarizes the changes in the three bi-polar dimensions between 1982-1989 through a transition matrix. In this analysis each municipality, for both 1982 and 1989, was classified according to their value above or below the average values of each of the three bi-polar dimensions. As for the trend maps, the results of the classification were summed into 8 types (see Figure 5). The results of this analysis illustrate that 158 of the 255 municipalities had the same relative position in 1982 and 1989. 97 municipalities had changed position - 44 moved in the direction of post-productivism and 53 toward productivism.

In Figure 6 the change of the regional typology between 1982 and 1989 is mapped, based on the analysis above. Regions in central Jutland show evidence of post-productivist transition, but also individual municipalities on islands in eastern Denmark. Development of a productivist typology has mainly taken place in the north and eastern part of Denmark.

Discussion

For the intensification-extensification dimension, the correlation analysis shows that a significant positive correlation ($p=0,0001$) exists between regions which have intensified (i.e. increase in standard gross margin) between 1982 and 1989, and regions with an increase in the amount of pigs (Table 3). A positive significant correlation also exists between the amount of pigs in the reference year (1982) and the intensification index. A significant negative correlation ($p=0,0001$) was found between the intensification index and the specialisation level in 1982 and between the intensification index and density of cattle/ha in 1982. This implies that areas with a high number of cattle and areas with a low specialisation level had extensified (a high specialisation level in the calculation equal a low specialisation level in

the 'real life', see table 2 and Figure 3). No significant correlation was found between the change in cattle density and the intensification index. However, the decline in intensification in certain parts of Jutland may be related to a decline in the number of cattle, due to the introduction of the EU milk quota system in the investigated period.

For the concentration-dispersion dimension, a significant negative correlation ($p=0.0001$) was found between the concentration index and the concentration level in 1982 (i.e. farm size in 1982). This implies that areas with smaller farm sizes have increased concentration more than areas with bigger farm sizes (i.e. a lag-behind effect). A significant negative correlation was also found between the concentration index and the specialisation level of 1982, between the concentration index and the specialisation index, and between the concentration index and the cattle density of 1982. This can be interpreted as, that areas of increasing specialisation and areas already high in specialisation also have a stronger process of concentration, and that areas with a high number of cattle have experienced a more moderate increase in concentration (i.e. farm size enlargement) than other regions. This latter relationship confirms the conclusion of Wiborg & Rasmussen (1997). For explanation of the lack of dispersion in general (i.e. decline in concentration) Ilbery & Bowler (1998) argue that this dimension of change is the least likely to occur, largely because its still possible to have benefit from creation of economic of scale under the PPT.

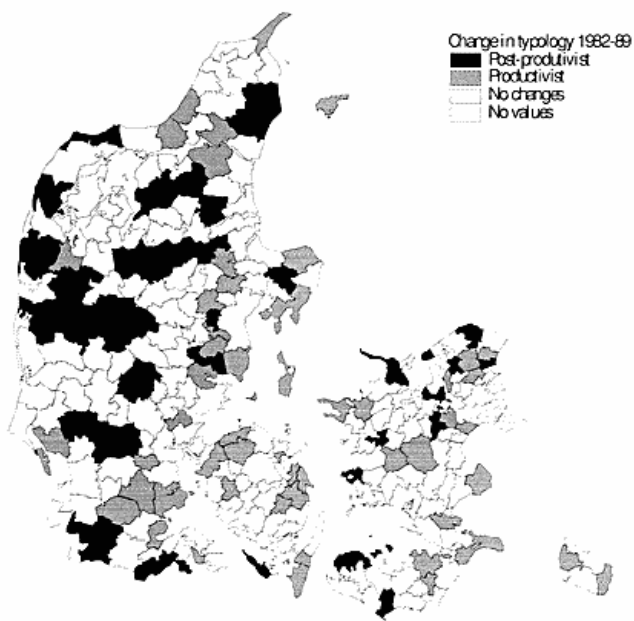


Figure 6: Change in the regional typology between 1982 and 1989.

Beyond the above mentioned correlations of the specialisation index, the correlation analysis shows a significant correlation between the specialisation index and the concentration level in 1982, and between the specialisation index and amount of cattle per hectare in 1982 ($p=0.0001$). This illustrates how areas with a high number of cattle and a high concentration level in 1982 have become less specialised. The specialisation index map shows a more regionalised development pattern than the other indices mapped, which makes a closer analysis of the land use diversification relevant.

Looking at small regions within Denmark land use diversification in Zealand (eastern part of Denmark) is related to a decline in cereals and an increase in mainly horticultural products; whereas the increase in land use diversity in the western part of Denmark is related to a decline in cereals and root crops and an increase in seed crops - a crop pattern change which has also been reported by Reenberg (1988). These differences in crop change patterns may be reflected in or related to differences in farm production systems, but may also be related to local development trends or adjustment pathways as mentioned earlier in the article.

The geographical distribution of the results of the aggregated trend index (Figure 4) shows a complex regional pattern of development. However, it seems that the processes of industrialisation in agriculture are only occurring in the eastern parts of Denmark, while combinations of extensification and diversification are related to areas in central and western Jutland. Areas with just increases in extensification or diversification have no clear regional distribution, except for the regions of diversification in southern Jutland and around Ringkøbing Fjord.

Thus general results of the analysis show that agricultural industrialisation is far from being the most dominant development trend in the period from 1982 to 1989. However, concentration has taken place all over the country. This conclusion conflicts with the conventional understanding of agricultural development in Denmark (see Reenberg (1988), Rasmussen (1996) and Wiborg & Rasmussen (1997),) who in general report increasing specialisation and intensification, in addition to concentration. The alternative conclusion drawn from this analysis may partly be explained by the different data used for measuring specialisation and intensification and by the method of analysis. For example, the measurement of change in specialisation, which only includes land use, may have shown different results if measurement was based on farm types, taking into account both land use and animals.

The map of typological change (Figure 6) shows a com-

Table 3: Correlations between selected variable. The first line is the coefficient of correlation (*r*), the second and the third line express the level of significance. *N*=255. *Ns*: non-significant, *: *p*<0.05, **: *p*<0.01 and ***: *p*<0.001. *Inten.* = Intensification, *Conc.* = Concentration and *Spec.* = Specialisation. Only variables with *p*< 0.001 are mentioned in the text.

	Cattle index	Pig index	Inten. index	Spec. index	Conc. index	Cattle /ha 1982	Pigs /ha 1982	Inten. 1982	Spec. 1982
Pig index	-0.01073 0.8646 ns	1.0	-	-	-	-	-	-	-
Inten. index	-0.02786 0.6579 ns	0.36605 0.0001 ***	1.0	-	-	-	-	-	-
Spec. index	0.14478 0.0207 *	0.02858 0.6496 ns	0.04086 0.5160 ns	1.0	-	-	-	-	-
Conc. index	-0.03363 0.5930 ns	-0.13787 0.0277 *	-0.16050 0.0103 *	-0.33905 0.0001 ***	1.0	-	-	-	-
Cattle /ha 1982	0.36372 0.0001 ***	0.29575 0.0001 ***	-0.23141 0.0002 ***	0.36330 0.0001 ***	-0.29748 0.0001 ***	1.0	-	-	-
Pigs /ha 1982	-0.09776 0.1194 ns	0.59520 0.0001 ***	0.37321 0.0001 ***	0.12746 0.0420 *	-0.00481 0.9390 ns	0.12849 0.0403 *	1.0	-	-
Inten. 1982	-0.09210 0.1425 ns	0.05112 0.4163 ns	0.18634 0.0028 **	-0.08874 0.1577 ns	0.12813 0.0409 *	-0.02839 0.6518 ns	0.25394 0.0001 ***	1.0	-
Spec. 1982	0.24381 0.0001 ***	0.01091 0.8624 ns	-0.22154 0.0004 ***	0.01961 0.7553 ns	-0.19020 0.0023 **	0.58508 0.0001 ***	-0.10205 0.1045 ns	0.08920 0.1556 ns	1.0
Conc. 1982	0.03493 0.5787 ns	0.18899 0.0024 **	0.10373 0.0984 ns	0.26831 0.0001 ***	-0.34808 0.0001 ***	0.09444 0.1326 ns	-0.24707 0.0001 ***	-0.28829 0.0001 ***	-0.15589 0.0127 *

plex regional distribution of trends. Explanation of the complex regional pattern cannot be derived from the correlation analysis discussed above. Rather the regional pattern appears to reflect the influence of more local, social, economic or organisational structures on agricultural development. This has been investigated for the largest area of typological change towards post-productivism (i.e. central Jutland). A map of the typology change was presented to the local agricultural advisory centre in the area for a discussion. However, it was not possible, even after consultation, to identify specific local reasons for the complex variation in typological changes. It was suggested by some of the experts that the variable poor soil conditions of the area could be an explanation. It was their common understanding that farmers on poor soils were the first to react to new 'external' conditions.

The conclusion drawn is that processes of endogenous development, understood in the narrow sense as by Ploeg & Saccomadi (1995), are not the explanation of the complex

spatial changes in agriculture; rather it seems more likely that the changes are related to specific kinds of adjustments adopted by farmers. However, there is no unambiguous relationship with soil conditions or farm structures. Areas with poor soil conditions have, in general, not changed in the typology towards PPT nor have areas dominated by a specific farm structure.

For some areas (often single municipalities), which have changed typology towards PPT, it seems likely that they have in common a relatively high quantity of more extensive land uses (e.g. the municipality of Them (central Jutland)).

Conclusions

The results of this analysis indicate that the industrialisation of agriculture is far from the most dominant development trend in Denmark in the period from 1982 to 1989. How-

ever, concentration has taken place all over the country. These results conflict with the conventional understanding of Danish agricultural development; however, part of this new interpretation may be explained by the data and methodology used in the analysis.

The results of the investigation imply that certain developments towards a PPT, have taken place during the 1980s, especially as regards extensification and diversification in the form of change to a more diversified crop pattern. Some complex regional development patterns have appeared, but broadly with agricultural industrialisation in the eastern part of Denmark and extensification, in combination with diversification, taking place in central and western parts of Denmark.

For the development of individual dimensions, correlation analyses show significant relationship between increasing concentration and increasing number of pigs; whereas areas with a high cattle density have become less concentrated and more diversified. This shows that a variety of adjustments have taken place, partly dependent on existing agricultural structures.

Evidence of a more endogenous development process cannot be confirmed by the investigation. However, it seems that some of the development patterns may be related to specific, local adjustment pathways and thus require further investigation.

Despite reservations about the variables employed in the analysis, it seems likely that the method employed in this analysis can provide new, meaningful and interesting results on the structural development of agriculture. The method of analysis developed by Bowler and Ilbery (1997) has not previously been employed to describe Danish agriculture and has not been used elsewhere for the analysis of agricultural development of such a detailed level.

As the data employed in the analysis are more than 10 years old, it is mainly in the methodology that the significant of the results of this study may be found. Employment of new updated data (e.g. manipulated data from the GLR/CHR database) and data for a wider span of years will make this mode of analysis of interest for the current policy development process and ongoing research.

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References

- Bowler, I. (1992a): Sustainable Agriculture as an Alternative Path of Farm Business Development. Pp. 237-253 in: Bowler, I.R., Bryant, C.R. & Nellis, M.D. (ed.): Contemporary Rural Systems in Transition, Volume 1, Agriculture and Environment. Wallingford, CAB International.
- Bowler, I. (1992b): The industrialization of agriculture. Pp. 7-31 in: Bowler, I.(ed): The geography of agriculture in developed market economies. Harlow, Longman Scientific & Technical.
- Bowler, I. (1999): Endogenous Agricultural Development in Western Europe. Tijdschrift voor Economische en Sociale Geografie 90(3): 260-271. Bowler, I. R. (1987): The regional restructuring of production in capitalist agriculture. *Rural Systems* 5(1): 17-25.
- Bowler, I. R. (1996): A short history of agricultural geography in the United Kingdom. *Geotema* 5:37-39.
- Bowler, I. & Ilbery, B. (1997): The regional consequences for agriculture of changes to the Common Agricultural Policy. Pp.105-116 in: Bowler, I. and Laurent, C. (ed): CAP and the Regions. Paris, INRA Editions.
- Bowler, I. & Ilbery, B. (1999): Agricultural land-use and landscape change under the post-productivist transition - examples from the United Kingdom. Pp 121-140 in: Krönert,R., Baudry,J., Bowler,I. & Reenberg, A.(ed): Land-use changes and their environmental impact in rural areas in Europe. Paris, The Parthenon Publishing Group.
- Brouwer, F. & Lowe, P.(1998): CAP Reform and the Environment. Pp. 13-38 in: Brouwer, F. & Lowe,P. (ed): CAP and the Rural Environment in Transition. A panorama of national perspectives. Wageningen, Wageningen Pers.
- Gilg, A.W. (1996): Countryside planning. London, Routledge.
- Healey, M.J. & Ilbery, B.W. (1990): Location and change. Perspectives on Economic Geography. Oxford, Oxford University Press.
- Ilbery, B. & Bowler, I. (1998): From agricultural productivism to post-productivism. Pp. 57-84 in: Ilbery,B. (ed): The Geography of Rural Change. Essex, Longman.
- Ilbery, B., Chiotti, Q. & Rickard, T. (1997): Introduction.

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The results of the investigation imply that certain developments towards a PPT, have taken place during the 1980s, especially as regards extensification and diversification in the form of change to a more diversified crop pattern. Some complex regional development patterns have appeared, but broadly with agricultural industrialisation in the eastern part of Denmark and extensification, in combination with diversification, taking place in central and western parts of Denmark.

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Despite reservations about the variables employed in the analysis, it seems likely that the method employed in this analysis can provide new, meaningful and interesting results on the structural development of agriculture. The method of analysis developed by Bowler and Ilbery (1997) has not previously been employed to describe Danish agriculture and has not been used elsewhere for the analysis of agricultural development of such a detailed level.

As the data employed in the analysis are more than 10 years old, it is mainly in the methodology that the significant of the results of this study may be found. Employment of new updated data (e.g. manipulated data from the GLR/CHR database) and data for a wider span of years will make this mode of analysis of interest for the current policy development process and ongoing research.

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References

- Bowler, I. (1992a): Sustainable Agriculture as an Alternative Path of Farm Business Development. Pp. 237-253 in: Bowler, I.R., Bryant, C.R. & Nellis, M.D. (ed.): Contemporary Rural Systems in Transition, Volume 1, Agriculture and Environment. Wallingford, CAB International.
- Bowler, I. (1992b): The industrialization of agriculture. Pp. 7-31 in: Bowler, I.(ed): The geography of agriculture in developed market economies. Harlow, Longman Scientific & Technical.
- Bowler, I. (1999): Endogenous Agricultural Development in Western Europe. Tijdschrift voor Economische en Sociale Geografie 90(3): 260-271. Bowler, I. R. (1987): The regional restructuring of production in capitalist agriculture. Rural Systems 5(1): 17-25.
- Bowler, I. R. (1996): A short history of agricultural geography in the United Kingdom. Geotema 5:37-39.
- Bowler, I. & Ilbery, B. (1997): The regional consequences for agriculture of changes to the Common Agricultural Policy. Pp.105-116 in: Bowler, I. and Laurent, C. (ed): CAP and the Regions. Paris, INRA Editions.
- Bowler, I. & Ilbery, B. (1999): Agricultural land-use and landscape change under the post-productivist transition - examples from the United Kingdom. Pp 121-140 in: Krönert,R., Baudry,J., Bowler,I. & Reenberg, A.(ed): Land-use changes and their environmental impact in rural areas in Europe. Paris, The Parthenon Publishing Group.
- Brouwer, F. & Lowe, P.(1998): CAP Reform and the Environment. Pp. 13-38 in: Brouwer, F. & Lowe,P. (ed): CAP and the Rural Environment in Transition. A panorama of national perspectives. Wageningen, Wageningen Pers.
- Gilg,A.W.(1996): Countryside planning. London,Routledge.
- Healey, M.J. & Ilbery, B.W. (1990): Location and change. Perspectives on Economic Geography. Oxford, Oxford University Press.
- Ilbery, B. & Bowler, I. (1998): From agricultural productivism to post-productivism. Pp. 57-84 in: Ilbery,B. (ed): The Geography of Rural Change. Essex, Longman.
- Ilbery, B., Chiotti, Q. & Rickard, T. (1997): Introduction.

- Pp. 1-9 in: Ilbery, B., Chiotti, Q. & Rickard, T. (ed): *Agricultural Restructuring and Sustainability. A geographical Perspective*. Wallingford, CAB International.
- Jansen, A. J. & Hetsen, H. (1991): *Agricultural Development and Spatial Organization in Europe*. *Journal of Rural Studies* 7(3): 143-151.
- Johnston, R.J., Gregory, D., Pratt, G. & Watts, M. (2000): *The Dictionary of Human Geography*. Oxford, Blackwell Publishers.
- Long, A. & Ploeg, J.D. van der (1994): *Endogenous Development: Practices and Perspectives*. Pp 1-6 in: Ploeg, J.D. van der and Long, A. (ed): *Born from within. Practice and Perspectives of Endogenous Rural Development*. Assen, Van Gorcum.
- Long, N. & Ploeg, J.D. van der (1994): *Heterogeneity, actor and structure: towards a reconstitution of the concept of structure*. Pp. 62-89 in: Booth, D. (ed): *Rethinking Social Development. Theory, Research and Practice*. Harlow, Longman Scientific & Technical.
- Lowe, P., Murdoch, J., Marsden, T., Munton, R. & Flynn, A. (1993): *Regulating the New Rural Spaces: the Uneven Development of Land*. *Journal of Rural Studies* 9:205-222.
- Marsden, T. (1998): *New Rural Territories: Regulating the Differentiated Rural Spaces*. *Journal of Rural Studies* 14:107-117.
- Marsden, T., Munton, R. & Ward, N. (1992): *Incorporating Social Trajectories into Uneven Agrarian Development: Farm Businesses in Upland and Lowland Britain*. *Sociologia Ruralis* 32:408-430.
- Marsden, T., Murdoch, J., Lowe, P., Munton, R. & Flynn, A. (1993): *Constructing the countryside*. London, UCL Press.
- Marsden, T., Murdoch, J. & Whatmore, S. (1992): *Regulating Agricultures in Deregulating Economies: Emerging Trends in the Uneven Development of Agriculture*. *Geoforum* 23:333-345.
- Marsden, T., Whatmore, S. & Munton, R. (1987): *Uneven Development and the Restructuring Process in British Agriculture: a Preliminary Exploration*. *Journal of Rural Studies* 3:297-308.
- Meeus, J. H. A., Wijermans, M. P. & Vroom, M. J. (1990): *Agricultural landscapes in Europe and their transformation*. *Landscape and Urban Planning* 18: 289-352.
- Ministry of the environment (1994): *The Danish environmental strategy*. Copenhagen, Ministry of the Environment.
- Murdoch, J., Ward, N. & Lowe, P. (1994): *Sustainable Agriculture and Endogenous Development: A Socio-Political Perspective*. Pp. 262-296 in: Ploeg, J.D. van der and Long, A. (ed): *Born from within. Practice and Perspectives of Endogenous Rural Development*. Assen, Van Gorcum.
- Pile, S. (1991): *All winds and weathers: uncertainty, debt and the subsumption of the family farm*. Pp 69-84 in: Gilg, A. (ed): *Restructuring the Countryside*. Aldershot, Avebury.
- Ploeg, J.D. van der (1990): *Heterogeneity and Styles of Farming*. Pp. 1-35 in: Ploeg, J.D. van der (ed): *Labor, markets and agricultural production*. Oxford, Westview Press.
- Ploeg, J.D. van der (1992): *The reconstitution of Locality: Technology and Labour in Modern Agriculture*. Pp. 19-43 in: Marsden, T. (ed): *Labour and Locality*. London, David Fulton.
- Ploeg, J.D. van der (1994): *Styles of Farming: An Introductory Note on Concepts and Methodology*. Pp. 7-29 in: Ploeg, J.D. van der & Long, A. (ed): *Born from within. Practice and Perspectives of Endogenous Rural Development*. Assen, Van Gorcum.
- Ploeg, J.D. van der & Saccomandi, V. (1995): *On the impact of endogenous development in agriculture*. Pp 10-27 in: Ploeg, J.D. van der & Dijk, G. van (ed): *Beyond modernization. The impact of endogenous rural development*. Assen, Van Gorcum.
- Primdahl, J. (1996): *Denmark*. Pp 45-69 in: Whitby, M (ed): *The European environment and CAP reform*. Wallingford, CAB International.
- Rasmussen, S. (1996): *En analyse af strukturudviklingen i dansk landbrug og en fremskrivning til år 2003*. Arbejds-papir nr 10, september 1996. Institut for Økonomi, Skov og Landskab, KVL.
- Reenberg, A. (1988): *Agricultural land-use in Denmark in the 1980s*. *Geografisk Tidsskrift* 88: 8-13.
- Shucksmith, M. (1993): *Farm Household Behaviour and the Transition to Post-Productivism*. *Journal of Agricultural Economics* 44: 466-478.
- Stryg P.E. (1991): *Landbrugets driftsformer, miljø og økonomi*. København, DSR-Forlag.
- Wiborg, T. & Rasmussen, S. (1997): *Strukturudviklingen i landbruget - årsager og omfang*. Arbejds-papir nr 12, januar 1997. Institut for Økonomi, Skov og Landskab, KVL.
- Winter, M. (1996): *Rural politics. Policies for agriculture, forestry and the environment*. London, Routledge.

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References

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- Bowler, I. R. (1996): A short history of agricultural geography in the United Kingdom. *Geotema* 5:37-39.
- Bowler, I. & Ilbery, B. (1997): The regional consequences for agriculture of changes to the Common Agricultural Policy. Pp.105-116 in: Bowler, I. and Laurent, C. (ed): CAP and the Regions. Paris, INRA Editions.
- Bowler, I. & Ilbery, B. (1999): Agricultural land-use and landscape change under the post-productivist transition - examples from the United Kingdom. Pp 121-140 in: Krönert,R., Baudry,J., Bowler,I. & Reenberg, A.(ed): Land-use changes and their environmental impact in rural areas in Europe. Paris, The Parthenon Publishing Group.
- Brouwer, F. & Lowe, P.(1998): CAP Reform and the Environment. Pp. 13-38 in: Brouwer, F. & Lowe,P. (ed): CAP and the Rural Environment in Transition. A panorama of national perspectives. Wageningen, Wageningen Pers.
- Gilg, A.W. (1996): *Countryside planning*. London, Routledge.
- Healey, M.J. & Ilbery, B.W. (1990): *Location and change. Perspectives on Economic Geography*. Oxford, Oxford University Press.
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