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A cluster analysis of Norwegian municipalities with respect to agriculture's multifunctionality

Klaus Mittenzwei
Maria Loureiro
Wenche Dramstad
Wendy Fjellstad
Ola Flaten
Arnt Kristian Gjertsen
Sjur Spildo Prestegard

SeMM Centre for Food Policy
NILF Norwegian Agricultural Economics Research Institute

NIJOS Norwegian Institute of Land Inventory

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Authors	Klaus Mittenzwei, Maria Loureiro, Wenche Dramstad, Wendy Fjellstad, Ola Flaten, Arnt Kristian Gjertsen og Sjur Spildo Prestegard
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About NILF

- Research and analyses on agricultural policy, food industry, commodity trade, economics, farm management and rural development.

- Documentation of economical results in the agricultural sector at national and farm level. This includes acting as secretariat for the Budget Committee for Agriculture and publication of annual Account Results in Agriculture and Forestry.

- Publication of research reports and analyses. Development of tools for farm management and accountancy.

- Funded by the Ministry of Agriculture, the Research Council of Norway and by assignments for public and private clients.

- Main office in Oslo; regional offices in Bergen, Trondheim and Bodø.

Preface

Agriculture's contribution to the provision of public goods through its production of food and fibre (so-called multifunctionality) is in many countries seen as a legitimate reason to justify public intervention in the agricultural sector. Although a lot of theoretical research has been carried out within the field of multifunctionality, much remains to be done when it comes to empirical analyses.

The research project "*Operationalization of multifunctionality using the CAPRI modeling system*" financed by the Research Council of Norway makes an attempt to narrow this gap. Its aim is to study the effects of policy instruments on agriculture's multifunctionality by defining quantitative indicators for selected elements of agriculture's multifunctionality that can be implemented in the agricultural sector model CAPRI.

This working paper describes the establishment of an appropriate regionalization in the CAPRI model. It follows from the nature of the project that it is important to design regions that exhibit similar characteristics with respect to the multifunctionality of agriculture. Currently, the regionalization in the model follows county borders. This level is not appropriate when multifunctionality is concerned.

The task has been addressed by performing a cluster analysis by which Norwegian municipalities have been grouped with respect to their performance on variables that aim at describing agriculture's multifunctionality.

The paper is the product of a joint effort by Klaus Mittenzwei, Maria Loureiro, Ola Flaten, Sjur Spildo Prestegard (all NILF), Wenche Dramstad, Wendy Fjellstad and Arnt Kristian Gjertsen (all NIJOS). Klaus Mittenzwei, the project manager, has done most of the writing. Sjur Spildo Prestegard has written parts of chapter 1. Maria Loureiro has conducted the cluster analyses. All members of the project team have contributed with valuable comments. Anne Moxnes Jervell has read the working paper and made useful comments and corrections. Siri Fauske has edited the final paper for printing.

Oslo, December 2004

Ivar Pettersen

Contents

Summary

The level of support to Norwegian agriculture is partly justified with reference to agriculture's multifunctionality. The concept of multifunctionality involves the provision of so-called "public goods" by agriculture, in addition to the production of food and fibre. Examples of these public goods include cultural landscape, biodiversity, ecological functions, cultural heritage, the viability of rural areas, and food security.

The overall aim of the research project "*Operationalization of multifunctionality using the CAPRI modeling system*" is to study the effects of policy instruments on agriculture's multifunctionality by defining quantitative indicators for selected elements of agriculture's multifunctionality that can be implemented in the agricultural sector model CAPRI. This working paper takes a first step towards the appropriate regionalization when multifunctionality is concerned.

The current regionalization of the CAPRI model is at the county level. This approach fails when multifunctionality is concerned, because many issues of multifunctionaliy (e.g., cultural landscape aspects) are independent of administrative borders at that level. As the aim of the overall project is to study the effects of policy instruments on agriculture's multifunctionality, it is important to design regions within the CAPRI model that to a greater extent exhibit similar characteristics with respect to aspects of agriculture's multifunctionality. Accordingly, it is reasonable to assume that policy changes will have quite similar effects on the multifunctionality indicators within each of these CAPRI regions. This task has been addressed by performing a cluster analysis by which Norwegian municipalities have been grouped with respect to their performance on variables that are expected to describe different aspects of the multifunctionality of agriculture. This information will then later on be used to regionalize the CAPRI model accordingly.

The term cluster analysis encompasses a large number of techniques developed to identify groups of observations with similar characteristics. The theory behind clustering is an expected positive relationship between the variables' Euclidean distance and the similarity of the observations. Numerous methods for cluster analysis are available. For the purpose of our analysis, disjoint clusters are appropriate, i.e. each geographical area is placed in one and only one cluster. Based on the analysis of our dataset, we use a direct clustering of the data. As the number of clusters is exogenously given, the analysis is run for different numbers ranging from 6 to 15. In a final step, the appropriate number of clusters is selected.

The unit of observation in the cluster analysis is the municipality. For each of the 435 municipalities in Norway, variables covering various aspects of multifunctionality such as natural conditions, socio-demographics, environmental issues, the agro-food sector, land use and animal numbers, pluriactivity of farm businesses, landscape issues and the farm structure were defined. Starting out with more than 70 variables, 19 variables were selected for the final analyses on the basis of their expected importance with respect to multifunctionality.

Having studied the results of cluster analyses with different numbers of clusters, the result producing ten regions was finally selected. The regions are ordered alphanumercially with respect to their centrality. Region A covers three major towns with little agricultural activity. Region B consists of larger town and centres where agriculture plays a minor role. Regions C to G contain municipalities in central areas with a high degree of agricultural activity. Most of the country's cereal production and animal production based on feed concentrates is located in these regions. Region H and I cover rural areas in which agriculture is dominated by grassland and the husbandry of grazing animal. Region J contains municipalities in rural areas in which agriculture is marginal due to natural conditions.

1 Introduction

Multifunctional agriculture has become a frequently used term with regard to agricultural policy debate in Norway, especially connected to agricultural trade negotiations within the World Trade Organization (WTO). It has also become an important subject matter within the European Union and the Organisation for Economic Cooperation and Development (EuroChoices 2001, OECD 2001, OECD 2003).

The concept of multifunctionality involves the provision by agriculture of public goods[1] or positive externalities[2] in addition to the production of food and fibre (Prestegard 2004, Vatn 2002). Examples of these public goods include among others cultural landscape, biodiversity, ecological functions, cultural heritage, the viability of rural areas, food security, and animal welfare (Romstad *et al.* 2000). Elgersma (in press) gives a broad definition of agriculture's multifunctionality as "*a socially constructed concept that recognises that agriculture beyond its primary role of producing food and fibre also provides other functions (...)*". According to Hall *et al.* (2004), multifunctional agriculture attempts to establish a new balance between traditional commodity support and payment for the production of non-market or public goods and services that are increasingly demanded by the public. On the other hand, Knickel & Peters (in press) interpret multifunctional agriculture as a broadening and a deepening of typical agricultural activities. Examples of the former include management of nature and land-scape and agri-tourism, while examples of the latter include organic farming and direct marketing of typical agricultural activities. Sometimes, public goods or positive externalities will be produced automatically as a by-product of the production of food and fibre, and without additional costs. In other cases, these goods will not be produced, or will be produced in sub-optimal quantities, unless an "extra payment" is assured. Consequently, in a free

[1] Baumol & Oates (1988, pp. 18-19) define public goods by two characteristics: undepletability (consumption of a good by one person does not reduce the consumption available to anyone else) and non-excludability (once the good has been provided for one consumer, it is not possible to prevent other people from consuming it).

[2] Agricultural production may also result in negative external effects (or "public bads") such as nutrients runoff, erosion, and pollution from pesticide and herbicide use. Accordingly these negative effects may also be included in the term multifunctional agriculture, e.g. Romstad *et al.* (2000).

market situation a positive externality or public good, such as the cultural landscape[3], could be provided for below its optimum level (Dillman & Bergstrom 1991). Latacz-Lohmann & Hodge (2001: 43) argue that "*if government policies reduce agriculture to areas that are competitive at world prices, the associated loss of countryside benefits may be substantial and may outweigh the (politically less visible) gains from freer trade*".

The justification of (trade-distorting) agricultural support as a means to promote agriculture's multifunctionality is not undisputed. The Norwegian Ministry of Agriculture and Food argues that current support levels to agriculture are justified, at least in part, to maintain the positive effects of agricultural multifunctionality (Norwegian Ministry of Agriculture and Food 2004). Researchers of the US Department of Agriculture argue, however, that multifunctionality is an insufficient basis for continuing trade-distorting agricultural policies, and they maintain that many non-food benefits are achieved with greater efficiency through non-agricultural policy instruments (Bohman *et al.* 1999).

Although there exists theoretical and analytical research on the concept of multifunctionality, there is a lack of empirical application and qualitative assessment on the impact of agricultural policies on multifunctionality. This gap is addressed in the current project "*Operationalizing multifunctionality in the CAPRI modeling system*" financed by the Research Council of Norway (2003-2006). The principal objective of the project is to operationalize multifunctionality by developing indicators that measure aspects of agriculture's multifunctionality, and that can be implemented into the CAPRI modeling system. CAPRI is an agricultural sector model covering more than 200 regions in the EU and Norway in addition to 13 regions in a world trade model for agricultural commodities (Mittenzwei and Prestegard 2004).

As part of the project, this working paper describes the establishment of a more appropriate regionalization for use in assessing the effects of policies on multifunctionality. In the present version of the CAPRI model, regions follow the county level. When it comes to multifunctionality, this approach is not satisfactory. Nersten *et al.* (1999) have shown that Norwegian farming regions typically cross counties. Alternatively, one could use the various support zones that have been established for different agricultural policy instruments in Norway or other existing regionalizations (Hegrenes *et al.* 2002). The support zones are primarily designed to cover costs for primary agriculture related to less favourable natural conditions. Thus, they reflect primarily natural conditions as one selected aspect of multifunctionality. Therefore, the support zones are not appropriate either.

For that reason, a different kind of regionalization had to be found. This task has been addressed by performing a cluster analysis by which Norwegian municipalities have been grouped with respect to their performance on variables that could describe different aspects of agriculture's multifunctionality. This information will then later on be used to regionalize the CAPRI model accordingly. The next chapter gives a detailed description of the cluster analysis and the variables that have been selected/constructed to perform the grouping of the municipalities into more homogenous regions regarding aspects of multifunctional agriculture. Different methods are discussed, and the cluster analysis is run for different predetermined numbers of clusters. Chapter 3 presents the results of the analyses making intensive use of graphical presentation and describes the selection of the final clustering result. Chapter 4 gives a short description of the major characteristics of the ten regions in the selected clustering result. The last chapter draws some conclusions and points towards future research. Three annexes complete the paper. The first annex contains definitions and maps for all variables used in the cluster analyses. Annex 2 provides an overview of the variable means for the clusters in the different runs, while annex 3 presents a list showing which cluster each municipality belongs to in the different runs.

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[3] Cultural landscapes are increasingly regarded as being at the heart of European society's concern about the future of agriculture and land use (Knickel & Peter, in press). The European Landscape Convention from 2000 is proof of the increasing interest in the issue of landscapes.

2 Method

The approach used to group municipalities is cluster analysis, which is a well-known method within the multivariate statistical approach (Hair *et al.* 1995). The term "cluster analysis" (or clustering) encompasses a large number of techniques developed to decide whether a data set contains distinct groups or clusters of observations, and if so, to identify which of the observations belong to the same cluster (Der & Everitt 2002). The theory behind clustering is an expected positive relationship between the variables' Euclidean distance and the similarity of the observations. As a result, cluster analysis is driven by the trade-off between minimizing the Euclidean distance of observations within a cluster, and maximizing the Euclidean distance between clusters.

Numerous methods for cluster analysis are available. Clustering can be conducted directly on the data set, or as a two-step procedure in combination with other statistical methods like factor analysis or principal component analysis. Sometimes, the number of clusters is exogenous, while other methods determine the optimal number of clusters as part of the analysis. The resulting clusters can be disjoint, hierarchical, overlapping or fuzzy.

For the purpose of our analysis, disjoint clusters are appropriate, i.e. each municipality is placed in one and only one cluster. Based on the analysis of our data set, two alternatives to conduct the cluster analysis appear appropriate: (1) Direct clustering of the data set, and (2) a two-step procedure using principal component analysis in the first step and a cluster analysis in the second step based on the principal components. In both alternatives, the number of clusters is exogenously given. This requires the selection of the final number of clusters by comparing the cluster results for a different number of clusters.

Cluster analysis as a method to identify regions with similar conditions with respect to a set of variables has gained increasingly interest in recent years. This is especially true for agriucltural and rural development. Vidal *et al.* (2001) present a cluster analysis for the EU-15 at the NUTS-2 level in order to group regions with respect to variables describing agriculture and rural development. Baum *et al.* (2004) conduct a similar analysis for the ten new EU-member states at the NUTS-3 level. Furthermore, Mazzocchi and Montresor (2000) apply cluster analysis to study agriculture and rural development for Italian regions. While these studies focus on agriculture and rural development, our scope is somewhat broader as we aim at covering several aspects of multifunctionality.

The regional dimension for the cluster analysis is the municipality level. Agriculture's multifunctionality, however, does not stop at administrative border. This is especially true for some large Norwegian municipalities that stretch from the coastline to mountainous regions. As shown in Nersten *et al.* (1999), Norwegian farming regions typically cross the borders of municipalities. From this point of view, the analysis could have been enhanced by not relying at any administrative border at all. Due to data availability, this has not been possible. Instead, the municipality level as the lowest administrative level for which sufficient data are available, has been chosen for the analysis. Figure 2.1 shows the geographic distribution of the 435 Norwegian municipalities, which enter the analysis.

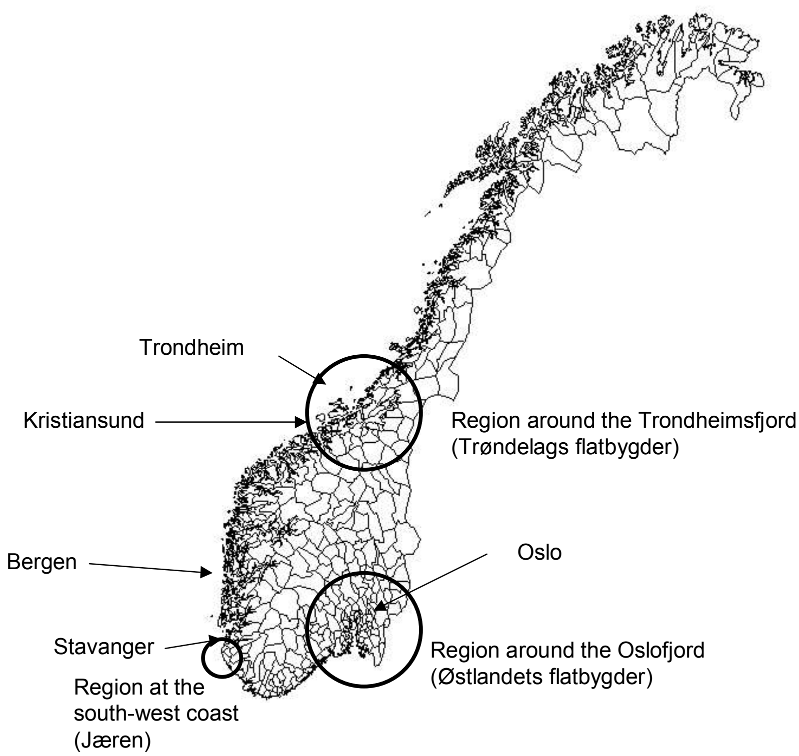

Figure 2.1 Map of the 435 Norwegian municipalities

The circles in figure 2.1 identify the three centres of agricultural production in Norway; the region around the Oslofjord, the region around the Trondheimsfjord and a region called "Jæren" at the South-Western coast. In addition, important towns like Oslo, Bergen and Trondheim are shown.

At the beginning of the analysis, more than 70 variables were defined for all municipalities in order to cover a wide range of aspects that are expected to have a significant impact on the status and change of agriculture's multifunctionality. The selected variables are quite similar to the variables used in the studies of Vidal *et al.* (2001), Baum *et al.* (2004) and Mazzocchi and Montresor (2000). In addition, variables on agricultural landscapes are included. It should be noted, however, that the selection of variables hings to a great extent on data availability. This is especially true for a wide range of landscape indicators for which data at the municipality level are not available. The different aspects and their related variables are listed in table 2.1.

Table 2.1 Variables considered for the cluster analysis

Aspect of multi-functionality	Variables
Natural conditions	Altitude, temperature, rainfall, growing days, growing energy
Socio-demographics	Pr capita total area, % change in population 1991-2001, % women of men of age 30-39 years, % people > 67 years of total population, mean age of population, pr capita GDP, % rate of unemployment, centrality index, road density
Environmental issues	Emissions from agriculture (CO_2, CH_4, N_2O and NH_3)
Agro-food sector	% employment in food industry of all industry, % firms in food industry of all industry, % agricultural employment of all employment
Land use and animal numbers	% fallow land of total utilisable agricultural area (UAA), No of dairy cows pr capita, % UAA of total area, % pasture of UAA, % GRCU (cereals and oilseeds) of UAA, % potatoes of UAA, %/100 greenhouse of UAA, % vegetables of UAA, % fruits of UAA, % berries of UAA, % organic land of all farm land, No of suckler cows pr capita, No of sheep pr capita, No of sows pr capita, No of laying hens pr capita, No of dairy cows pr UAA, No of suckler cows pr UAA, No of sheep pr UAA, No of sows pr UAA, No of laying hens pr UAA
Pluriactivity of farm business	No. of businesses related to forestry, hunting and fishing pr farm, No. of other businesses pr farm, % of farms involved in businesses related to forestry, hunting and fishing of all farms, % of farms involved in other businesses of all farms
(Agricultural) land-scape	No. of farm buildings pr ha UAA, % farm buildings built before 1949 of all farm buildings, usable old buildings pr ha UAA, ruined old buildings pr ha UAA, % not-in-use farm buildings of all farm buildings, % of farms with > 8 lots, ha UAA pr lot, Mountain cottages for dairy pr UAA, % steep UAA of UAA, % prod. forest area (FA) of land area (LA), % unprod. FA below prod. FA of LA, % unprod. FA above prod. FA of LA, Cows on mountain pastures of all cows, Sheep and goat on mountain pastures of all sheep and goat
Farm structure and education	% farmers with ag. education, UAA pr farm, % farms < 10 ha, % farms > 20 ha, % change in farms 1989-1999, % farms >20 cows of all dairy farms, % farms >30 sows of all farms with sows, % farms >99 sheep of all farms with sheep, % farms >100 laying hens of all farms with hens, % occupied farms of all farms, % rented land of all farm land

A first cluster analysis including all variables did not give a satisfactory result, because it appeared difficult to interpret the results – even for a wide range of numbers of clusters. It appeared that the number of variables was too high so that the grouping of municipalities became somewhat arbitrary.

Accordingly, the number of variables was reduced significantly from over 70 to 19. The process of selecting variables was made manually by identifying variables with the highest expected impact on aspects of agriculture's multifunctionality. Special consideration was put on variables measuring forest area. Several tests with and without the forest variable indicated a tremendous impact on the cluster result. This is probably due to forest as either important or insignificant for land use in many municipalities. When including the forest variable, the cluster result was very much dominated by that single variable.

Table 2.2 Final variables selected for the cluster analysis

Aspect of multifunctionality	Variable	Code	Map in Annex 1
Natural conditions	Energydays	ENERGY	Figure 5.1
Socio-demographics	Population density	POPDENS	Figure 5.2
Socio-demographics	Centrality index	CENTRAL	Figure 5.3
Agro-food sector	Employment in food industry	FOODEMP	Figure 5.4
Agro-food sector	Employment in primary agriculture	AGEMP	Figure 5.5
Pluriactivity of farm business	"*Utmark*" related farm businesses [1)]	UTMARK	Figure 5.6
Pluriactivity of farm business	Non-"*utmark*" related farm businesses [2)]	NUTMARK	Figure 5.7
(Agricultural) landscape	Farm buildings from before 1949	OLDBLDG	Figure 5.8
Land use and animal numbers	Share of agricultural area	UAASHR	Figure 5.9
(Agricultural) landscape	Size of lot	LOTSIZE	Figure 5.10
(Agricultural) landscape	Mountain cottage density	COTTGE	Figure 5.11
(Agricultural) landscape	Cows on "*utmark*"	MONCOW	Figure 5.12
Land use and animal numbers	Steep agricultural area	STEEP	Figure 5.13
Land use and animal numbers	Pasture	PASTURE	Figure 5.14
Land use and animal numbers	Organic agricultural area	ORGAREA	Figure 5.15
Farm structure	Share of small farms	FARMSIZE	Figure 5.16
Farm structure	Farm occupation	FARMOCCP	Figure 5.17
Land use and animal numbers	Grazing animal density	GRAZING	Figure 5.18
Land use and animal numbers	Non-grazing animal density	NONGRAZ	Figure 5.19

1) Hiring out hunting and fishing rights, processing of own forest products, hiring out cottages.
2) Agro-services, campgrounds, and crafts.

From a landscape point of view, forest is an important aspect of multifunctionality. On the other hand, the CAPRI model does not contain forest so that the forest area is supposed to be stable in all model runs. In addition, the focus of this analysis is on agriculture's multifunctionality. For these reasons, the forest variable was excluded.

The final list of variables is shown in table 2.2. A detailed description of the variables together with a graphical presentation can be found in Annex 1. The description also contains a brief argument why the variables concerned have been selected.

No standard procedure to select the final number of clusters exists (Hair *et al.* 1995:499). Instead, many criteria and guidelines have been developed. Most of them examine the similarity or distance between clusters. For that reason, the set of variables is run for different numbers of clusters: six, seven, eight, nine, ten and fifteen clusters.

Since the number of clusters is not *a priori* given, one needs to decide which number of clusters to choose. One method to evaluate the fitness or "goodness" of the cluster results has been developed. It is based on the aim of cluster analysis, which is maximizing the difference between clusters. More technically, the method calculates the sum of the absolute differences of the normalized cluster means for each variable separately. This allows the determination of those variables that have most effect on the cluster result. The results of this method are presented in absolute terms and relative terms. The latter measures the absolute difference relative to the maximal possible difference. In the case of six, seven, eight, nine, ten and fifteen clusters, the maximum difference is nine, twelve, sixteen, twenty, twenty-five and fifty-six, respectively.[4]

There are a large number of different methods available how to conduct cluster analysis. Based on the intensive study on the data and the correlation between them, the cluster analysis itself is run as a non-hierarchical analysis. Other methods like factor analysis and principal component analysis have also been used, but the results were less fruitful.

[4] The maximal possible difference is calculated as the solution to an optimization problem that maximizes the sum of n variables, where the variables can take all values between 0 and 1 (n = 6, 7, 8, 9, 10, 15).

3 Results of the cluster analysis

The results of the cluster analysis are shown below making extensively use of tables and graphs.

3.1 Result for 6 clusters

A regionalization with 6 clusters gives a rather uneven distribution of municipalities (figure 3.1). Cluster 6 dominates the overall result containing 275 out of 435 municipalities or almost 2/3 of all municipalities (table 3.1).

Table 3.1 Characterization of the six clusters

Cluster	No.	%-share	Description
1	94	21.61	Central areas, low population density
2	11	2.53	Central areas, high population density
3	35	8.05	Central areas, low population density
4	3	0.69	Towns with little agriculture (Oslo, Stavanger, Kristiansund)
5	17	3.91	Central areas, medium population density
6	275	63.22	Rural areas
Total	435	100.00	

Source: Own calculations

Cluster 6 covers all of rural Norway. The five other clusters cover central areas in Norway. Cluster 4 is comprised of Oslo, Stavanger and Kristiansund characterized as highly populated towns with a rather low level of agricultural activity.

Somewhat surprising cluster 1 contains seemingly quite different municipalities like Hå in the agricultural intensive region of Jæren and Hammerfest in the northern part of Norway. It seems that the population density variable is partly responsible for that result. Hå has just

55 inhabitants per sqkm, which is about national average and a little bit higher than cluster average.

There are small differences for the means between cluster 1 and cluster 3.

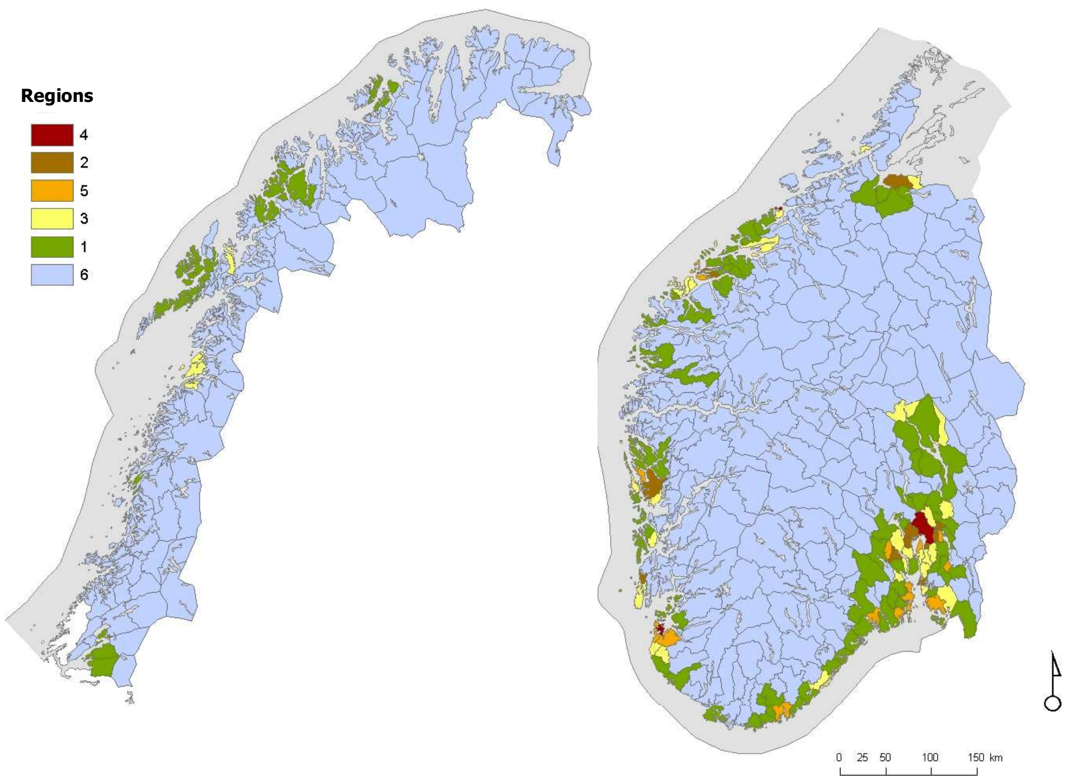

Figure 3.1 Result for 6 clusters

Table 3.2 indicates that the most important variables are population density (POPDENS), centrality (CENTRAL), the share of pasture of all agricultural area (PASTURE) and natural conditions measured as (sun) energy delivery in the growing season (ENERGY). Among these four variables, only PASTURE is directly related to agricultural activity. Other important agricultural variables are the occupation of farms (FARMOCCP), the intensity of grazing animals (GRAZING) and the share of agricultural land of total land (UAASHR).

Table 3.2 Importance of variables in the six clusters

Range	Variablecode	Value	%-value
1	POPDENS	4.61	51 %
2	CENTRAL	4.24	47 %
3	PASTURE	3.36	37 %
4	ENERGY	2.71	30 %
5	FARMOCCP	2.19	24 %
6	GRAZING	2.10	23 %
7	UAASHR	1.89	21 %
8	LOTSIZE	1.80	20 %
9	AGEMP	1.79	20 %
10	OLDBLDG	1.68	19 %
11	MONCOW	1.61	18 %
12	NUTMARK	1.02	11 %
13	UTMARK	0.83	9 %
14	NONGRAZ	0.83	9 %
15	ORGAREA	0.47	5 %
16	FARMSIZE	0.42	5 %
17	STEEP	0.41	5 %
18	FOODEMP	0.41	5 %
19	COTTGE	0.26	3 %

Source: Own calculations

3.2 Result for 7 clusters

As figure 3.2 shows, the most important difference compared to 6 clusters is that rural Norway now is divided into two clusters (cluster 3 and cluster 5). In addition, some municipalities in rural Norway are contained in cluster 6. Cluster 3 and cluster 5 cover 295 out of 435 municipalities representing a share of 66% (table 3.3). This indicates still a rather uneven distribution of clusters between rural areas and central areas.

Table 3.3 Characterization of the seven clusters

Cluster	No.	%-share	Description
1	3	0.69	Towns with little agriculture (Oslo, Stavanger, Kristiansund)
2	11	2.53	Central areas, high population density
3	105	24.14	Rural areas, farm size above national average
4	17	3.91	Central areas, medium population density
5	190	43.68	Rural areas, farm size below national average
6	77	17.70	Central areas, low population density,
7	32	7.36	Central areas, medium population density, natural conditions less favourable compared to cluster 4
Total	435	100.00	

Source: Own calculations

The “town” cluster survives the increase of the number of clusters. The same is true for the grouping of municipalities in Jæren and Northern Norway in cluster 6.

There are only small differences between cluster 4 and cluster 7.

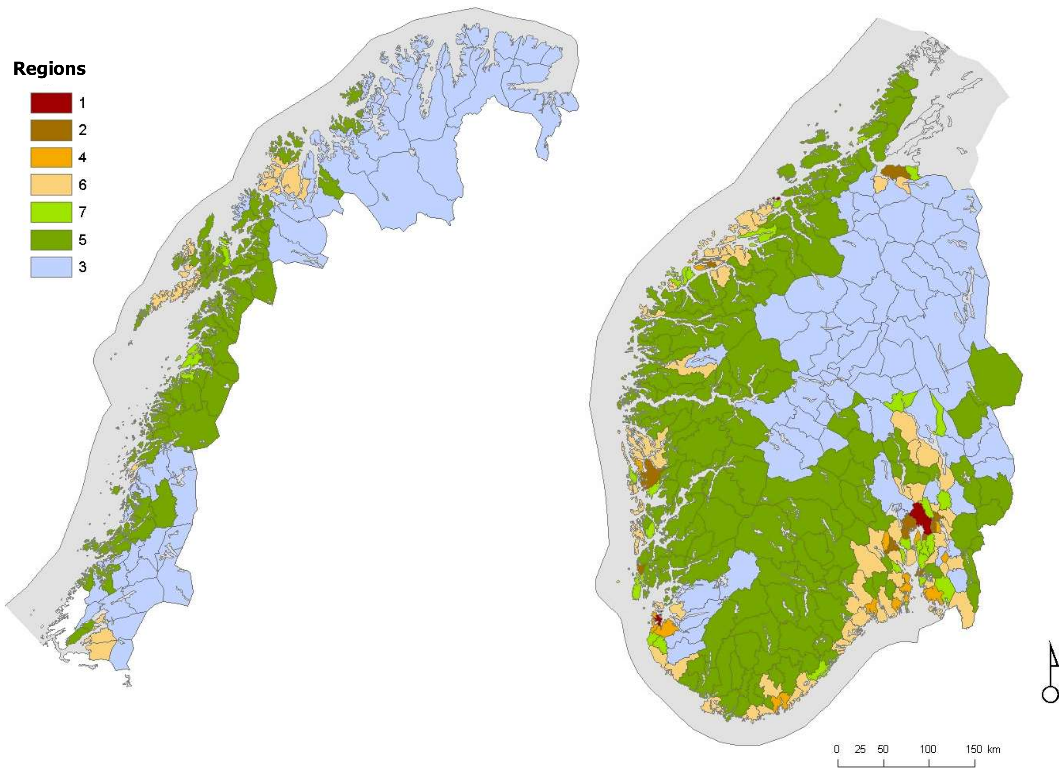

Figure 3.2 Result for 7 clusters

Table 3.4 Importance of variables in the seven clusters

Range	Variablecode	Value	%-value
1	CENTRAL	6.72	56 %
2	POPDENS	5.86	49 %
3	ENERGY	4.71	39 %
4	PASTURE	3.48	29 %
5	AGEMP	3.13	26 %
6	GRAZING	3.10	26 %
7	FARMOCCP	3.04	25 %
8	UAASHR	2.65	22 %
9	LOTSIZE	2.47	21 %
10	MONCOW	2.39	20 %
11	OLDBLDG	2.38	20 %
12	NUTMARK	1.36	11 %
13	FARMSIZE	1.36	11 %
14	UTMARK	1.28	11 %
15	NONGRAZ	1.25	10 %
16	FOODEMP	1.01	8 %
17	STEEP	0.66	5 %
18	ORGAREA	0.61	5 %
19	COTTGE	0.43	4 %

Source: Own calculations

The importance of variables is quite similar regarding the 6 cluster result and the 7 cluster result (table 3.4). The same four variables are still the most important ones although their range changes a little.

3.3 Result for 8 clusters

Comparing this result with the one with 7 clusters, two clusters still dominate rural areas. Cluster 3 and cluster 8 cover almost 65% of all municipalities – 292 out of 435 (table 3.5 and figure 3.3). The cluster with three towns exhibits a considerable strength and survives again. It seems that cluster 6 of the 7 clusters result (77 municipalities) is split up between cluster 1 and cluster 5 in the 8 clusters result (46 and 45 municipalities, respectively). In addition, cluster 5 in the 8 clusters results takes some municipalities from cluster 3 in the 7 clusters result. There are just small differences between cluster 2 and cluster 7. Both clusters are made up of municipalities in agricultural important regions.

Table 3.5 Characterization of the eight clusters

Cluster	No.	%-share	Description
1	46	10.57	Central areas, low population density, lot size below national average
2	17	3.91	Central areas, medium population density
3	86	19.77	Rural areas, lot size above national average
4	11	2.53	Central areas, high population density
5	45	10.34	Central areas, low population density, lot size above national average
6	3	0.69	Towns with little agriculture (Oslo, Stavanger, Kristiansund)
7	31	7.13	Central areas, medium population density
8	196	45.06	Rural areas, lot size below national average
Total	435	100.00	

Source: Own calculations.

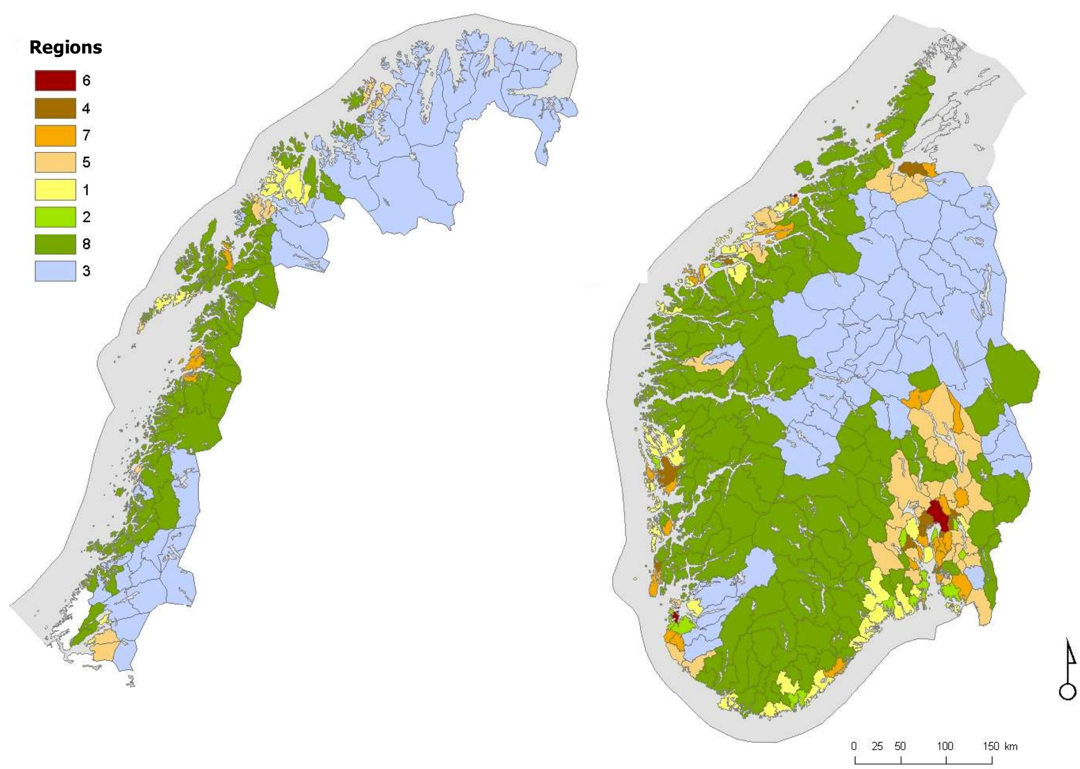

Figure 3.3 Result for 8 clusters

When it comes to variables, nearly the same variables, that were important for the proceeding clusters, seem to be important for this cluster result (table 3.6).

Table 3.6 Importance of variables in the eight clusters

Range	Variablecode	Value	%-value
1	CENTRAL	8.94	56 %
2	POPDENS	7.09	44 %
3	ENERGY	6.17	39 %
4	PASTURE	4.79	30 %
5	GRAZING	4.16	26 %
6	AGEMP	4.14	26 %
7	LOTSIZE	4.13	26 %
8	FARMOCCP	3.87	24 %
9	UAASHR	3.57	22 %
10	OLDBLDG	3.10	19 %
11	MONCOW	2.91	18 %
12	FARMSIZE	2.78	17 %
13	NUTMARK	1.84	11 %
14	UTMARK	1.63	10 %
15	NONGRAZ	1.54	10 %
16	FOODEMP	1.46	9 %
17	STEEP	0.80	5 %
18	ORGAREA	0.77	5 %
19	COTTGE	0.60	4 %

Source: Own calculations

3.4 Result for 9 clusters

As previously, the addition of one more cluster does not change the map considerably. Rural areas are still dominated by two clusters, cluster 1 and cluster 5, which both cover 258 municipalities (table 3.7 and figure 3.4). The percentage share, however, declines somewhat from 65% to 60%. This implies a greater differentiation of municipalities in central areas. Although the number of cluster has increased by one, municipalities at Jæren are still grouped together with municipalities in Northern Norway. As earlier, the "big town" cluster persists.

Table 3.7 Characteristics of the nine clusters

Cluster	No.	%-share	Description
1	179	41.15	Rural areas, lot size below national average
2	44	10.11	Central areas, medium population density, lot size above national average, share of small farms below national average
3	3	0.69	Towns with little agriculture (Oslo, Stavanger, Kristiansund)
4	17	3.91	Central areas, high population density, non-grazing animal density above national average, share of small farms below national average
5	79	18.16	Rural areas, lot size above national average
6	23	5.29	Central areas, high population density, non-grazing animal density above national average, share of small farms above national average
7	11	2.53	Central areas, high population density, non-grazing animal density below national average
8	31	7.13	Central areas, medium population density, lot size above national average, non-grazing animal density above national average
9	48	11.03	Central areas, medium population density, lot size below national average
Total	435	100.00	

Source: Own calculations.

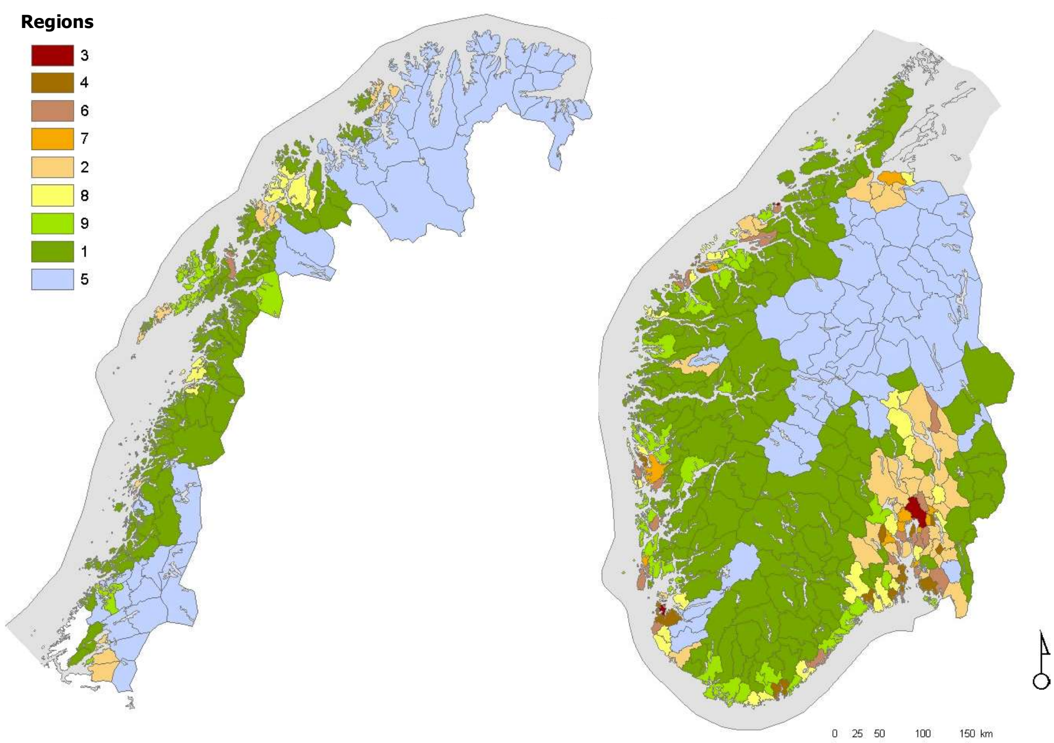

Figure 3.4 Result for 9 clusters

The same variables still tend to be most important for the grouping of municipalities into the clusters.

Table 3.8 Importance of variables in the nine clusters

Range	Variable code	Value	%-value
1	CENTRAL	11.30	56 %
2	POPDENS	8.58	43 %
3	ENERGY	7.62	38 %
4	PASTURE	6.32	32 %
5	GRAZING	5.48	27 %
6	AGEMP	5.15	26 %
7	LOTSIZE	4.98	25 %
8	FARMOCCP	4.90	25 %
9	UAASHR	4.17	21 %
10	OLDBLDG	3.94	20 %
11	FARMSIZE	3.55	18 %
12	MONCOW	3.50	18 %
13	NUTMARK	2.29	11 %
14	NONGRAZ	2.11	11 %
15	UTMARK	2.09	10 %
16	FOODEMP	1.96	10 %
17	STEEP	1.01	5 %
18	ORGAREA	0.92	5 %
19	COTTGE	0.76	4 %

Source: Own calculations

3.5 Result for 10 clusters

Moving from 9 clusters to 10 clusters seems to change the picture significantly. As can be inferred from table 3.9 and figure 3.5, rural areas are now covered by 3 clusters (cluster 4, cluster 6, cluster 8). Not surprisingly, the "town" cluster still survives and municipalities of Jæren are still grouped with municipalities in Northern Norway.

Table 3.9 Characteristics of the ten clusters

Cluster	No.	%-share	Description
1	23	5.29	Central areas, high population density, share of small farms above national average
2	17	3.91	Central areas, high population density, share of small farms about national average, highest share agricultural area
3	11	2.53	Central areas, high population density, non-grazing animal density about national average
4	138	31.72	Rural areas, agricultural employment about national average
5	44	10.11	Central areas, medium population density, non-grazing animal density above national average, lot size above national average
6	30	6.90	Rural areas, agricultural employment above national average, "*utmark*"-related businesses below national average
7	3	0.69	Towns with little agriculture (Oslo, Stavanger, Kristiansund)
8	93	21.38	Rural areas, agricultural employment above national average, "*utmark*"-related businesses above national average
9	45	10.34	Central areas, medium population density, non-grazing animal density above national average, lot size below national average
10	31	7.13	Central areas, medium population density, non-grazing animal density above national average, lot size about national average
Total	435	100.00	

Source: Own calculations.

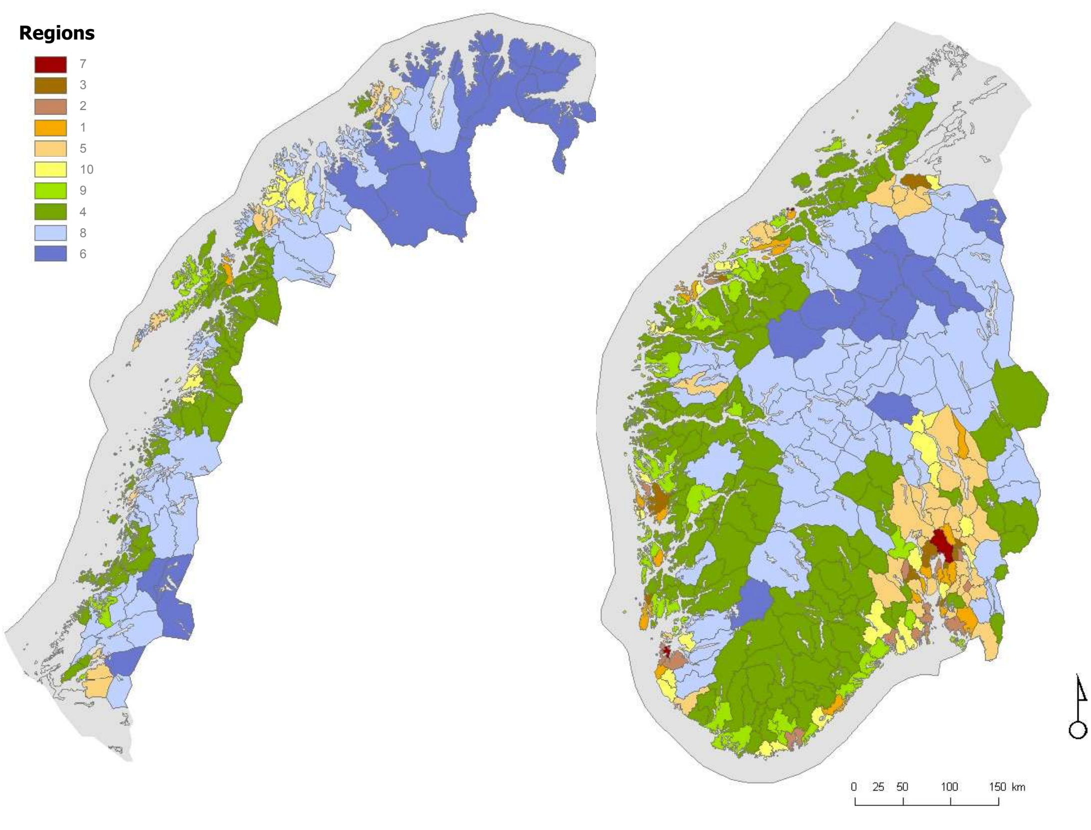

Figure 3.5 Result for 10 clusters

Table 3.10 Importance of variables in the ten clusters

Range	Variablecode	Value	%-value
1	CENTRAL	15.71	63 %
2	POPDENS	11.07	44 %
3	ENERGY	10.86	43 %
4	PASTURE	8.32	33 %
5	GRAZING	7.01	28 %
6	AGEMP	6.74	27 %
7	FARMOCCP	6.25	25 %
8	LOTSIZE	5.61	22 %
9	UAASHR	5.49	22 %
10	OLDBLDG	5.40	22 %
11	MONCOW	4.66	19 %
12	FARMSIZE	4.23	17 %
13	NONGRAZ	2.68	11 %
14	UTMARK	2.65	11 %
15	NUTMARK	2.65	11 %
16	FOODEMP	2.32	9 %
17	STEEP	1.36	5 %
18	ORGAREA	1.18	5 %
19	COTTGE	1.00	4 %

Source: Own calculations

Compared to the other cluster results, the importance of variables shows persistence. The variables on centrality, population density, energy days and pasture are still most important.

3.6 Result for 15 clusters

Moving from 10 to 15 clusters changes the map considerably (see figure 3.6). Many municipalities seem to have been grouped differently from their neighbouring municipalities. As a result, the map looks like a patchwork quilt.

Nine clusters are comprised of municipalities in rural areas, while six clusters contain municipalities in central areas. One of these six clusters is the “town” cluster that comes out as a result of the cluster analysis for all number of clusters chosen in the analysis.

Some clusters are quite similar. Cluster 5 and cluster 12 exhibit only small differences in the respective cluster means for most variables.

Table 3.11 Characteristics of the fifteen clusters

Cluster	No.	%-share	Description
1	41	9.43	Rural areas, low populated, lot size about national average
2	26	5.98	Rural areas, highly populated, lot size below national average
3	43	9.89	Rural areas, medium populated
4	17	3.91	Central areas, share of small farms about national average,
5	22	5.06	Central areas, share of small farms below national average
6	18	4.14	Rural areas, low populated, lot size above national average, share unoccupied farms above national average
7	23	5.29	Rural areas, highly populated, lot size above national average
8	42	9.66	Rural areas, low populated, lot size below national average, agricultural employment about national average
9	11	2.53	Central areas, share of small farms above national average, non-grazing animal density below national average
10	3	0.69	Towns with little agriculture (Oslo, Stavanger, Kristiansund)
11	34	7.82	Rural areas, low populated, lot size below national average, agricultural employment below national average
12	28	6.44	Central areas, share of small farms below national average
13	67	15.40	Rural areas, low populated, lot size below national average, agricultural employment above national average
14	18	4.14	Central areas, share of small farms above national average, non-grazing animal density above national average
15	42	9.66	Rural areas, low populated, lot size above national average, share unoccupied farms below national average
Total	435	100.00	

Source: Own calculations.

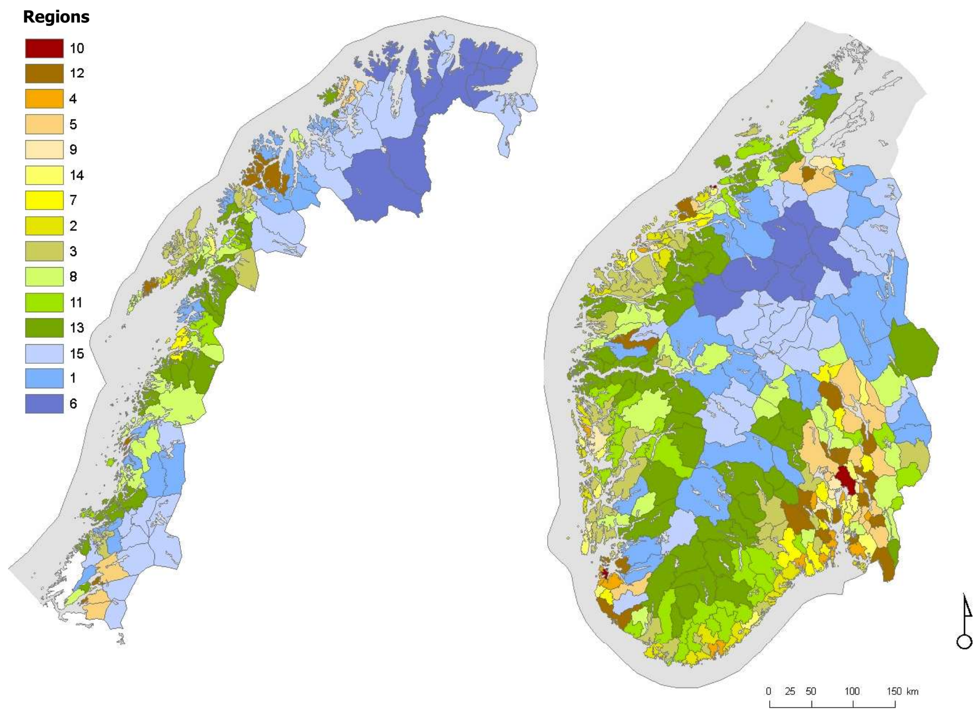

Figure 3.6 Result for 15 clusters

Table 3.12 Importance of variables in the fifteen clusters

Range	Variable code	Value	%-value
1	CENTRAL	35.98	64 %
2	ENERGY	25.99	46 %
3	PASTURE	17.71	32 %
4	POPDENS	16.43	29 %
5	AGEMP	16.02	29 %
6	LOTSIZE	15.40	27 %
7	GRAZING	14.81	26 %
8	FARMOCCP	14.71	26 %
9	UAASHR	12.72	23 %
10	FARMSIZE	12.31	22 %
11	OLDBLDG	11.56	21 %
12	MONCOW	10.58	19 %
13	FOODEMP	7.54	13 %
14	UTMARK	7.16	13 %
15	NUTMARK	6.45	12 %
16	NONGRAZ	5.64	10 %
17	STEEP	3.80	7 %
18	ORGAREA	2.99	5 %
19	COTTGE	2.64	5 %

Source: Own calculations

Concerning the important variables that are most responsible for the cluster result, there are no significant differences between the previous clusters and the actual cluster.

3.7 Selection of final cluster

In order to be able to select the final cluster, the different clusters are compared.

Table 3.13 Comparison of importance of variables across cluster analyses (average %-value)

	6	7	8	9	10	15
First 5	36 %	40 %	39 %	39 %	42 %	40 %
First 10	28 %	31 %	31 %	31 %	33 %	33 %
All	19 %	21 %	21 %	21 %	22 %	23 %

Source: Own calculations

The numbers in table 3.13 show the average %-value of the five most important variables, ten most important variables and all variables included in the cluster analysis.

The six cluster result scores lowest. Concerning the five most important variables, the ten cluster result scores highest, while the ten cluster result and the fifteen cluster result scores highest when taking all variables into account. There are only small differences between the clusters with 7, 8 and 9 numbers.

Another interesting aspect may be the distribution of the 435 municipalities among the clusters. This is shown in table 3.14.

Table 3.14 Distribution of municipalities among clusters

	6	7	8	9	10	15
Minimum	3	3	3	3	3	3
Maximum	275	190	196	179	138	67
No. of clusters within +/- 25% of the equal distribution [1)]	1	1	2	2	2	5

1) Equal distribution is defined as number of observations divided by number of clusters.

Source: Own calculations

Not surprisingly, the fifteen cluster result provides the most even distribution of municipalities among the different cluster analyses. As the number of clusters increases, the size of the clusters tends to be more equal.

The six cluster result provides the most uneven distribution of municipalities. While the maximum number of municipalities in a cluster is quite the same in the seven cluster result, the eight cluster result and the nine cluster result, the number decreases remarkably in the ten cluster result from around 180 to 138.

Considering the important variables, there are small differences between all clusters (table 3.15). The most important variables CENTRAL, POPDENS, ENERGY and PASTURE take the first four places in all clusters.

Table 3.15 Rank of variables among clusters

Rank	6	7	8	9	10	15
1	POPDENS	CENTRAL	CENTRAL	CENTRAL	CENTRAL	CENTRAL
2	CENTRAL	POPDENS	POPDENS	POPDENS	POPDENS	ENERGY
3	ENERGY	ENERGY	ENERGY	ENERGY	ENERGY	PASTURE
4	PASTURE	PASTURE	PASTURE	PASTURE	PASTURE	POPDENS
5	FARMOCCP	AGEMP	GRAZING	GRAZING	GRAZING	AGEMP
6	GRAZING	GRAZING	AGEMP	AGEMP	AGEMP	LOTSIZE
7	UAASHR	FARMOCCP	LOTSIZE	LOTSIZE	FARMOCCP	GRAZING
8	LOTSIZE	UAASHR	FARMOCCP	FARMOCCP	LOTSIZE	FARMOCCP
9	AGEMP	LOTSIZE	UAASHR	UAASHR	UAASHR	UAASHR
10	OLDBLDG	MONCOW	OLDBLDG	OLDBLDG	OLDBLDG	FARMSIZE
11	MONCOW	OLDBLDG	MONCOW	FARMSIZE	MONCOW	OLDBLDG
12	NUTMARK	NUTMARK	FARMSIZE	MONCOW	FARMSIZE	MONCOW
13	UTMARK	FARMSIZE	NUTMARK	NUTMARK	NONGRAZ	FOODEMP
14	NONGRAZ	UTMARK	UTMARK	NONGRAZ	UTMARK	UTMARK
15	ORGAREA	NONGRAZ	NONGRAZ	UTMARK	NUTMARK	NUTMARK
16	FARMSIZE	FOODEMP	FOODEMP	FOODEMP	FOODEMP	NONGRAZ
17	STEEP	STEEP	STEEP	STEEP	STEEP	STEEP
18	FOODEMP	ORGAREA	ORGAREA	ORGAREA	ORGAREA	ORGAREA
19	COTTGE	COTTGE	COTTGE	COTTGE	COTTGE	COTTGE

Source: Own calculation

As a result, the six cluster result does not seem to provide a sufficient description of multifunctionality regions and should not be considered further.

The fifteen cluster result scores high regarding the distribution of municipalities in the different clusters, but this is rather by definition – as the number of clusters is considerably higher than for the other alternatives. Since the map of the fifteen cluster results is quite scattered, it should not be considered further.

We are then left with the seven, eight, nine and ten cluster results. There are small differences between the seven, eight, and nine clusters. The main argument against the seven, eight and nine cluster results is that in each result, two clusters cover more than 55% of all municipalities. This leads to a quite uneven distribution of municipalities. For that reason, they should not be considered further.

That leaves the ten cluster result as the most appropriate grouping of municipalities with regard to agriculture's multifunctionality.

4 Description of the selected cluster

This chapter provides a short description of the ten cluster result with respect to important agricultural variables like land use, animal husbandry, production and agricultural support.

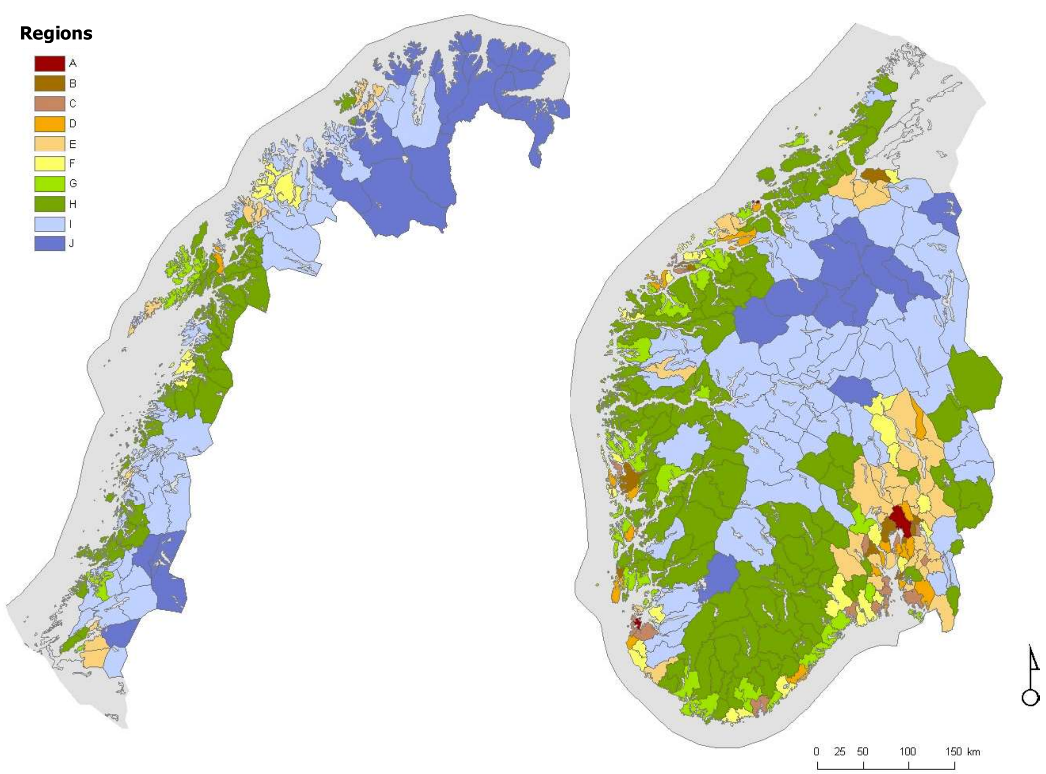

Figure 4.1 Region labels for the selected cluster

In order to simplify the regional identification, the regions are given new labels. Alphanumerical labels have been used, and the regions are ordered following the central-peripheral dimension. The most central region is given label "A", while the most remote region is identified with label "J". Figure 4.1 shows the new labels for the regions.

Table 4.1 shows the regional share of land use and animal husbandry for the ten regions in 2002. Note that the ordering of regions has been changed compared to chapter 3.5. The regions are now labelled alphanumerically, and ordered following the central-peripheral dimension.

Table 4.1 Regional share of land use and animal husbandry in 2002 (%)

Region	Cereals and oilseeds	Grassland [1)]	Other agr. land use	Grazing live-stock [2)]	Granivores [3)]
A	0	0	0	0	1
B	3	1	1	1	1
C	6	2	7	2	6
D	8	4	9	3	8
E	41	13	27	12	37
F	11	8	16	8	11
G	2	9	6	9	3
H	10	25	14	26	8
I	18	30	17	31	22
J	1	9	2	8	4
Country	100	100	100	100	100

1) Forage crops (grass, green fodder).

2) Dairy cows, suckler cows, other cattle, sheep and goats.

3) Pigs, hens and poultry.

Source: Own calculations.

On an overall basis, regions H, E, I, and F seem to be largest from an agricultural point of view. Two of these regions cover rural areas (H and I), while the other two regions cover central areas (E and F). Roughly speaking, these four regions cover two-thirds of all agricultural land and two-thirds of all animal husbandry in Norway.

Regarding cereals and oilseeds, region E is clearly the most important region followed by region I. Both regions together cover more than half of agricultural land for cereals and oilseeds production. Region E includes municipalities in the most productive Norwegian farming regions. The two regions dominate also regarding the distribution of granivores (i.e., pigs, hens and poultry) indicating that the production of cereals is closely linked to the production of pig meat, poultry meat and eggs.

Grassland (including fodder production on arable land and pasture) dominates in regions H and I, and is positively correlated with the distribution of animal husbandry among the regions.

Table 4.2 shows the distribution of agricultural production between the regions of cluster 10. There is, of course, a close link between production on the one hand and land use and animal husbandry on the other hand. Again, the four regions H, E, I, and F cover around 70% of all agricultural production.

Table 4.2 Regional share of agricultural production in 2002 (%)

Region	Cereals and oilseeds	Potatoes	Fruits and vegetables	Milk	Meat	Eggs
A	0	1	0	0	0	1
B	2	0	2	1	1	2
C	6	5	12	3	4	8
D	8	8	13	4	6	13
E	41	31	25	13	25	22
F	11	14	25	10	11	15
G	2	2	7	7	6	10
H	11	12	11	23	16	14
I	17	24	6	30	23	13
J	1	3	0	9	6	1
Country	100	100	100	100	100	100

Source: Own calculations.

The distribution of different types of support is shown in table 4.3. Budget support comprises all direct support measures that are financed by Norwegian taxpayers. AMS (Aggregate Measurement of Support) measures support from Norwegian consumers to farmers resulting from the fact that producer prices in Norway are higher than at world markets.

Table 4.3 Regional share of different types of support in 2002 (%)

Region	Budget support	AMS 1)	Total support
A	0.15	0.26	0.21
B	1.21	1.29	1.25
C	2.72	4.16	3.44
D	3.91	5.87	4.90
E	15.62	21.36	18.52
F	7.75	10.33	9.05
G	7.91	6.85	7.37
H	24.55	18.96	21.73
I	28.77	24.65	26.69
J	7.41	6.28	6.84
Country level	100.00	100.00	100.00

1) AMS (Aggregate Measurement of Support) is a term used by the WTO. It measures the difference between a fixed external reference price and the applied administered price multiplied by the quantity of production.

Source: Own calculations.

Norwegian agricultural policy has a long tradition to differentiate direct support regionally in order to compensate rural areas for less favourable natural conditions. Not surprisingly, rural areas receive the lion's share of budget support with 60% of total budget support in regions H, I, and J. Budget support in central areas (regions A, B, C and D) is, accordingly, almost insignificant. This finding is, of course, partly a result of the size of the regions.

The share of AMS in rural areas (regions H, I, and J) is only 50%. It is lower than the share of budget support. AMS is not regionally differentiated as farmers receive the same producer prices in the whole country. The regional distribution of AMS reflects the regional distribution of production and the type of production in each region. Regions I, E and H receive most AMS, and these are also the regions in which most of cereal, milk and meat production is localized (see table 4.2).

The ten Norwegian "multifunctionality" regions can be characterized along two dimensions: (1) the central-periphery dimension, and (2) the division of agriculture into arable crops combined with non-grazing animals and grassland combined with grazing animals.

- **Region A:** Urban centres with little agriculture.
- **Region B:** Urban centre or close to urban centre with little agriculture.
- **Region C:** Municipalities in Southern Norway with the best natural conditions for agriculture, the largest share of agricultural area and specialisation in cereals production and meat production based on feed concentrates.
- **Region D:** Municipalities in Southern Norway with favourable natural conditions for agriculture, and specialisation in cereals production and meat production based on feed concentrates. Much like region C, but less central.
- **Region E:** Central areas mostly in the South-Eastern Lowland and the region around the Trondheimsfjord; large-scale agriculture. Due to its scale it covers 40% of cereals production and 25% of meat production.
- **Region F:** Central areas mostly in Southern Norway comparable to region E, but smaller lot size, and higher element of pasture.
- **Region G:** Individual central areas mostly along the coast surrounded by municipalities of region H.
- **Region H:** Rural areas in Southern Norway and along the Western coast up to Northern Norway with a low share of agricultural area. Due to its large size the region covers a quarter of all grassland and grazing livestock.
- **Region I:** Remote areas covering valleys and mountainous regions in Southern Norway and parts of Northern Norway with more favourable natural conditions than region J, but less favourable conditions than region H. Due to its large size it covers 30% of all milk production.
- **Region J:** Most remote areas in Northern Norway and the mountainous regions around the Trondheimsfjord with unfavourable natural conditions and insignificant agricultural activities besides milk production.

5 Conclusion and discussion

The current regionalization of the CAPRI model follows county borders. This approach fails when multifunctionality is concerned, because many issues of multifunctionaliy (e.g., cultural landscape aspects) are independent from the administrative borders at that level. As the aim of the overall research project is to study the effects of policy instruments on agriculture's multi-functionality, it is important to design regions that to a greater extent exhibit similar characteristics with respect to agriculture's multifunctionality. This task has been addressed by performing a cluster analysis by which Norwegian municipalities have been grouped with respect to their performance on variables that could describe different aspects of the multifunctionality of agriculture. We have in this study successfully conducted such a cluster analysis of Norwegian municipalities and grouped them into 10 more homogenous regions regarding multifunctionality variables. As a result, the database of the CAPRI model can now be regionalized with respect to the 10 new regions. Finally, in later parts of the project the CAPRI model with its new regionalization will be used to analyse effects of policy changes on agriculture's multifunctionality.

The cluster analysis was not strigthforward, however. The results reinforce the critical issue that the selection of variables has an important impact on the grouping of municipalities. When using all 72 variables, the result of the cluster analysis became difficult to interpret. It appeared that the information contained in the variables was too scattered in order to receive "meaningful" groups of regions. It follows, that more information is not necessarily of the better. Reducing the number of variables improved the quality of the cluster analysis, but supported the fact that single variables may dominate the overall result. In our case, the variable representing forest area made a significant difference when excluded from the data set.

With respect to the cluster analysis conducted in this working paper, it turns out that two non-agricultural related variables, centrality and population density, are quite important for the overall result. As a matter of fact, both variables are positively correlated. Municipalities in central areas are often highly populated, while municipalities with a low population density are often to be found in remote areas. Although being variables that are not directly related to agriculture, they are important in describing the viability of rural areas, which is an important element of agriculture's multifunctionality. In addition, the variables describing aspects of cultural landscape did not score very high in the cluster analysis. In other words, these variables were not very decisive in the clustering process. This result somewhat contradicts the prior expectation that cultural landscape aspects play a major role for agriculture's multifunctionality. A possible explanation is that even the municipality level is too large in order to capture the large varieties of agricultural landscapes. The numerical value at the municipality level represents the variable's average value and it may be the case that too much information (or variation) on agricultural landscapes is lost at that point already. From a cultural landscape point of view, a level below the municipality level would be desirable. This aspect is also supported by the literature (Fry *et al.* 1999). For that reason, a possible approach for future research could be to build variables describing different aspects of agriculture's multifunctionality at the farm level (although the number of observations would increase tremendously from 435 to around 60 000). Furthermore, for some elements of multifunctionality, variables that only indirectly describe multifunctionality were used in the analysis. This aspect is especially evident for elements like the viability of rural areas. Hence, this research highlights the need for a broader perspective for farm statistics. Data at the farm level should no longer be restricted to primary agriculture as such, but take a broader perspective and describe the farm sector as an integrated part of the regional and social economy.

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Annex 1: Maps of final variables selected for the cluster analysis

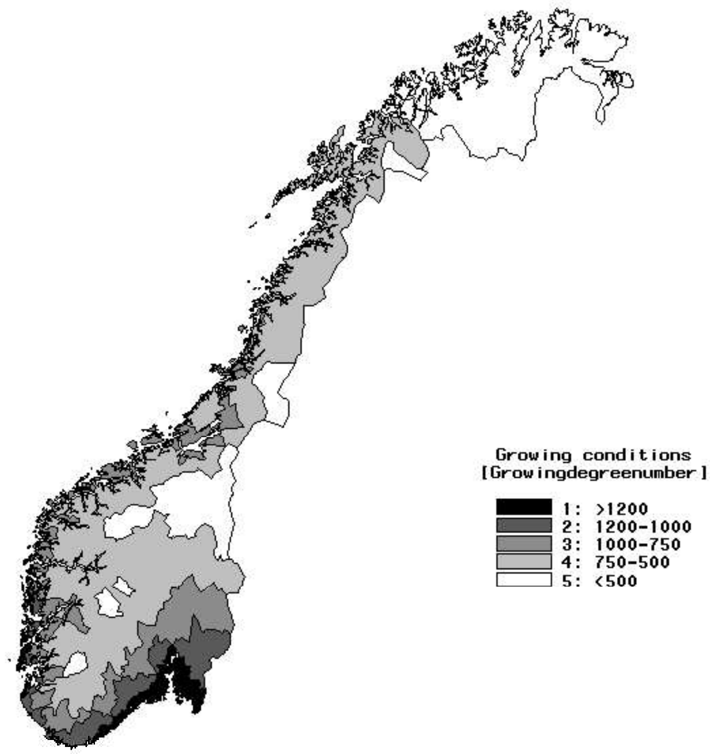

Figure 5.1 Growing conditions (ENERGY)

The growingdegreenumber (GDN, *vekstgradtall* in Norwegian) takes differences in the day-average temperature into account. The GDN is defined as the maximum of the actual day-average temperature minus 5 or zero. For example, the GDN of a day with a day-average temperature of 12 ^{o}C becomes (12-5=) 7. Likewise, the GDN of a day with a day-average temperature of 3 ^{o}C becomes zero. The variables measures the sum of GDN in the growing season May-August based on the period 1961-1990 and valid for the areas below 800 m in Southern Norway and 500 m in Northern Norway. The data source is the Norwegian Meteorological Institute at the University of Oslo (http://www.met.no).

As with the temperature and the growing days, the map showing growingdegreenumbers identifies the south-eastern part of Norway as the region with the best natural conditions for agriculture. Also, coastal regions have better climatic conditions for agriculture than mountainous regions.

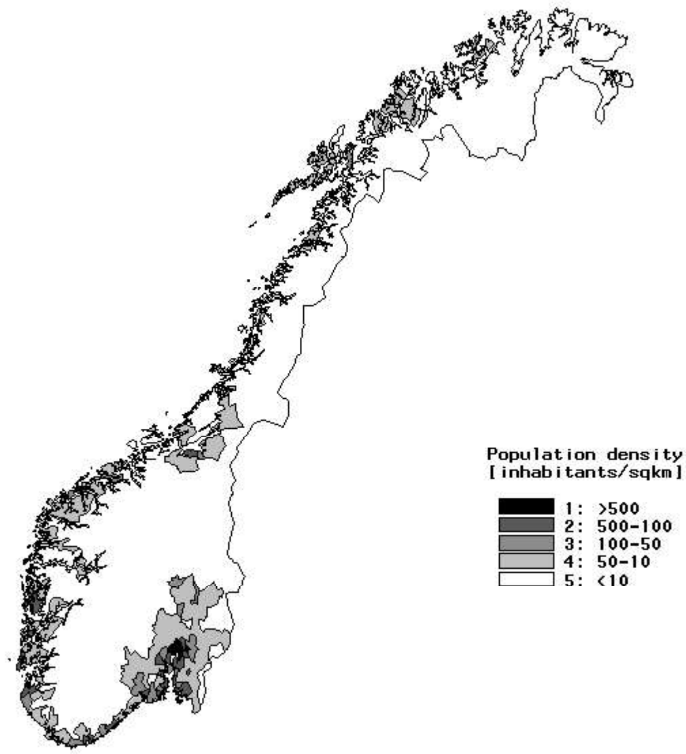

Figure 5.2 Population density (POPDENS)

The variable measuring population density is defined as the number of inhabitants divided by the total land area for the year 2001. The values are taken from the publicly accessible database of Statistics Norway in Oslo (http://www.ssb.no).

The population density is highest in the area around the Oslofjord. The coastal area in Southern Norway and Western Norway as well as the area around Trondheim in Mid-Norway is also relatively highly populated. In most other parts of the country, the population density is below 10 inhabitants per square kilometer.

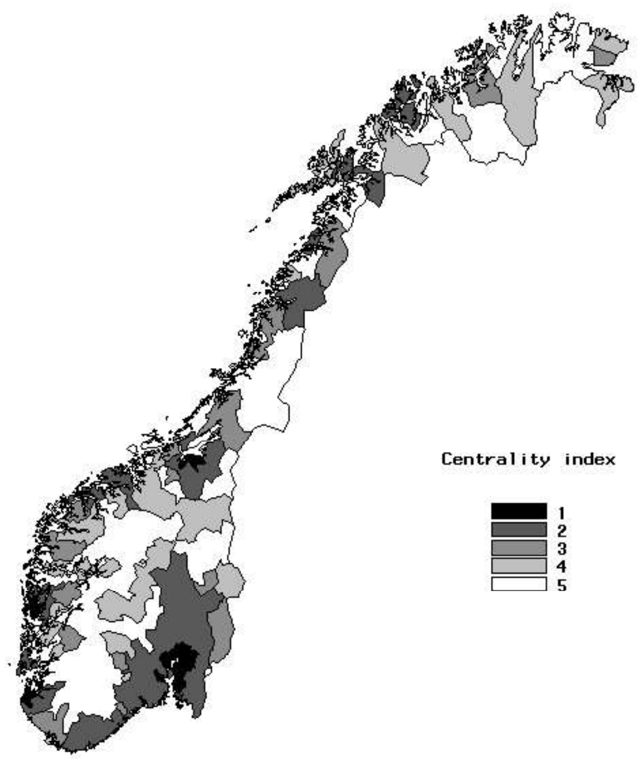

Figure 5.3 Centrality index (CENTRAL)

The centrality index used in this analysis is taken from the Norwegian Institute for Urban and Regional Research (NIBR). The index is based on the size of the centre in a region, the travel time to the regional centre and the size of the regional labour market.

The map exhibits similarities to the map showing population density. The most central areas are the ones in the south-east, along the coast in Southern Norway and Western Norway and in Mid-Norway.

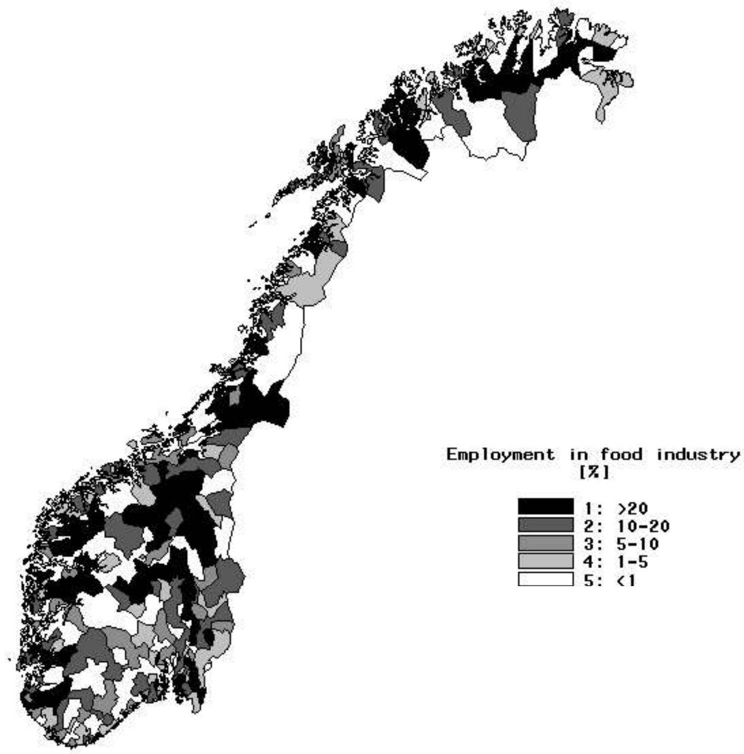

Figure 5.4 Employment in food industry (FOODEMP)

Employment in the food industry is calculated as the number of workers in that part of the food industry, which is based on agricultural produce, divided by all industrial workers for the year 2000. In particular, the fishing industry, which may be very important in certain municipalities in Northern Norway, is not included in the share. The values are taken from the publicly accessible database of Statistics Norway in Oslo (http://www.ssb.no).

It appears from the map that the food industry is scattered all over Norway. Due to the relatively small number at the whole, food industry firms are usually not located in all municipalities. In those municipalities in which a food industry firm is present, the share of employment in the food industry may well exceed 20%. In surrounding municipalities, the share may be below 1%. Therefore, firms in the food industry have the potential to be a major local supplier of labour.

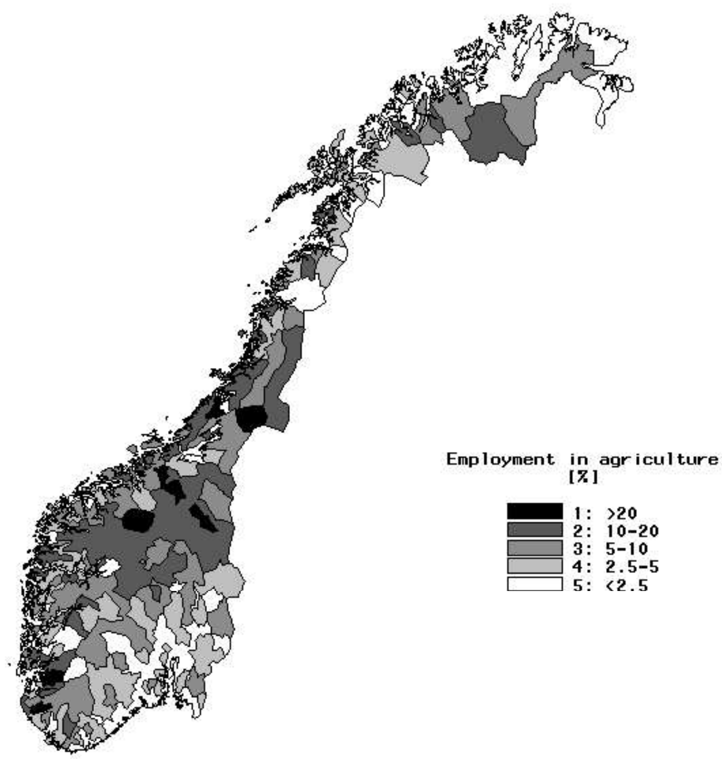

Figure 5.5 Employment in agriculture (AGEMP)

The variable measures those working in primary agriculture as the share of all persons working in 2001. The values are taken from the publicly accessible database of Statistics Norway in Oslo (http://www.ssb.no). In OECD (1998, p. 57), it is found that the agro–food sector has significant economic linkages to other sectors of the economy and constitutes an important generator of employment in rural economies. This argument is also relevant to the previous variable FOODEMP.

Employment in agriculture is negatively correlated with centrality and population density. Employment in agriculture is low in highly populated and central areas. This is partly because these areas provide a wide rage of alternative employment possibilities in other sectors. There are 12 municipalities in which the primary agricultural sector counts for more than 20% of total employment.

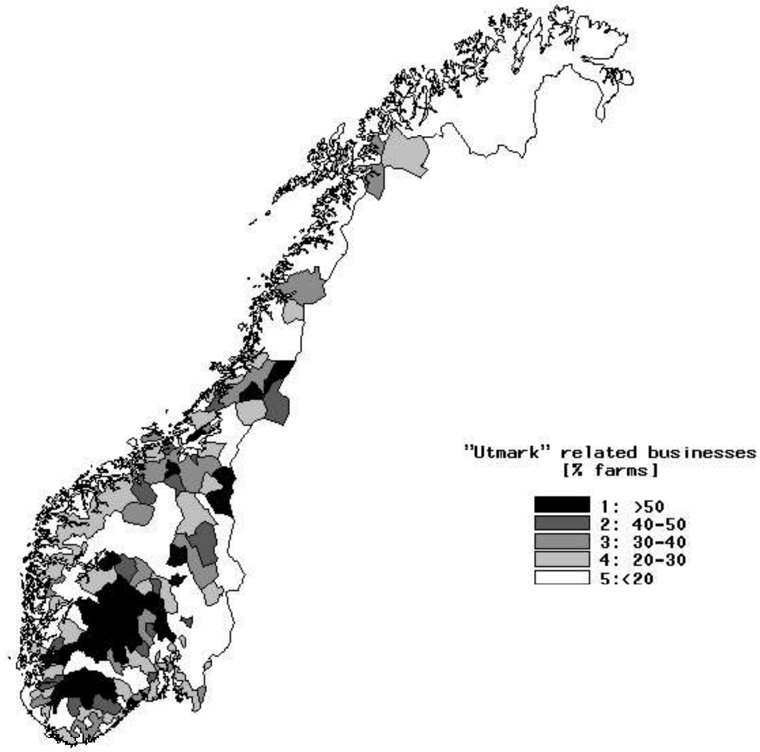

Figure 5.6 Share of farms participating in "Utmark"-related businesses (UTMARK)

The variable is defined as the percentage of farms that is involved in so-called "utmark"-related businesses. These businesses are defined as processing of own forest products, the planting of christmastrees, the hiring out of cottages and the hiring out of fishing rights and hunting rights. It may also involve own fishing and hunting, and the processing of such produce. The figures are based on the 1999 Census of Agriculture, provided by Statistics Norway in Oslo (http://www.ssb.no).

"Utmark"-related businesses are most common in the central part of Norway. In some municipalities the share of farms involved in such types of farm diversification exceeds 50%. This does not mean, however, that "utmark"-related businesses are not present in other parts of Norway as it only measures the share of farms that are involved in these businesses.

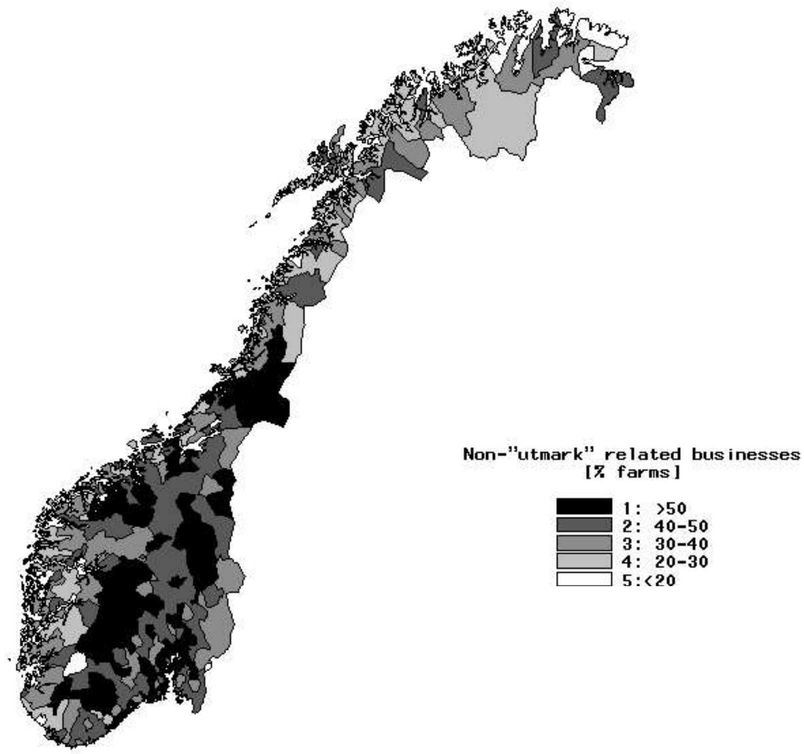

Figure 5.7 Share of farms participating in non-"utmark"-related businesses (NUTMARK)

The variable is defined as the percentage of farms that is involved in so-called non-"utmark"-related businesses. These businesses are defined as agro-services, campgrounds or traditional crafts. The figures are based on the 1999 Census of Agriculture provided by Statistics Norway (http://www.ssb.no). Bryden et al. (1993) and Jervell (1999) emphasise that many linkages between agriculture and the viability of rural areas occur through the pluriactivity of farm families. Similar linkages between agriculture and other activities through pluriactive farm families occur in form of the variable UTMARK (see Figure 5.6).

Non-"utmark"-related businesses are common on many farms. There are just a couple of municipalities in which the share of farms not involved in non-"utmark"-related businesses is higher than 80%.

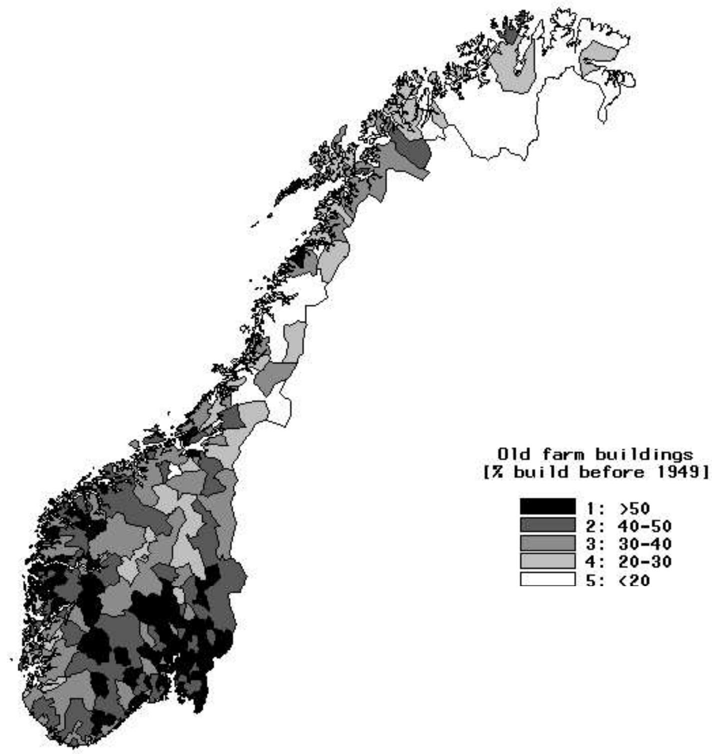

Figure 5.8 Old farm buildings (OLDBLDG)

The variable measures the share of farm buildings build before 1949 out of all farm buildings. The data are taken from the 1999 Census of Agriculture provided by Statistics Norway (http://www.ssb.no). The data include not only farm buildings that are used in primary agriculture (like barns), but also historical farm buildings that may be used for businesses related to tourism. Old farm buildings often imply certain heritage values.

The municipalities with the highest share of oldest farm buildings can be found in the southern part of Norway, while the municipalities in the northern part of Norway are in general characterized by a share of old farm buildings below 30%.

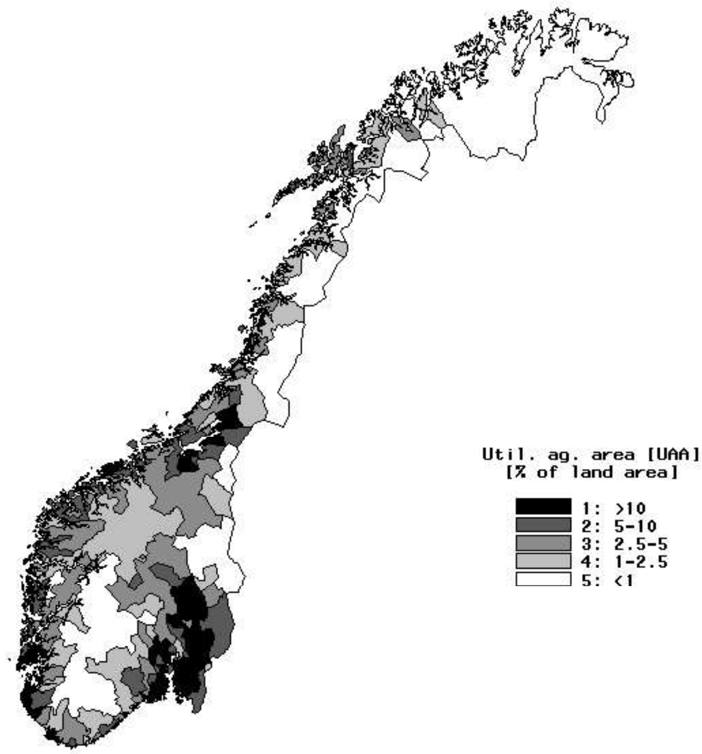

Figure 5.9 Utilizable agricultural area (UAASHR)

The variable measures utilizable agricultural area as a percentage of total land area in 1999-2000. The term "utilizable" indicates that it comprises not only agricultural area in use, but also fallow land and agricultural area not currently in use. The data are taken from the publicly accessible database at Statistics Norway (http://www.ssb.no).

The regions with the highest share agricultural land can be found around in the south-eastern lowlands, at the south-west coast (Jæren) and around the city of Trondheim. In general, the percentage of agricultural land is low compared to other European countries. On the national average the share is about 3%.

The map corresponds to a certain extent with the maps showing natural conditions, but there is also a positively correlated link to the map on population density. The share of utilizable agricultural area is highest in those municipalities with a high population density.

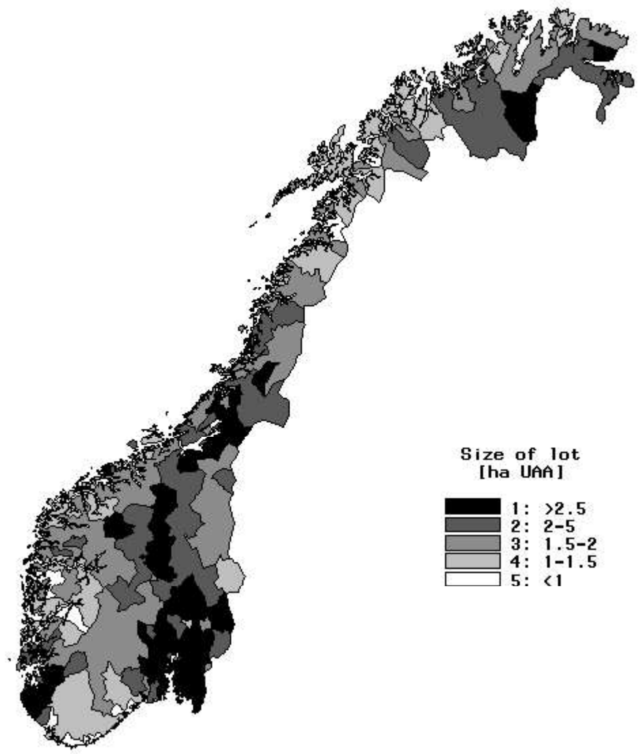

Figure 5.10 Lot size (LOTSIZE)

The variable measures the size of a lot, where a "lot" is defined as a piece of land surrounded by a different land use than the lot itself. For example, a grass field surrounded by woods, a river and a crop field would be defined as a lot. Biologists normally consider small lots with higher biodiversity due to a more diversified landscape. Many people also prefer to view a diversified landscape with small lot sizes compared to high lot sizes and monocultures. Changes in agricultural landscapes over time show a polarization with intensification in some areas and abandonment in others, while varied farming landscapes, with small–scale landscape elements, generally provide richer habitats and higher aesthetic and recreational values (Fjellstad et al., 1999). In a recent Norwegian study, Bergland (1998) investigated peoples willingnesss to pay (WTP) for various landscape elements in a relatively intensively farmed arable area. Manipulated photos of the same landscape were presented to various groups of people. Zone vegetations along with open streams and paths, in combination, were seen as the most important landscape elements. WTP per household was NOK 175 for only stream; NOK 225 for only zone vegetations; and NOK 625 for both.

The data are taken from the 1999 Census of Agriculture provided by Statistics Norway (http://www.ssb.no).

The largest lots can be found in the main regions of agricultural acitivity, i.e. the south-eastern Lowlands, the south-west coast, and the region around the Trondheimsfjord in Mid-Norway. The lot size is also relatively high in the valley of Gudbrandsdalen between Oslo and Trondheim.

The lot size is smallest on the southern and western coast, mostly due to the scattered landscape with fjords and mountains close together.

The map is positively correlated with the map on utilizable agricultural area as a share of the total area in the municipality.

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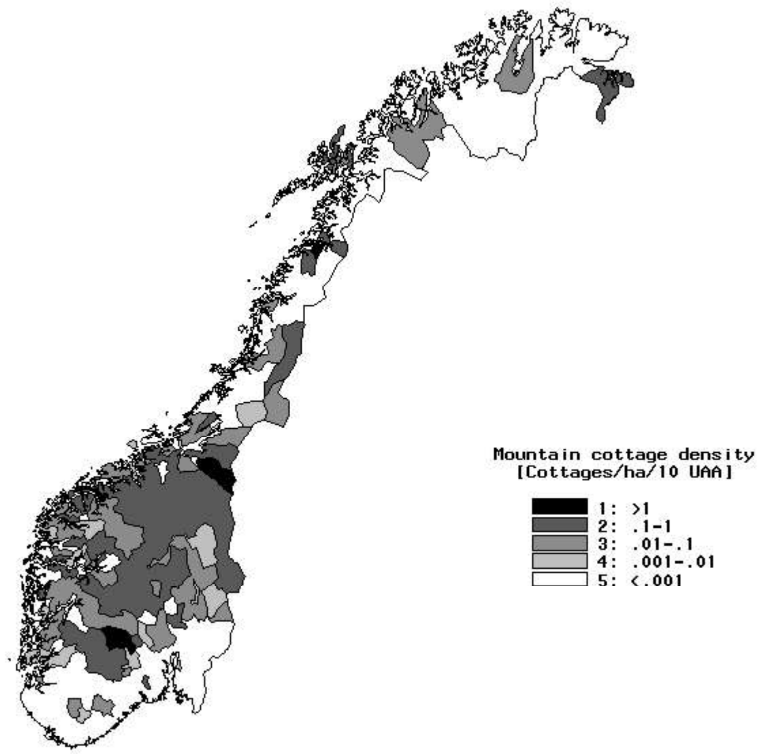

Figure 5.11 Density of mountain cottages (COTTGE)

The variable measures the density of mountain cottages for dairy measured as the number of mountain cottages for dairy receiving agricultural support in a municipality divided by the municipality's utilizable agricultural area. According to many biologists, pastures used in connection to mountain dairy cottages often imply greater biodiversity. Quite a few of the plant species in Norway on the so-called red list are dependent upon grazing for their survival. A high density of mountain dairy cottages within a municipality thus means high biodiversity. Many visitors, both local and from other parts of the country or even from abroad, seem to appreciate the view of mountain dairy cottages, the pastures and the grazing cows; i.e. because of their high landscape values.

For the mountain cottages, the data are for 2001 and taken from the publicly accessible database on agricultural support at the Norwegian Agricultural Authority (http://www.slf.dep.no). The data cover code 610 (own mountain cottages) and code 620 (common mountain cottages). For utilizable agricultural area, the data are for 1999 and taken from Statistics Norway (http://www.ssb.no) for utilizable agricultural area

Mountain cottages for dairy are traditionally used in the mountainous areas of Southern Norway.

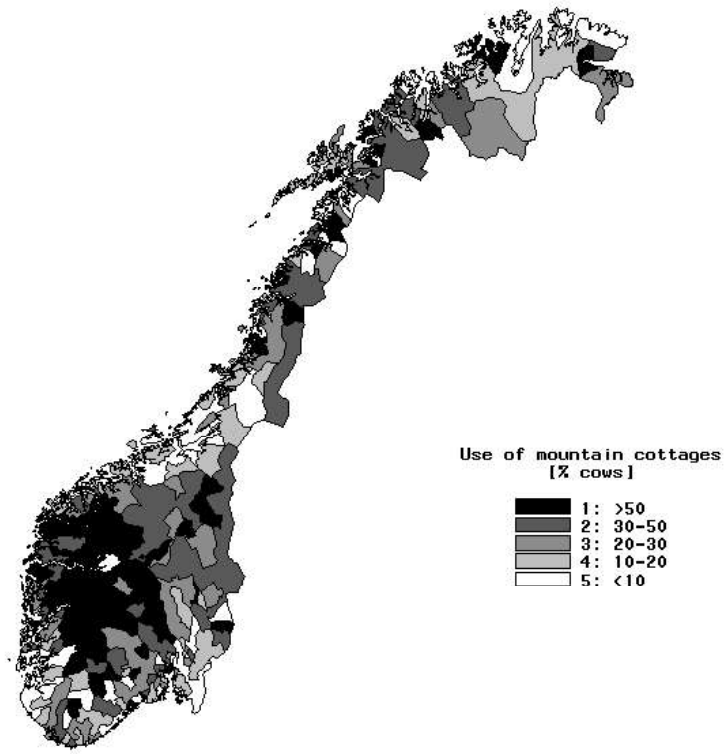

Figure 5.12 Use of mountain cottages (MONCOW)

The variable measures the share of dairy cows as well as suckler cows that are eligible for the so-called "*utmark*"-support, and can be used as an indication of the size and use of mountain cottages. It should be noted, however, that cows that receive the "utmark"-support do not necessarily need to graze on mountain cottages.

The data are for 2001 and taken from the publicly accessible database on agricultural support at the Norwegian Agricultural Authority (http://www.slf.dep.no). The data cover code 410 (cows on "*utmark*").

The areas with the highest shares of cows receiving "utmark"-support are the western and mountainous parts of Norway and along the coastline in the North.

The map coincides with the map on mountain cottages when it comes to the western parts of Norway.

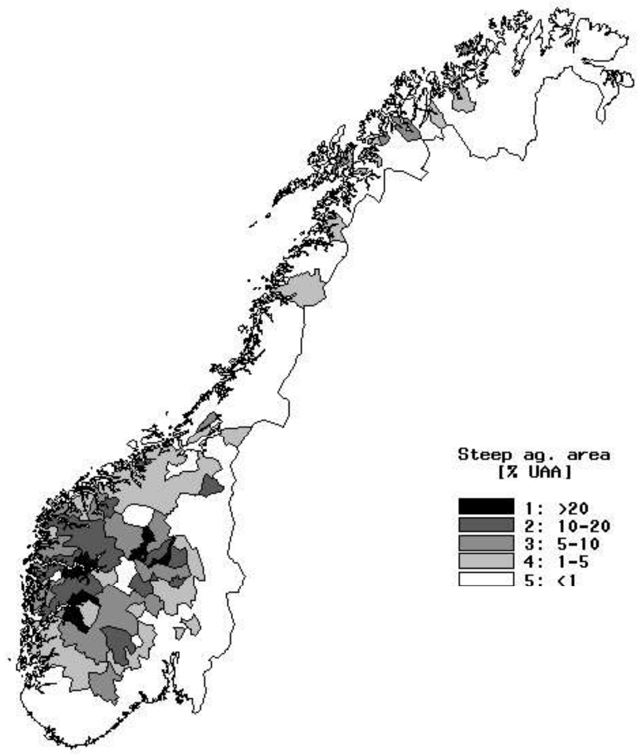

Figure 5.13 Steep agricultural area (STEEP)

The variable measures the share of utilizable agricultural area that is eligible for the so-called "*steep agricultural area*"-support. These steep agricultural areas are often found in the fjord districts or mountain valleys often associated with high landscape values with importance for tourism.

The data are for 2001 and taken from the publicly accessible database on agricultural support at the Norwegian Agricultural Authority (http://www.slf.dep.no) and cover code 295 (steep area).

The areas with the highest share of agricultural area receiving the "*steep agricultural area*"-support are the western and mountainous parts of Norway and to some extent the coast-line in the North.

The map is somewhat similar to the map on the use of mountain cottages.

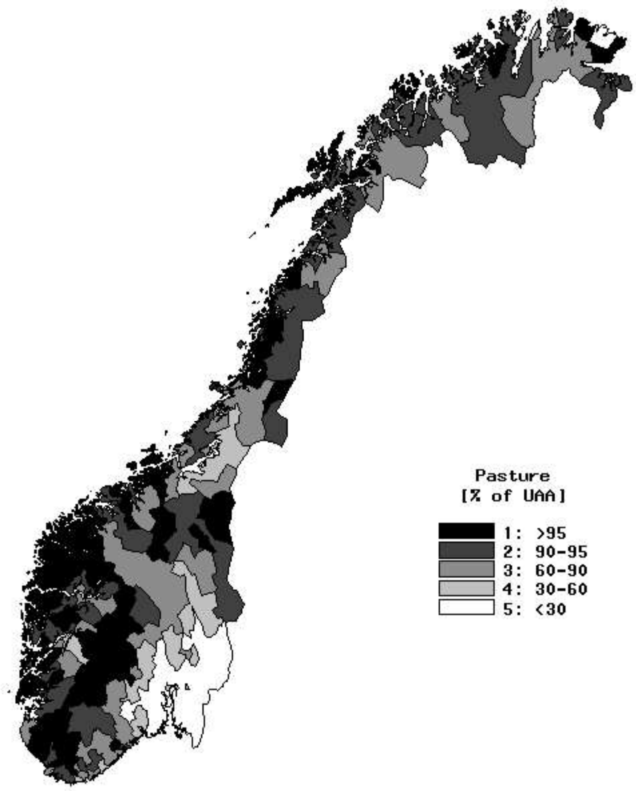

Figure 5.14 Share of pasture (PASTURE)

The variable measures grassland as a share of utilizable agricultural area.

The data for pasture are for 2001 and taken from the publicly accessible database on agricultural support at the Norwegian Agricultural Authority (http://www.slf.dep.no) and cover code 210 (grass on arable land), code 211 (grass on surface cultivated land) and code 212 (grazing land).

The map shows a clear demarcation between the south-eastern Lowlands and the other parts of Norway. The share of pasture is below 30% in the south-eastern Lowlands and above 30% in the rest of Norway. This is partly an effect of Norwegian agricultural policy starting in the 1950s to increase the use of arable land in the south-eastern Lowlands by increasing the cereal price relative to the milk price. Another cause for the distinct regional distribution is natural conditions.

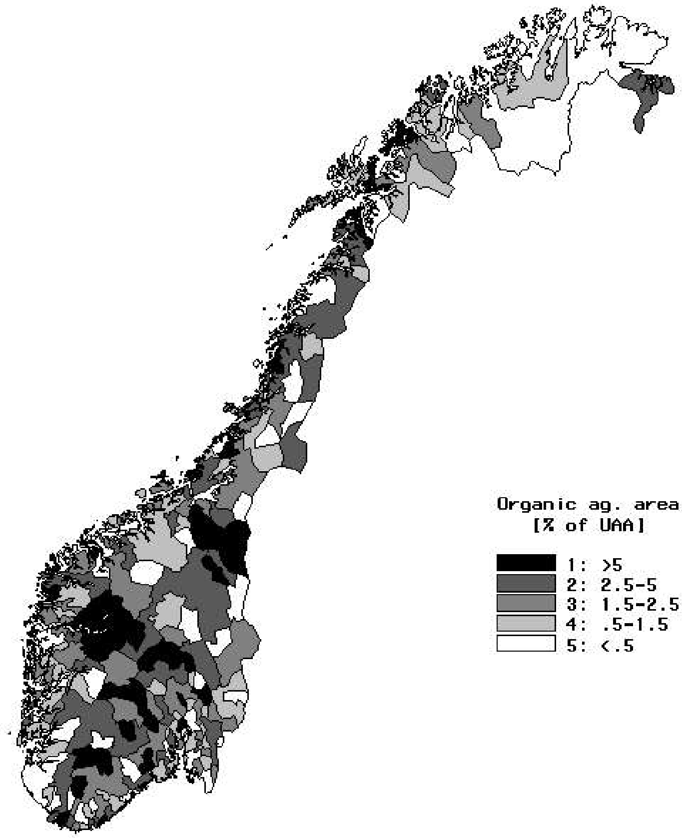

Figure 5.15 Organic agricultural area (ORGAREA)

The variable measures agricultural area used to produce organic food as a share of utilizable agricultural area. Kuiper (1997), Rossi and Nota (2000) and Clemetsen and van Laar (2000) suggest that organic farms can have more positive effects on landscape values than conventional farms (greater diversity of landscapes, ecosystems and species).

The data for organic agricultural area are for 2001 and taken from the publicly accessible database on agricultural support at the Norwegian Agricultural Authority (http://www.slf.dep.no) and cover code 203 (organic area for cereals production), code 204 (other organic area), code 205 (area under conversion to organic farming practices) and code 208 (organic area to be fertilized with organic crop material).

The map indicates no clear centres for organic farming in Norway. It seems, however, that the share is higher in mountainous regions compared to lowland regions.

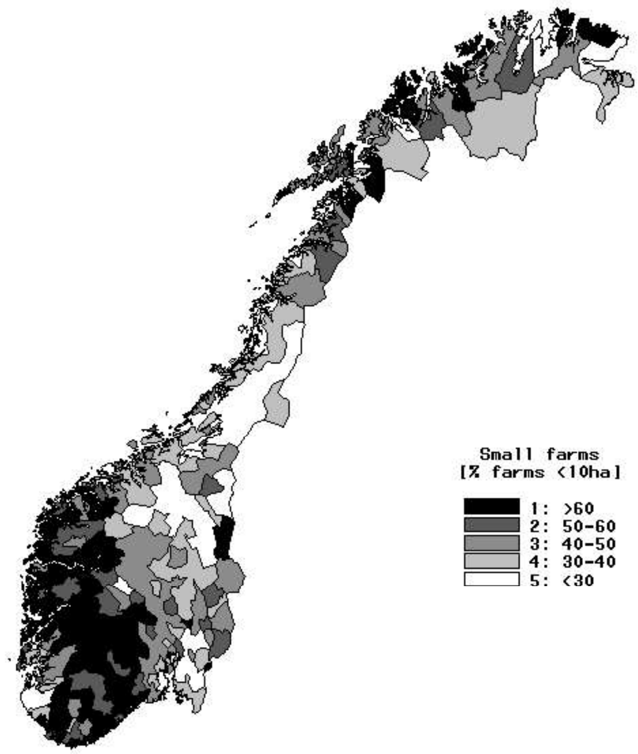

Figure 5.16 Small farms (FARMSIZE)

The variable measures the share of farms below 10 ha per farm out of all farms. A high share of small farms in an area are often associated with a more aesthetical landscape and higher biodiversity than a high share of larger farms in an area.

The data are taken from the 1999 Census of Agriculture provided by Statistics Norway (http://www.ssb.no).

The map indicates a clear regional distribution regarding farm size. The largest farms are to be found in the centres of agricultural production (i.e., the south-eastern Lowlands, the south-west coast and the region around Trondheim in Mid-Norway). The share of small farms is highest in the central parts of Southern Norway, in the Western part of Norway and along the coast in Northern Norway.

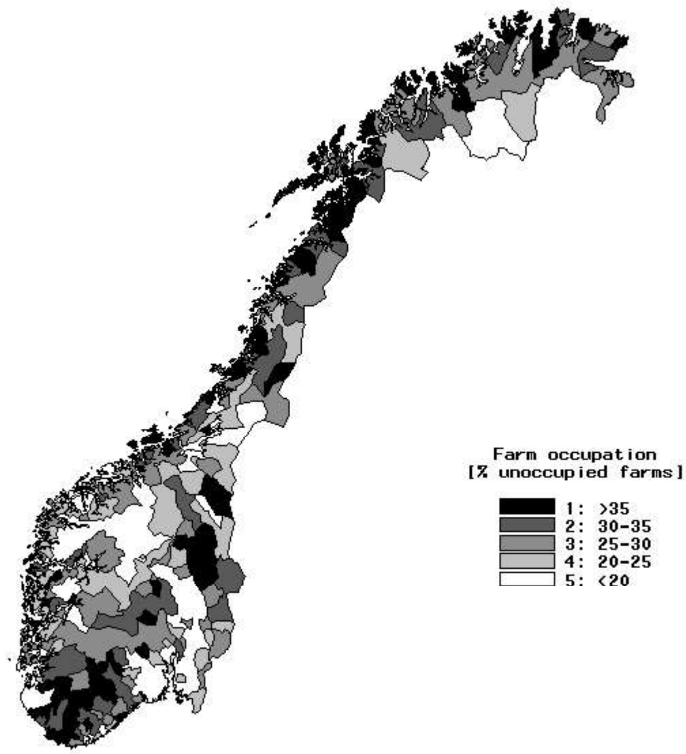

Figure 5.17 Farm occupation (FARMOCCP)

The variable measures the share of unoccupied farms out of all farms. A low share of unoccupied farms in an area must be regarded as a sign of a viable rural area, while a high share is the opposite.

The data are taken from the 1999 Census of Agriculture provided by Statistics Norway (http://www.ssb.no).

The map corresponds with the centre of agricultural production in Norway. The highest share of occupied farms can be found in the south-eastern Lowlands, the south-west coast and the region around Trondheim in Mid-Norway. In addition, there is high share of farm occupation in the western part of Norway.

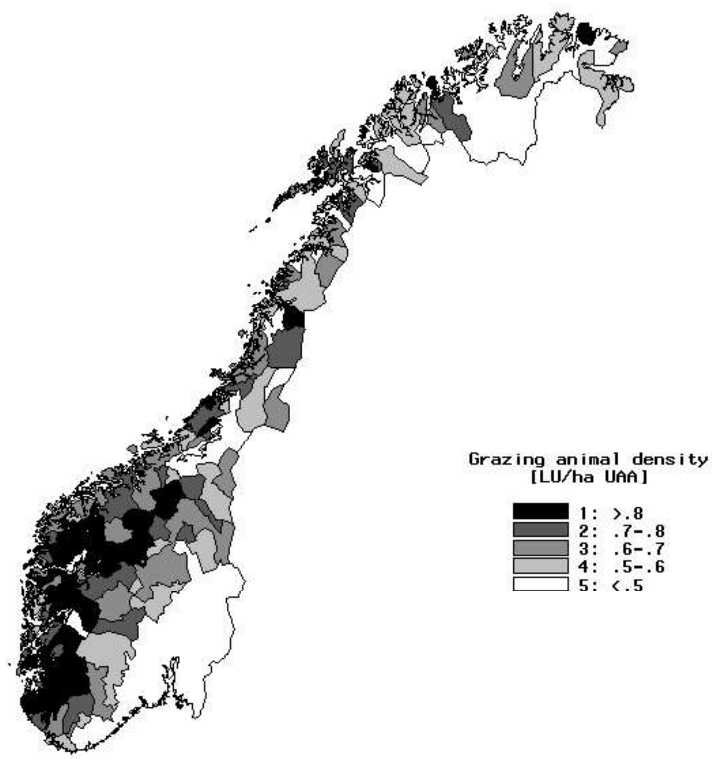

Figure 5.18 Grazing animal density (GRAZING)

The variable measures the density of grazing animals (measured as livestock units (LU)) per ha of utilizable agricultural area. Grazing animals cover dairy cows (1 LU), suckler cows (2/3 LU) and ewes (1/7 LU). The weights are taken from Norwegian regulations concerning manure ("*Forskrift om husdyrgjødsel*").

The data for animal numbers are for 2001 and taken from the publicly accessible database on agricultural support at the Norwegian Agricultural Authority (http://www.slf.dep.no). The utilizable agricultural area is taken from the 1999 Census of Agriculture provided by Statistics Norway (http://www.ssb.no).

The map shows a clear regional differentiation. The south-eastern Lowlands are characterized by a low density of grazing animals. This is partly due to the policy in the 1950s to increase cereals production in this area, but also a consequence of general economic development. The density of grazing animals is highest in the south-western and western parts of Norway.

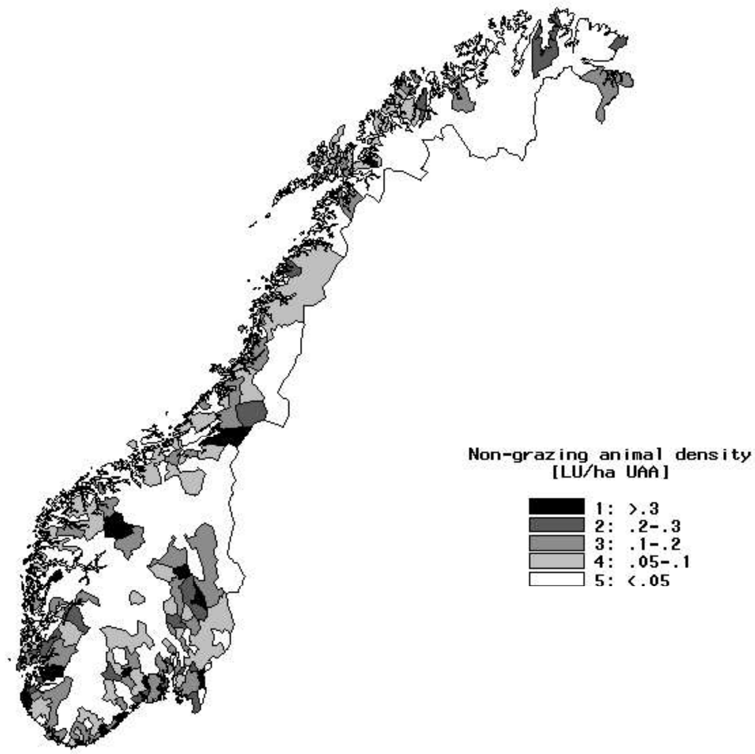

Figure 5.19 Non-grazing animal density (NONGRAZ)

The variable measures the density of non-grazing animals (measured as livestock units (LU)) per ha of utilizable agricultural area. Non-grazing animals cover laying hens (1/80 LU) and sows (incl. 20 pigs for slaughtering) (1/2.5 LU + 20*1/18 LU = 1.511 LU). The weights are taken from Norwegian regulations concerning manure ("*Forskrift om husdyrgjødsel*").

The data for animal numbers are for 2001 and taken from the publicly accessible database on agricultural support at the Norwegian Agricultural Authority (http://www.slf.dep.no). The utilizable agricultural area is taken from the 1999 Census of Agriculture provided by Statistics Norway (http://www.ssb.no).

The map shows a clear regional differentiation and corresponds somewhat to the map showing the density of grazing animals. The south-eastern Lowlands are characterized by a high density of non-grazing animals. The density is also high at the south-west coast (where also the density of grazing animals is high) and in the region around Trondheim in Mid-Norway.

Annex 2: Statistics for cluster results

Means for variables with 6 clusters

	ENERGY	POPDENS	FOODEMP	AGEMP	CENTRAL	UTMARK	NUTMARK	OLDBLDG	LOTSIZE	COTTGE
1	991.6500	34.8075	0.1166	0.0384	2.4894	0.1477	0.3712	0.4178	23.0048	0.0005
2	1155.7180	468.9818	0.1590	0.0129	1.2727	0.1389	0.5254	0.4876	32.0818	0.0008
3	1083.9510	97.8000	0.0885	0.0235	2.0857	0.1351	0.3876	0.4283	26.1800	0.0007
4	1148.8000	1147.2000	0.1217	0.0035	1.3333	0.0549	0.2950	0.2979	15.7667	0.0000
5	1243.6650	245.2588	0.1111	0.0143	1.6471	0.1451	0.4616	0.4392	25.0647	0.0004
6	688.7273	5.9182	0.1273	0.0779	3.8873	0.2316	0.3787	0.3661	19.0067	0.0010
Total	822.6552	48.4878	0.1220	0.0604	3.2690	0.1988	0.3842	0.3878	20.9929	0.0009

	STEEP	UAASHR	PASTURE	ORGAREA	MONCOW	FARMSIZE	FARMOCCP	GRAZING	NONGRAZ
1	0.0090	0.1257	0.6594	0.0238	0.1949	0.4688	0.2391	0.0460	0.0516
2	0.0120	0.1073	0.4221	0.0266	0.2092	0.4731	0.1817	0.0211	0.0382
3	0.0054	0.1813	0.5805	0.0146	0.1549	0.4638	0.1870	0.0429	0.0681
4	0.0000	0.0737	0.3035	0.0078	0.0270	0.3935	0.3009	0.0218	0.0495
5	0.0014	0.2343	0.4370	0.0104	0.1128	0.4679	0.1432	0.0274	0.0760
6	0.0372	0.0348	0.8244	0.0245	0.3187	0.4711	0.2991	0.0617	0.0296
Total	0.0263	0.0761	0.7402	0.0229	0.2660	0.4694	0.2680	0.0542	0.0396

Source: Own calculations

Means for variables with 7 clusters

	ENERGY	POPDENS	FOODEMP	AGEMP	CENTRAL	UTMARK	NUTMARK	OLDBLDG	LOTSIZE	COTTGE
1	1148.8000	1147.2000	0.1217	0.0035	1.3333	0.0549	0.2950	0.2979	15.7667	0.0000
2	1155.7180	468.9818	0.1590	0.0129	1.2727	0.1389	0.5254	0.4876	32.0818	0.0008
3	574.6190	5.5495	0.2047	0.0947	3.8381	0.2361	0.4182	0.3189	24.3777	0.0014
4	1243.6650	245.2588	0.1111	0.0143	1.6471	0.1451	0.4616	0.4392	25.0647	0.0004
5	772.8163	7.6995	0.0838	0.0652	3.7842	0.2220	0.3607	0.3996	16.5072	0.0008
6	1023.0820	39.8117	0.1121	0.0363	2.4935	0.1396	0.3578	0.4162	22.6994	0.0004
7	1081.4370	100.3531	0.0945	0.0231	1.9375	0.1436	0.3942	0.4219	26.9281	0.0008
Total	822.6552	48.4878	0.1220	0.0604	3.2690	0.1988	0.3842	0.3878	20.9929	0.0009

	STEEP	UAASHR	PASTURE	ORGAREA	MONCOW	FARMSIZE	FARMOCCP	GRAZING	NONGRAZ
1	0.0000	0.0737	0.3035	0.0078	0.0270	0.3935	0.3009	0.0218	0.0495
2	0.0120	0.1073	0.4221	0.0266	0.2092	0.4731	0.1817	0.0211	0.0382
3	0.0239	0.0404	0.7730	0.0218	0.3144	0.3619	0.2678	0.0572	0.0236
4	0.0014	0.2343	0.4370	0.0104	0.1128	0.4679	0.1432	0.0274	0.0760
5	0.0420	0.0382	0.8343	0.0263	0.3164	0.5311	0.3094	0.0623	0.0360
6	0.0075	0.1330	0.6660	0.0221	0.1732	0.4704	0.2415	0.0478	0.0480
7	0.0059	0.1866	0.5642	0.0156	0.1543	0.4597	0.1803	0.0396	0.0737
Total	0.0263	0.0761	0.7402	0.0229	0.2660	0.4694	0.2680	0.0542	0.0396

Source: Own calculations

Means for variables with 8 clusters

	ENERGY	POPDENS	FOODEMP	AGEMP	CENTRAL	UTMARK	NUTMARK	OLDBLDG	LOTSIZE	COTTGE
1	1054.4610	43.9935	0.0712	0.0297	2.8478	0.1342	0.3112	0.4114	15.6946	0.0005
2	1243.6650	245.2588	0.1111	0.0143	1.6471	0.1451	0.4616	0.4392	25.0647	0.0004
3	524.6593	3.1035	0.2056	0.1042	4.1047	0.2483	0.4124	0.3000	22.9961	0.0016
4	1155.7180	468.9818	0.1590	0.0129	1.2727	0.1389	0.5254	0.4876	32.0818	0.0008
5	956.2733	30.8400	0.1564	0.0429	2.0222	0.1500	0.4283	0.4402	33.6328	0.0003
6	1148.8000	1147.2000	0.1217	0.0035	1.3333	0.0549	0.2950	0.2979	15.7667	0.0000
7	1088.0100	101.7194	0.0975	0.0236	1.9355	0.1482	0.3973	0.4217	27.3613	0.0007
8	766.1577	7.6056	0.0921	0.0657	3.7806	0.2216	0.3635	0.3946	16.5525	0.0008
Total	822.6552	48.4878	0.1220	0.0604	3.2690	0.1988	0.3842	0.3878	20.9929	0.0009

	STEEP	UAASHR	PASTURE	ORGAREA	MONCOW	FARMSIZE	FARMOCCP	GRAZING	NONGRAZ
1	0.0082	0.0935	0.7946	0.0205	0.1855	0.5715	0.2652	0.0543	0.0593
2	0.0014	0.2343	0.4370	0.0104	0.1128	0.4679	0.1432	0.0274	0.0760
3	0.0262	0.0259	0.8253	0.0213	0.3225	0.3616	0.2770	0.0621	0.0200
4	0.0120	0.1073	0.4221	0.0266	0.2092	0.4731	0.1817	0.0211	0.0382
5	0.0151	0.1733	0.4417	0.0259	0.1930	0.3299	0.2008	0.0336	0.0439
6	0.0000	0.0737	0.3035	0.0078	0.0270	0.3935	0.3009	0.0218	0.0495
7	0.0058	0.1904	0.5508	0.0161	0.1578	0.4515	0.1815	0.0392	0.0637
8	0.0397	0.0382	0.8395	0.0257	0.3140	0.5287	0.3091	0.0624	0.0357
Total	0.0263	0.0761	0.7402	0.0229	0.2660	0.4694	0.2680	0.0542	0.0396

Source: Own calculations

Means for variables with 9 clusters

	ENERGY	POPDENS	FOODEMP	AGEMP	CENTRAL	UTMARK	NUTMARK	OLDBLDG	LOTSIZE	COTTGE
1	742.2302	6.0771	0.0927	0.0692	3.9106	0.2251	0.3614	0.3912	16.9374	0.0008
2	960.9909	30.2909	0.1646	0.0429	2.0909	0.1538	0.4385	0.4472	33.2517	0.0002
3	1148.8000	1147.2000	0.1217	0.0035	1.3333	0.0549	0.2950	0.2979	15.7667	0.0000
4	1243.6650	245.2588	0.1111	0.0143	1.6471	0.1451	0.4616	0.4392	25.0647	0.0004
5	511.8823	3.0241	0.2115	0.1057	4.0759	0.2601	0.4152	0.2955	23.0794	0.0017
6	1114.1220	112.0565	0.0808	0.0169	1.8261	0.1253	0.3883	0.4403	24.8435	0.0008
7	1155.7180	468.9818	0.1590	0.0129	1.2727	0.1389	0.5254	0.4876	32.0818	0.0008
8	1033.8320	59.8742	0.0851	0.0300	2.2903	0.1368	0.3598	0.3985	23.2315	0.0004
9	985.3813	25.6146	0.0840	0.0398	3.1042	0.1577	0.3277	0.4046	14.4974	0.0008
Total	822.6552	48.4878	0.1220	0.0604	3.2690	0.1988	0.3842	0.3878	20.9929	0.0009

	STEEP	UAASHR	PASTURE	ORGAREA	MONCOW	FARMSIZE	FARMOCCP	GRAZING	NONGRAZ
1	0.0397	0.0336	0.8336	0.0250	0.3199	0.5232	0.3117	0.0625	0.0332
2	0.0142	0.1692	0.4257	0.0255	0.2050	0.3295	0.2044	0.0315	0.0438
3	0.0000	0.0737	0.3035	0.0078	0.0270	0.3935	0.3009	0.0218	0.0495
4	0.0014	0.2343	0.4370	0.0104	0.1128	0.4679	0.1432	0.0274	0.0760
5	0.0273	0.0249	0.8392	0.0221	0.3227	0.3557	0.2745	0.0625	0.0175
6	0.0027	0.1560	0.5440	0.0167	0.1633	0.5080	0.1792	0.0362	0.0657
7	0.0120	0.1073	0.4221	0.0266	0.2092	0.4731	0.1817	0.0211	0.0382
8	0.0099	0.1634	0.6865	0.0166	0.1656	0.4531	0.2111	0.0522	0.0738
9	0.0210	0.0757	0.8537	0.0256	0.2236	0.5809	0.2942	0.0592	0.0488
Total	0.0263	0.0761	0.7402	0.0229	0.2660	0.4694	0.2680	0.0542	0.0396

Source: Own calculations

Means for variables with 10 clusters

	ENERGY	POPDENS	FOODEMP	AGEMP	CENTRAL	UTMARK	NUTMARK	OLDBLDG	LOTSIZE	COTTGE
1	1114.1220	112.0565	0.0808	0.0169	1.8261	0.1253	0.3883	0.4403	24.8435	0.0008
2	1243.6650	245.2588	0.1111	0.0143	1.6471	0.1451	0.4616	0.4392	25.0647	0.0004
3	1155.7180	468.9818	0.1590	0.0129	1.2727	0.1389	0.5254	0.4876	32.0818	0.0008
4	780.6957	6.4833	0.0813	0.0671	3.8623	0.2353	0.3638	0.4069	15.9638	0.0008
5	960.9909	30.2909	0.1646	0.0429	2.0909	0.1538	0.4385	0.4472	33.2517	0.0002
6	404.2833	2.0600	0.2162	0.0914	4.4000	0.1783	0.3392	0.2632	22.9158	0.0016
7	1148.8000	1147.2000	0.1217	0.0035	1.3333	0.0549	0.2950	0.2979	15.7667	0.0000
8	605.8398	4.4333	0.1692	0.0952	3.9032	0.2551	0.4112	0.3254	21.5439	0.0012
9	986.4133	26.3867	0.0866	0.0397	3.1778	0.1531	0.3248	0.4104	14.5973	0.0008
10	1033.8320	59.8742	0.0851	0.0300	2.2903	0.1368	0.3598	0.3985	23.2315	0.0004
Total	822.6552	48.4878	0.1220	0.0604	3.2690	0.1988	0.3842	0.3878	20.9929	0.0009

	STEEP	UAASHR	PASTURE	ORGAREA	MONCOW	FARMSIZE	FARMOCCP	GRAZING	NONGRAZ
1	0.0027	0.1560	0.5440	0.0167	0.1633	0.5080	0.1792	0.0362	0.0657
2	0.0014	0.2343	0.4370	0.0104	0.1128	0.4679	0.1432	0.0274	0.0760
3	0.0120	0.1073	0.4221	0.0266	0.2092	0.4731	0.1817	0.0211	0.0382
4	0.0393	0.0339	0.8368	0.0252	0.3278	0.5445	0.3176	0.0623	0.0352
5	0.0142	0.1692	0.4257	0.0255	0.2050	0.3295	0.2044	0.0315	0.0438
6	0.0123	0.0122	0.8647	0.0157	0.2938	0.3614	0.2934	0.0594	0.0180
7	0.0000	0.0737	0.3035	0.0078	0.0270	0.3935	0.3009	0.0218	0.0495
8	0.0375	0.0332	0.8260	0.0254	0.3168	0.4038	0.2778	0.0635	0.0214
9	0.0223	0.0776	0.8504	0.0257	0.2217	0.5798	0.2920	0.0594	0.0506
10	0.0099	0.1634	0.6865	0.0166	0.1656	0.4531	0.2111	0.0522	0.0738
Total	0.0263	0.0761	0.7402	0.0229	0.2660	0.4694	0.2680	0.0542	0.0396

Source: Own calculations

Means for variables with 15 clusters

	ENERGY	POPDENS	FOODEMP	AGEMP	CENTRAL	UTMARK	NUTMARK	OLDBLDG	LOTSIZE	COTTGE
1	602.1683	3.0805	0.0978	0.0964	4.2195	0.2321	0.4006	0.3296	19.7534	0.0014
2	1108.7310	41.0269	0.0385	0.0209	2.8077	0.1615	0.2821	0.3969	12.1837	0.0004
3	890.4605	17.4884	0.0864	0.0456	3.1628	0.1456	0.3499	0.4387	16.8488	0.0009
4	1243.6650	245.2588	0.1111	0.0143	1.6471	0.1451	0.4616	0.4392	25.0647	0.0004
5	923.2545	22.6318	0.1726	0.0500	2.0000	0.1764	0.4531	0.4338	36.3909	0.0003
6	377.0889	1.9000	0.1959	0.0909	4.5556	0.1018	0.2824	0.2654	23.5763	0.0007
7	1035.1570	71.1522	0.0725	0.0281	2.6087	0.1356	0.3732	0.3947	25.2729	0.0011
8	734.5714	8.8810	0.1747	0.0664	3.3095	0.1859	0.3310	0.3742	20.6731	0.0006
9	1155.7180	468.9818	0.1590	0.0129	1.2727	0.1389	0.5254	0.4876	32.0818	0.0008
10	1148.8000	1147.2000	0.1217	0.0035	1.3333	0.0549	0.2950	0.2979	15.7667	0.0000
11	908.8500	6.9971	0.0591	0.0542	3.2647	0.2211	0.3398	0.4201	12.6618	0.0001
12	1013.4890	38.9429	0.2101	0.0506	2.0357	0.1371	0.4253	0.4324	31.7179	0.0001
13	682.0000	3.5224	0.0656	0.0752	4.5522	0.2748	0.3864	0.3940	15.4448	0.0013
14	1137.7060	119.6833	0.0970	0.0178	1.5556	0.1301	0.4208	0.4636	26.8111	0.0002
15	512.7762	2.7905	0.2376	0.1098	4.0000	0.3234	0.4605	0.2858	22.4738	0.0019
Total	822.6552	48.4878	0.1220	0.0604	3.2690	0.1988	0.3842	0.3878	20.9929	0.0009

	STEEP	UAASHR	PASTURE	ORGAREA	MONCOW	FARMSIZE	FARMOCCP	GRAZING	NONGRAZ
1	0.0286	0.0241	0.8283	0.0278	0.3029	0.4373	0.3105	0.0632	0.0207
2	0.0085	0.0651	0.8785	0.0259	0.1686	0.6560	0.2916	0.0569	0.0611
3	0.0313	0.0707	0.7913	0.0250	0.2855	0.5372	0.2665	0.0553	0.0474
4	0.0014	0.2343	0.4370	0.0104	0.1128	0.4679	0.1432	0.0274	0.0760
5	0.0037	0.1556	0.3816	0.0205	0.2015	0.3234	0.1827	0.0281	0.0487
6	0.0115	0.0103	0.8452	0.0069	0.2658	0.3352	0.3063	0.0574	0.0215
7	0.0066	0.1840	0.6237	0.0165	0.1331	0.4080	0.2095	0.0494	0.0619
8	0.0429	0.0524	0.7994	0.0274	0.2604	0.4117	0.2841	0.0603	0.0285
9	0.0120	0.1073	0.4221	0.0266	0.2092	0.4731	0.1817	0.0211	0.0382
10	0.0000	0.0737	0.3035	0.0078	0.0270	0.3935	0.3009	0.0218	0.0495
11	0.0440	0.0287	0.8163	0.0159	0.3136	0.6185	0.3255	0.0589	0.0416
12	0.0069	0.1974	0.4789	0.0247	0.1899	0.3502	0.2042	0.0377	0.0451
13	0.0447	0.0207	0.8985	0.0306	0.3662	0.5489	0.3445	0.0690	0.0334
14	0.0021	0.1711	0.5010	0.0152	0.1766	0.4866	0.1650	0.0335	0.0675
15	0.0371	0.0235	0.8640	0.0223	0.3668	0.3709	0.2470	0.0653	0.0169
Total	0.0263	0.0761	0.7402	0.0229	0.2660	0.4694	0.2680	0.0542	0.0396

Source: Own calculations

Annex 3: List of municipalities in the clusters

Municipality	Name	6	7	8	9	10	15
0101	Halden	1	6	5	2	5	12
0104	Moss	2	2	4	7	3	9
0105	Sarpsborg	3	7	7	6	1	14
0106	Fredrikstad	5	4	2	4	2	4
0111	Hvaler	1	6	1	9	9	2
0118	Aremark	6	5	8	1	4	13
0119	Marker	6	5	8	1	8	8
0121	Rømskog	6	5	8	1	4	11
0122	Trøgstad	6	3	5	2	5	5
0123	Spydeberg	1	3	5	2	5	5
0124	Askim	5	4	2	4	2	4
0125	Eidsberg	1	6	5	2	5	12
0127	Skiptvet	1	6	5	2	5	5
0128	Rakkestad	6	3	3	5	8	5
0135	Rade	1	6	5	2	5	12
0136	Rygge	3	7	7	6	1	14
0137	Valer	6	5	8	1	4	8
0138	Hobøl	1	6	5	2	5	5
0211	Vestby	3	7	7	8	10	7
0213	Ski	3	7	7	6	1	14
0214	As	3	7	7	6	1	14
0215	Frogn	3	7	7	6	1	14
0216	Nesodden	5	4	2	4	2	4
0217	Oppegard	2	2	4	7	3	9
0219	Bærum	2	2	4	7	3	9
0220	Asker	2	2	4	7	3	9
0221	Aurskog-Høland	6	5	8	1	8	8
0226	Sørum	1	6	5	2	5	12
0227	Fet	1	6	1	8	10	12
0228	Rælingen	5	4	2	4	2	4
0229	Enebakk	1	6	5	2	5	12
0230	Lørenskog	2	2	4	7	3	9
0231	Skedsmo	2	2	4	7	3	9
0233	Nittedal	3	7	7	6	1	14
0234	Gjerdrum	1	6	5	2	5	12
0235	Ullensaker	3	7	7	8	10	7
0236	Nes	6	3	5	2	5	5
0237	Eidsvoll	1	6	5	2	5	12
0238	Nannestad	1	3	5	2	5	5
0239	Hurdal	6	5	8	1	4	11
0301	Oslo	4	1	6	3	7	10

Municipality	Name	6	7	8	9	10	15
0402	Kongsvinger	6	5	8	1	4	3
0403	Hamar	3	7	7	6	1	14
0412	Ringsaker	1	3	5	2	5	5
0415	Løten	6	3	5	2	5	5
0417	Stange	1	3	5	2	5	5
0418	Nord-Odal	6	5	8	1	4	11
0419	Sør-Odal	6	5	8	1	4	8
0420	Eidskog	6	5	8	1	4	11
0423	Grue	6	3	3	1	8	1
0425	Asnes	6	3	3	1	8	1
0426	Valer	6	3	3	5	8	15
0427	Elverum	6	5	8	1	4	8
0428	Trysil	6	5	8	1	4	13
0429	Amot	6	3	3	5	8	1
0430	Stor-Elvdal	6	3	3	5	8	1
0432	Rendalen	6	3	3	5	8	1
0434	Engerdal	6	3	3	5	8	1
0436	Tolga	6	3	3	5	6	15
0437	Tynset	6	3	3	5	6	6
0438	Alvdal	6	3	3	5	8	15
0439	Folldal	6	3	3	5	6	6
0441	Os	6	3	3	5	8	15
0501	Lillehammer	3	7	7	8	10	7
0502	Gjøvik	1	6	5	8	10	12
0511	Dovre	6	3	3	5	6	6
0512	Lesja	6	3	3	5	6	6
0513	Skjak	6	3	3	5	6	6
0514	Lom	6	3	3	5	8	15
0515	Vaga	6	3	3	5	8	15
0516	Nord-Fron	6	3	3	5	8	15
0517	Sel	6	3	3	5	8	15
0519	Sør-Fron	6	3	3	5	8	15
0520	Ringebu	6	3	3	5	8	15
0521	Øyer	6	3	8	1	8	8
0522	Gausdal	6	3	3	5	6	15
0528	Østre Toten	1	6	5	2	5	5
0529	Vestre Toten	1	6	5	8	10	7
0532	Jevnaker	1	6	5	2	5	12
0533	Lunner	1	6	5	2	5	12
0534	Gran	6	5	8	2	5	8
0536	Søndre Land	6	5	8	1	8	8
0538	Nordre Land	6	3	3	5	8	1
0540	Sør-Aurdal	6	5	8	1	4	13
0541	Etnedal	6	3	3	5	8	1
0542	Nord-Aurdal	6	5	8	1	8	8
0543	Vestre Slidre	6	3	3	5	8	1

Municipality	Name	6	7	8	9	10	15
0544	Øystre Slidre	6	3	3	5	8	15
0545	Vang	6	3	3	5	8	1
0602	Drammen	2	2	4	7	3	9
0604	Kongsberg	1	6	5	2	5	12
0605	Ringerike	6	3	5	2	5	5
0612	Hole	1	3	5	2	5	5
0615	Fla	6	5	8	1	4	13
0616	Nes	6	5	8	1	4	13
0617	Gol	6	3	8	1	8	8
0618	Hemsedal	6	3	3	5	8	15
0619	Al	6	3	3	5	8	15
0620	Hol	6	3	3	5	8	15
0621	Sigdal	6	5	8	1	8	1
0622	Krødsherad	6	5	8	1	4	13
0623	Modum	1	5	5	9	9	3
0624	Øvre Eiker	1	6	5	2	5	12
0625	Nedre Eiker	5	4	2	4	2	4
0626	Lier	3	6	1	8	10	7
0627	Røyken	3	7	7	6	1	14
0628	Hurum	1	6	1	2	5	12
0631	Flesberg	6	5	8	1	4	13
0632	Rollag	6	5	8	1	4	13
0633	Nore og Uvdal	6	5	8	1	8	1
0701	Borre	5	4	2	4	2	4
0702	Holmestrand	3	7	7	6	1	7
0704	Tønsberg	5	4	2	4	2	4
0706	Sandefjord	5	4	2	4	2	4
0709	Larvik	1	6	1	8	10	7
0711	Svelvik	3	7	7	6	1	14
0713	Sande	1	6	5	2	5	12
0714	Hof	6	5	8	1	4	3
0716	Vale	1	6	5	2	5	12
0718	Ramnes	6	5	8	9	9	3
0719	Andebu	1	5	8	9	9	3
0720	Stokke	1	6	1	8	10	7
0722	Nøtterøy	5	4	2	4	2	4
0723	Tjøme	3	7	7	6	1	7
0728	Lardal	6	5	8	1	4	8
0805	Porsgrunn	5	4	2	4	2	4
0806	Skien	1	6	1	8	10	7
0807	Notodden	6	5	8	1	4	3
0811	Siljan	6	5	8	1	4	11
0814	Bamble	1	6	1	9	9	2
0815	Kragerø	1	6	1	9	9	2
0817	Drangedal	6	5	8	1	4	11
0819	Nome	6	5	8	1	4	3

Municipality	Name	6	7	8	9	10	15
0821	Bø	6	5	8	1	4	3
0822	Sauherad	6	5	8	1	4	3
0826	Tinn	6	5	8	1	4	13
0827	Hjartdal	6	5	8	1	4	13
0828	Seljord	6	5	8	1	4	13
0829	Kviteseid	6	5	8	1	4	13
0830	Nissedal	6	5	8	1	4	11
0831	Fyresdal	6	5	8	1	4	13
0833	Tokke	6	5	8	1	4	13
0834	Vinje	6	5	8	1	8	1
0901	Risør	1	6	1	9	9	2
0904	Grimstad	1	6	1	8	10	2
0906	Arendal	3	7	7	6	1	14
0911	Gjerstad	6	5	8	1	4	11
0912	Vegardshei	6	5	8	1	4	11
0914	Tvedestrand	1	5	8	9	9	3
0919	Froland	6	5	8	1	4	11
0926	Lillesand	1	6	1	9	9	2
0928	Birkenes	6	5	8	1	4	11
0929	Amli	6	5	8	1	4	13
0935	Iveland	6	5	8	1	4	11
0937	Evje og Hornnes	6	5	8	1	4	11
0938	Bygland	6	5	8	1	4	13
0940	Valle	6	5	8	1	4	13
0941	Bykle	6	3	3	5	6	15
1001	Kristiansand	5	4	2	4	2	4
1002	Mandal	1	6	1	8	10	2
1003	Farsund	1	6	1	9	9	2
1004	Flekkefjord	6	5	8	9	9	3
1014	Vennesla	1	6	1	9	9	2
1017	Songdalen	1	5	8	9	9	3
1018	Søgne	1	6	1	8	10	2
1021	Marnardal	6	5	8	1	4	11
1026	Aseral	6	5	8	1	4	13
1027	Audnedal	6	5	8	1	4	11
1029	Lindesnes	6	5	8	9	4	11
1032	Lyngdal	6	5	8	9	9	3
1034	Hægebostad	6	5	8	1	4	13
1037	Kvinesdal	6	5	8	1	4	11
1046	Sirdal	6	5	8	1	4	13
1101	Eigersund	1	6	5	2	5	12
1102	Sandnes	5	4	2	4	2	4
1103	Stavanger	4	1	6	3	7	10
1106	Haugesund	2	2	4	7	3	9
1111	Sokndal	6	5	8	1	4	11
1112	Lund	6	5	8	1	4	8

Municipality	Name	6	7	8	9	10	15
1114	Bjerkreim	6	3	3	5	8	15
1119	Ha	1	6	5	8	10	12
1120	Klepp	3	7	7	6	1	14
1121	Time	3	7	7	8	10	7
1122	Gjesdal	6	3	3	5	8	5
1124	Sola	5	4	2	4	2	4
1127	Randaberg	5	4	2	4	2	4
1129	Forsand	6	3	3	5	8	1
1130	Strand	1	6	1	8	10	12
1133	Hjelmeland	6	3	3	1	8	1
1134	Suldal	6	5	8	1	4	13
1135	Sauda	6	5	8	1	4	8
1141	Finnøy	1	5	8	9	9	3
1142	Rennesøy	1	6	5	2	5	12
1144	Kvitsøy	3	7	7	8	10	7
1145	Bokn	6	5	8	1	4	3
1146	Tysvær	6	5	8	9	9	3
1149	Karmøy	3	7	7	6	1	14
1151	Utsira	1	6	1	9	9	2
1154	Vindafjord	6	5	8	1	4	8
1201	Bergen	2	2	4	7	3	9
1211	Etne	6	5	8	1	8	1
1214	Ølen	6	5	8	1	4	3
1216	Sveio	6	5	8	9	4	3
1219	Bømlo	1	6	1	9	9	2
1221	Stord	3	7	7	6	1	14
1222	Fitjar	1	5	8	9	9	3
1223	Tysnes	6	5	8	1	4	11
1224	Kvinnherad	6	5	8	1	4	3
1227	Jondal	6	5	8	1	4	11
1228	Odda	6	5	8	1	4	13
1231	Ullensvang	6	5	8	1	4	11
1232	Eidfjord	6	5	8	1	4	13
1233	Ulvik	6	5	8	1	4	13
1234	Granvin	6	5	8	1	4	11
1235	Voss	6	5	8	1	8	8
1238	Kvam	6	5	8	9	9	3
1241	Fusa	6	5	8	1	4	11
1242	Samnanger	6	5	8	1	4	11
1243	Os	3	7	7	6	1	14
1244	Austevoll	1	6	1	9	9	2
1245	Sund	1	6	1	8	10	2
1246	Fjell	3	7	7	6	1	14
1247	Askøy	5	4	2	4	2	4
1251	Vaksdal	6	5	8	1	4	11
1252	Modalen	6	5	8	1	4	13

Municipality	Name	6	7	8	9	10	15
1253	Osterøy	1	6	1	9	9	3
1256	Meland	1	6	1	8	10	2
1259	Øygarden	1	6	1	8	10	2
1260	Radøy	1	6	1	9	9	2
1263	Lindas	1	6	1	9	9	3
1264	Austrheim	1	6	1	9	9	2
1265	Fedje	3	6	1	8	10	7
1266	Masfjorden	6	5	8	1	4	11
1401	Flora	1	5	8	9	9	3
1411	Gulen	6	5	8	1	4	13
1412	Solund	6	5	8	1	4	13
1413	Hyllestad	6	5	8	1	4	13
1416	Høyanger	6	5	8	1	4	13
1417	Vik	6	5	8	1	4	13
1418	Balestrand	6	5	8	1	4	13
1419	Leikanger	6	5	8	9	9	3
1420	Sogndal	6	5	8	1	4	8
1421	Aurland	6	5	8	1	4	13
1422	Lærdal	6	3	3	1	8	1
1424	Ardal	6	5	8	1	8	8
1426	Luster	6	5	8	1	8	1
1428	Askvoll	6	5	8	1	4	8
1429	Fjaler	6	5	8	1	4	13
1430	Gaular	6	5	8	1	8	1
1431	Jølster	6	3	3	5	8	15
1432	Førde	1	6	5	2	5	12
1433	Naustdal	6	5	8	1	8	8
1438	Bremanger	6	5	8	1	4	13
1439	Vagsøy	1	6	1	8	10	2
1441	Selje	6	5	8	1	4	3
1443	Eid	6	5	8	1	4	3
1444	Hornindal	6	5	8	1	4	8
1445	Gloppen	6	5	8	1	8	8
1449	Stryn	6	5	8	1	4	13
1502	Molde	3	7	7	6	1	7
1503	Kristiansund	4	1	6	3	7	10
1504	Alesund	2	2	4	7	3	9
1511	Vanylven	6	5	8	1	4	3
1514	Sande	1	6	1	9	9	3
1515	Herøy	3	7	7	6	1	7
1516	Ulstein	3	7	7	6	1	14
1517	Hareid	3	7	1	8	10	7
1519	Volda	1	5	8	9	9	3
1520	Ørsta	6	5	8	1	4	3
1523	Ørskog	1	5	8	9	9	3
1524	Norddal	6	5	8	1	4	13

Municipality	Name	6	7	8	9	10	15
1525	Stranda	6	5	8	1	4	13
1526	Stordal	6	5	8	1	4	13
1528	Sykkylven	1	6	1	9	9	2
1529	Skodje	1	6	1	9	9	2
1531	Sula	5	4	2	4	2	4
1532	Giske	5	4	2	4	2	4
1534	Haram	1	6	1	8	10	2
1535	Vestnes	1	6	5	9	9	3
1539	Rauma	6	5	8	1	4	13
1543	Nesset	6	5	8	1	8	1
1545	Midsund	1	6	1	9	9	3
1546	Sandøy	3	6	1	8	10	7
1547	Aukra	1	6	1	8	10	7
1548	Fræna	1	6	5	2	5	12
1551	Eide	1	6	5	2	5	5
1554	Averøy	1	6	1	9	9	2
1556	Frei	3	7	7	6	1	14
1557	Gjemnes	6	5	8	1	4	8
1560	Tingvoll	6	5	8	1	4	11
1563	Sunndal	6	5	8	1	8	1
1566	Surnadal	6	5	8	1	8	1
1567	Rindal	6	3	3	5	8	15
1569	Aure	6	5	8	1	4	13
1571	Halsa	6	5	8	1	4	13
1572	Tustna	6	5	8	1	4	11
1573	Smøla	6	5	8	1	4	13
1601	Trondheim	2	2	4	7	3	9
1612	Hemne	6	5	8	1	4	8
1613	Snillfjord	6	5	8	1	4	13
1617	Hitra	6	5	8	1	4	11
1620	Frøya	6	5	8	9	9	3
1621	Ørland	3	7	7	8	10	7
1622	Agdenes	6	5	8	1	4	13
1624	Rissa	6	5	8	1	4	8
1627	Bjugn	6	5	8	1	4	8
1630	Afjord	6	5	8	1	4	13
1632	Roan	6	5	8	1	8	1
1633	Osen	6	5	8	1	4	13
1634	Oppdal	6	3	3	5	6	6
1635	Rennebu	6	3	3	5	6	6
1636	Meldal	6	3	3	5	8	15
1638	Orkdal	1	3	5	2	5	5
1640	Røros	6	3	3	5	8	15
1644	Holtalen	6	3	3	5	8	1
1648	Midtre Gauldal	6	3	3	5	8	15
1653	Melhus	1	3	5	2	5	5

Municipality	Name	6	7	8	9	10	15
1657	Skaun	1	6	5	2	5	12
1662	Klæbu	1	6	5	2	5	5
1663	Malvik	3	7	7	8	10	7
1664	Selbu	6	3	3	5	8	1
1665	Tydal	6	3	3	5	6	15
1702	Steinkjer	6	3	3	5	8	5
1703	Namsos	6	5	8	9	9	3
1711	Meraker	6	3	3	5	8	15
1714	Stjørdal	1	6	5	2	5	5
1717	Frosta	1	6	1	9	9	12
1718	Leksvik	6	5	8	1	4	8
1719	Levanger	1	6	5	2	5	5
1721	Verdal	6	3	3	5	6	15
1723	Mosvik	6	5	8	1	4	13
1724	Verran	6	3	8	1	8	1
1725	Mandalseid	6	3	3	5	8	15
1729	Inderøy	1	6	1	2	5	12
1736	Snasa	6	3	3	5	8	15
1738	Lierne	6	3	3	5	6	15
1739	Røyrvik	6	3	3	5	6	15
1740	Namskogan	6	3	3	5	6	15
1742	Grong	6	3	3	5	8	15
1743	Høylandet	6	3	3	5	8	15
1744	Overhalla	6	3	3	5	8	1
1748	Fosnes	6	3	3	5	8	1
1749	Flatanger	6	5	8	1	4	13
1750	Vikna	6	5	8	1	4	11
1751	Nærøy	6	5	8	1	4	13
1755	Leka	6	5	8	1	4	13
1804	Bodø	3	7	7	8	10	7
1805	Narvik	6	5	8	9	4	3
1811	Bindal	6	5	8	1	4	13
1812	Sømna	6	3	8	1	8	8
1813	Brønnøy	6	5	8	1	4	8
1815	Vega	6	5	8	1	4	11
1816	Vevelstad	6	3	3	5	8	1
1818	Herøy	1	6	1	9	9	2
1820	Alstahaug	1	6	5	2	5	12
1822	Leirfjord	6	5	8	1	8	1
1824	Vefsn	6	3	8	1	8	8
1825	Grane	6	5	8	1	8	1
1826	Hattfjelldal	6	3	3	5	8	1
1827	Dønna	6	5	8	1	4	8
1828	Nesna	6	5	8	1	8	8
1832	Hemnes	6	3	3	5	8	15
1833	Rana	6	5	8	1	8	8

Municipality	Name	6	7	8	9	10	15
1834	Lurøy	6	5	8	1	4	13
1835	Træna	1	6	1	9	9	2
1836	Rødøy	6	5	8	1	4	13
1837	Meløy	6	5	8	1	8	8
1838	Gildeskal	6	5	8	1	4	13
1839	Beiarn	6	5	8	1	4	13
1840	Saltdal	6	5	8	1	4	13
1841	Fauske	6	5	8	1	4	8
1842	Skjerstad	6	5	8	1	4	13
1845	Sørfold	6	5	8	1	4	11
1848	Steigen	6	5	8	1	8	1
1849	Hamarøy	6	5	8	1	4	13
1850	Tysfjord	6	5	8	1	4	13
1851	Lødingen	6	5	8	1	4	13
1852	Tjeldsund	6	5	8	1	4	8
1853	Evenes	6	5	8	1	4	13
1854	Ballangen	6	5	8	1	4	13
1856	Røst	3	7	7	6	1	7
1857	Værøy	1	6	1	8	10	7
1859	Flakstad	6	5	8	1	8	8
1860	Vestvagøy	1	6	1	2	5	12
1865	Vagan	1	6	1	9	9	2
1866	Hadsel	1	6	8	9	9	3
1867	Bø	1	5	8	9	9	3
1868	Øksnes	1	6	8	9	9	3
1870	Sortland	1	5	8	9	9	3
1871	Andøy	6	5	8	1	4	3
1874	Moskenes	6	5	5	2	5	8
1901	Harstad	3	7	7	6	1	14
1902	Tromsø	1	6	1	8	10	12
1911	Kvæfjord	6	5	8	1	4	8
1913	Skanland	6	5	8	1	4	8
1915	Bjarkøy	6	5	8	1	8	8
1917	Ibestad	6	5	8	1	4	11
1919	Gratangen	6	5	8	1	4	11
1920	Lavangen	6	5	8	1	4	13
1922	Bardu	6	3	3	5	8	15
1923	Salangen	6	5	8	1	4	13
1924	Malselv	6	3	3	5	8	15
1925	Sørreisa	6	5	8	1	8	8
1926	Dyrøy	6	5	8	1	4	13
1927	Tranøy	6	5	8	1	4	13
1928	Torsken	6	3	3	1	8	1
1929	Berg	6	3	8	1	8	1
1931	Lenvik	1	5	5	2	5	3
1933	Balsfjord	6	3	3	1	8	1

Municipality	Name	6	7	8	9	10	15
1936	Karlsøy	6	5	8	1	8	1
1938	Lyngen	6	3	8	1	8	1
1939	Storfjord	6	3	3	1	8	1
1940	Kafjord	6	5	8	1	8	1
1941	Skjervøy	6	3	3	5	8	8
1942	Nordreisa	6	3	3	5	6	15
1943	Kvænangen	6	3	3	5	8	15
2002	Vardø	6	3	3	5	6	6
2003	Vadsø	6	3	3	5	6	6
2004	Hammerfest	1	3	5	2	5	5
2011	Kautokeino	6	3	3	5	6	6
2012	Alta	6	3	3	5	6	15
2014	Loppa	6	5	8	1	8	1
2015	Hasvik	6	5	8	1	4	13
2017	Kvalsund	6	3	3	5	8	15
2018	Masøy	6	3	3	5	6	6
2019	Nordkapp	6	3	3	5	6	6
2020	Porsanger	6	3	3	5	8	15
2021	Karasjok	6	3	3	5	6	6
2022	Lebesby	6	3	3	5	6	6
2023	Gamvik	6	3	3	5	6	15
2024	Berlevag	6	3	3	5	6	6
2025	Tana	6	3	3	5	6	6
2027	Nesseby	6	3	3	5	6	6
2028	Batsfjord	6	3	3	5	6	6
2030	Sør-Varanger	6	3	3	5	6	15

Source: Own calculations.