Animal production and climate variation in the Faeroe Islands in the 19th century

Rolf Guttesen

Abstract

The article deals with aspects of the historical geography of the Faeroe Islands in the 19th century with a focus on animal production, i.e. sheep and cows. It is based on material from the Regional Archive, Føroya Landsskjalasavn. The tithe lists showing the King's third from Norderöe district, 1801-1859, are analysed in detail and compared with the statements from another series of documents, the Sheriff's half-yearly reports on the state of the district. Together these two sets of records give a detailed picture of the development and variation in the number of cows, paying "butter-tithe" and the number of sheep slaughtered, paying "wool-tithe". The number of cows surviving the winter, depended on the amount and quality of winter fodder or hay, which was produced in the infield the preceding summer. The sheep, on the other hand, that can survive the winter while grazing in the outfield, are dependent on the severity or mildness of the winter as well as their condition in the lambing period. The two series provide data on summer as well as winter weather conditions. The analysis makes an attempt, using the concepts known from the critical realist theory of science, to find the mechanisms as well as necessary and contingent conditions involved in the two processes.

Keywords

Faeroe Islands, historical agriculture, tithe lists, cows, sheep, agricultural systems, proxy data, climatic variation.

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Geografisk Tidsskrift
Danish Journal of Geography 103(2): 81-91, 2003

The old Faeroese peasant society was based on the rearing of cattle for milk, sheep for mutton and wool for export, barley for bread and fishing especially in the spring season supplemented by fowling in a few villages. During the 19th century some fundamental developments took place that transformed the economic base of the society by launching large scale fishing.

Several works describe these changes in a qualitative way, e.g. Joensen (1987). In an article by Guttesen (1999), the importance of the cows was underlined as milk supplied the population with about 40 % of the calorific intake in 1813, the year when the so-called Loebner Tables, a population and agricultural census, were compiled. Furthermore, the plant production on a farm on Norðoyri was described, based on the unique Diaries of the Matras peasants, in Guttesen (2001a & 2001b), and a generalized description of the changing weather condition was presented for the first time. The importance of the introduction of the potato was underlined, as well as the continuous relationship with the climate variations. Further searches in Føroya Landsskjalasavn (FLS), the regional archive in Tórshavn, have produced new evidence on the animal production. The object of this article is to describe, present and discuss fresh information on cows and sheep and the influence of variations in climatic conditions. Newly compiled time-series are evaluated as climate proxy data, and some methodological problems are examined.

To avoid misunderstandings all personal names, placenames and other central appellations are written in the form that they usually appear in the records, and no effort is made to modernize them to either contemporary Danish or Faroese. In Figure 1, though, the modern Faeroese names are added for convenience.

The historical geographer often works with information drawn from different records and archives. This scientific work might be compared to some kind of archaeological excavation. You cannot just go in and pick up the wanted information, because you cannot see what is beneath the surface. But when a number of trial trenches have been dug, you have a limited idea of what material of interest may be found. Working in archives is very time consuming and the search is rarely finished. So, as in archaeology, interim reports are a necessity.

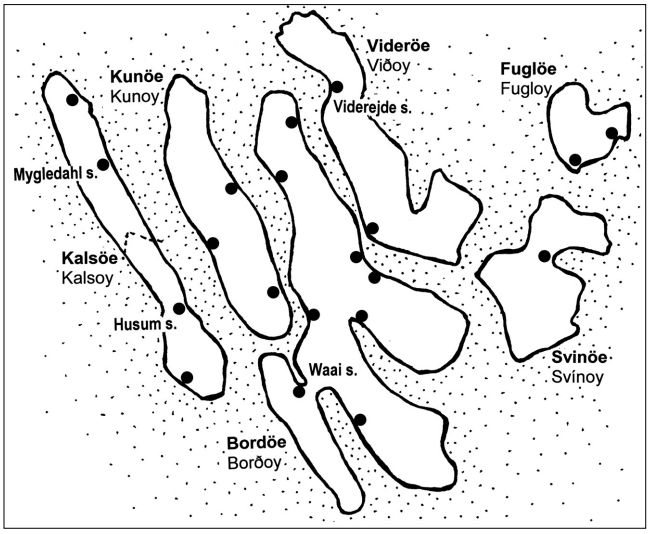

Figure 1: *Norderöe Syssel (Norðoya Sýsla) with its parishes and villages (black dots). When parish names do not correspond to the island names, the names are specially mentioned on the map. The names are spelled in the old way as in the documents, with the modern Faeroese version below.*

The Faeroese tithe lists

According to the Norwegian Law made by King Christian V in 1687, owners or users of land had to pay a tithe, an ecclesiastical tax, which is one tenth of the agricultural production or catches from the sea. Prior to the Reformation in the 16th century, the tithe was usually divided into three, one part to the bishop, one to the clergyman and one to the church. After the Reformation the bishop's part went to the King. Zachariassen (1961:13-14 and 72) refers to a period in the 17th century when the tithe was divided into four parts, the fourth part being given to the poor. According to the records the main objects for the taxation in the Faeroe Islands were grain, butter from the cows, wool from each slaughtered lamb or sheep, as well as catches of fish, birds and whales.

The conditions for tithe paying in the Faeroe Islands are regulated by tradition and by several statutory instruments, the latter collected in Bang and Bærentsen (1901). The problem for today is how to interpret these old laws and traditions? The oldest regulation described in Bang and Bærentsen is from 1691 and says that a tithe is to be paid "according to old practice", but it continues "from now on tithe shall only be paid of the sheep slaughtered". The first sentence explains nothing, but the second describes the rule as it was practised in the 19th century.

The collection and control system was laid down in "Rescript from 6. November 1776". The main points are, that in every village two attendants were nominated for a three year period. Furthermore a number of people were involved in a system that both offers support and control: the attendants, the churchwarden, the clergyman, the local sheriff (sysselmand) and above these the bailiff (landfoged). Informing was rewarded, as the informer received half of any fine.

It was the local sheriff's duty to organize the collection of the tithe in each district (syssel). The sheriff in Norderöe district 1801-1857 was Samuel Michael Matras who was one of the writers of the so-called "Matras-diaries" (FLS-a), described in Guttesen (2001a). One of sheriff Matras's memos from 1853 is found in the archive (FLS-b). It shows clearly that things were well organised, and that the possibilities for swindling and evasion were small, though some cases appeared at the local court (vårting).The memo shows that the sheriff made three yearly official visits to the parishes and villages in the district, and that he was accompanied by two assistants (kaldsmænd).

The first tour in 1853 took place from March 4th to 15th, the second from July 11th to 19th, and the third from august 15th to 19th. For each tour he noted a general and a special part. The general part lists affairs that are related to all villages, such as the collection of taxes, beak duty (næbtold), the revision of the boat list, the inspection of whaling weapons, revision of the list of conveyance men (skydsskaffere), servants, tithe inspectors and other positions of trust. The special part mention matters to be solved in the different villages, e.g. the calling in of debt from named persons, registration of the estates of the deceased, the inspection of bridges and roads, and the appointment of tithe collectors.

The lists of the King's tithe

The documents in the FLS-archive relating to the different forms of tithe and the different levels of the collection system are numerous but arranged awkwardly. Two collections of tithe lists, covering long and nearly continuous periods, have been found. One is from Norderöe Syssel covering the period 1801-59 (FLS-c), the other from Strömöe Syssel covering 1807-1907 (FLS-g) and both have the heading "Tithe account" (Tienderegnskab). It concerns the above mentioned King's tithe that is one third of the total. It is noteworthy that the same form and statements were used for more than 100 years, only the num-

	Unwashed wool		Cows		Fish
	W	pd	Number	W	pd
Mÿgledals Sogn	2	6 2/3	11 5/12	2	16
Husum Sogn	1	35 1/3	11 5/8	2	25
Kunöe Sogn	3	26 1/3	13 1/3	1	21
Waai Sogn	6	9 2/3	22 7/12	1	31
Svinöe Sogn	1	1 2/3	9 7/12	0	31
Fuglöe Sogn	1	27 0/3	9 1/12	1	15
Wideröe Sogn	4	2 2/3	16 1/4	2	12
Summa	21	19 1/3	94 11/12	12	20

Table 1: *The first preserved tithe account, King's tithe, Norderöe Syssel 1801. The units used are: W for Wog á 36 pounds, pd for pound (c.½ kg).*

bers in the table are updated yearly. To present the main content of the series, Table 1 is presented and shows the preserved tithe account from Norderöe Syssel from 1801.

According to the fixed form that is repeated each year, 1 Wog (18 kg) of butter was paid for every 16 cows. 1 Wog of unwashed wool was paid for every 80 sheep and lambs that were slaughtered. For three of the villages in Strömöe Syssel the wool tithe was paid in cash, 1 Gylden (Guilder) for every 50 lambs or sheep slaughtered. With these conversion relationships it is easy to convert the numbers in the table to real numbers of cows and sheep.

The reliability of the tithe lists

The tithe has been sporadically analysed by some Faeroese authors. But the data presented in this article has never been published before. Zachariassen (1961) discusses the oldest known records for King's tithe covering the period 1584 to 1654, with some lacunae. In different parts of his three-volume opus, Bjørk (1956-63) discusses problems related to the tithe. He cites Den færøske Landbokommission (1911) for this consideration on the reliability of the wool-tithe:

"Wool tithe was paid in common by the whole out-field ownership. If one owner intended to swindle, the other ones had to agree, and this must be considered morally impossible". (Bjørk vol.1;223).

But in those few cases when a single owner was responsible for the whole outfield, the situation is different.

So, it may be assumed with some confidence that the tithe lists give a fair and correct picture of the situation. But one other problem remains - exactly who is under an obligation to pay the tithe? Only a preliminary answer to this question can be given, but a more comprehensive study of the available material, especially the detailed household lists that form the basis of the account system, can obviously provide an answer. This is that all landowners and copyholders were obliged to pay. The main exception was the clergy as users of beneficed farms (beneficeret jord). But during the 19th century there was the appearance of new groups and classes of people, especially smallholders and fishermen, and the status of these is not quite clear. It seems as if there were increasing problems in collecting fish tithe after the introduction of free trade in 1856, but this problem is not relevant to this article. Furthermore, it seems that new crop potatoes, becoming common from about 1820-30, were never an object for the tithe. A special problem in relation to this is the capital Thorshavn. The inhabitants of the town were divided in three classes, administration and trade, military personnel and the proletariat. It seems as if only some of the officials - the prefect (amtmand), the sheriff (sysselmand), the bailiff (landfoged) and the judge (sorenskriver) - that had their income from farms in the nearby villages, paid tithes.

The reports on the state of the districts

The prefect of the Faeroe Islands in 1830, Frederik Tillisch, ordered the sheriffs of the districts to report half-yearly on the state of the district on the topics: health and disease, sheep and cow-breeding, bird-catching and fishing, grain and potato growing, and disorder and innovations. These reports supplemented and partly replaced an older series of annual reports that can be traced back to 1778, (FLS-h). It is likely that these reports are a result of a directive from May 1777 concerning agriculture and servants, (Bang and Bærentsen 1901:5). The focus of these reports is on wool-begging, idleness and vagrancy, but here and there valuable information on the agriculture is found, even if the common style is in the form: "The agriculture is usually run with customary diligence". Until now, only the new reports from Norderöe Syssel, covering

the period 1831-1903, have been transcribed and analysed, (FLS-d). They give a good and continuous insight into the state and development of cattle-supply and sheep-breeding. Furthermore, they can supply explanations of quite another kind than the usual "event regularity", often based on statistical manipulations, common in socio-economic research. These reports make it possible to search for causal relations and the mechanisms that are hidden behind statistics of the empirical level.

The use of critical realist ontology and mode of explanation

An attempt is made here to use some basic ideas from the ontology and mode of explanation of transcendental and critical realism, presented in Bhaskar (1975/97) and later works. One main point is that systems in society and nature are understood as open, not closed. Only controlled laboratory experiments can be said to be closed. In the reality of nature and society, the systems are open, and therefore in most cases they are unpredictable. Furthermore, critical realism makes a distinction between three ontological levels: the empirical, the actual and the real. Explanations of the kind "when x then y", also called invariant conjunctions, are rejected as just seeking event regularity on the empirical level. Such simple regularities or laws are only found in closed systems. Instead critical realism tries to go beyond the empirical level to the real one, trying to find structures and generative mechanisms that cause things to happen. Nothing happens without a cause, and even if a thing happens only once it has a cause, and therefore an explanation is to be found in the generative mechanism that causes the thing to happen. So, recurrence or the number of observations is not decisive. Things have causal power, which may or may not be realized under different necessary and contingent conditions.

"Most things are complex objects, in virtue of which they possess an ensemble of tendencies, liabilities and powers," (Bhaskar 1997:51).

As Callinicos says, in Bhaskar and Callinicos (2003:90)

"…what occurs is a consequence of interaction between a number of different powerful particulars, and the operation of any individual particular is modified and restricted in various ways because it is operations in relation to all sorts of other powers. That's what critical realism calls an open system."

Thus laws are to be understood as tendencies, interacting with other tendencies such that a possible event may or may not be produced. For further development and explanation of these problems, see Bhaskar (1997).

The role of cows in the Faeroese villages in the 19th century

Before turning to the tithe lists and sheriff's reports in the search for some mechanisms, some main points of the yearly rhythm in the old agricultural system will be outlined. A Faeroese village in the beginning of the 19th century consisted of one or more farms together with a number of houses. The infield around the farms, the *bøur*, was surrounded by a stone dyke, and in it grain was grown for human consumption and hay was produced for the winter-feeding of cattle. About 90% of the infield was usually grassland that was cut in August to September. The grass was dried and then transported as hay to the barn to be used as winter fodder for the cows. The outfield beyond the dyke, the *hagi*, was a grazing area for the sheep flocks, in summer high up in the mountains, in winter in the lower areas or in the infield, after the hay had been cropped. The lambing season is in April and May. In the autumn, usually in October, the sheep and lambs were driven together in sheepfolds, and the animals for slaughtering were selected. The cows grazed the outfield adjacent to the village from May or June to the beginning of October. In this period the cows were visited twice daily in the outfield by milkmaids. During the winter the cows were housed in the byre and were fed with hay from the infield. The manure from the byre was gathered in a dunghill. Each year a part of the infield was, after thorough cultivation and manuring, sown with barley. There was a rather fixed relationship between the area of the infield, the yield of hay, the number of cows that could be fed in winter, the gathering of farmyard manure and the practicable area for grain. In this way the possible production of milk as well as grain was fixed. In the same way the number of sheep in the outfield was relatively stable. The Faeroese village and agricultural system in the past has been described further in the literature by several authors: Svabo (1782/1957), Landt (1800/1965), Effersöe (1886), Rasmussen (1947), Brú (1958), Joensen (1980), Guttesen (1996) and Brandt (1992, 1996a & 1996b).

Variation in the number of cows

In the following section, the empirical data for cows and slaughtered sheep respectively from the tithe lists from Norderöe Syssel will be presented. Norderöe is selected for analysis, because it covers the same district as the simultaneous Sheriff's reports, even if the tithe lists from Strömöe Syssel cover a longer period. The half-yearly reports will then be cited to illustrate and explain the background for the events described quantitatively in the tithe lists. Finally, some conclusions will be drawn on the mechanisms as well as the different conditions that are impeding or promoting these mechanisms.

The first group of statistical data drawn from the tithe lists relates to the cows that produced up to 50 % of the calorific intake of humans in the traditional peasant society. In Figure 2 the number of cows is shown for the period 1801 to 1859 for Norderöe Syssel. The numbers are equal to those in Table 1 for 1801 and the following years, and thus correspond to the number of cows that contribute to a King's tithe, i.e. a third of the total number. To get a first differentiated overview, the district is divided into two areas, the eastern consisting of the parishes Fuglöe, Svinöe and Viderejde, the western of Waaj (now Klaksvík), Kunöe, Husum and Mygledahl, cf. Figure 1.

The trend lines for the two areas show a slightly increasing number of cows, from 55 to 65 in the west and from 35 to 41 in the east, so the trends for the two areas are approximately parallel. The 7 years moving averages for the two areas exhibit the same maxima and minima,

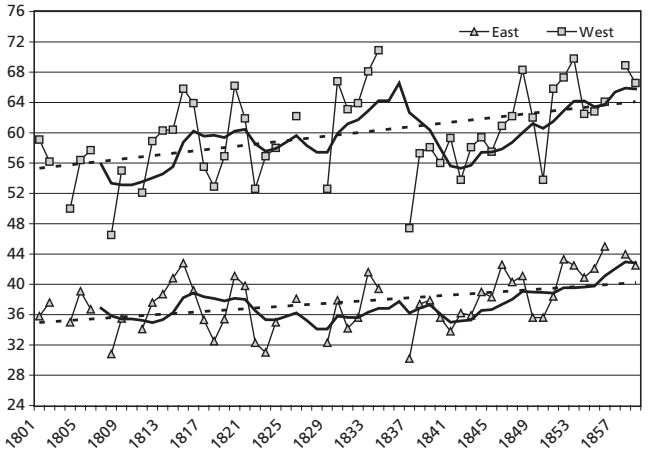

Figure 2: *Number of cows 1801-1859 in the eastern and western parishes of Norderöer according to the King's tithe. The real number of cows is thus three times the numbers in the Figure. This relation apply for the following figures. Trendline and 7 years moving average are added.*

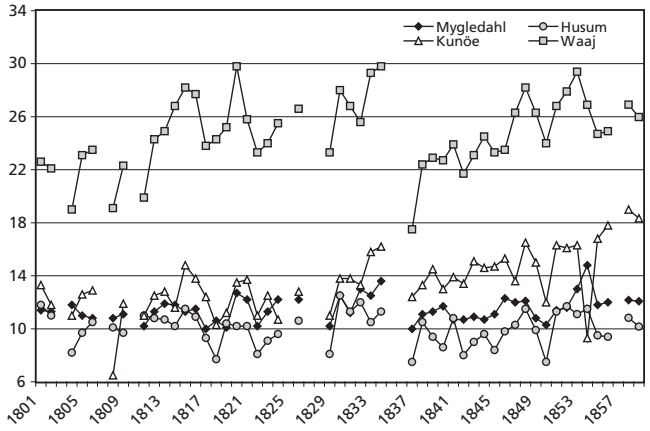

Figure 3: *Number of cows 1801-1859 in the four western parishes of Norderöe Syssel according to the King's tithe.*

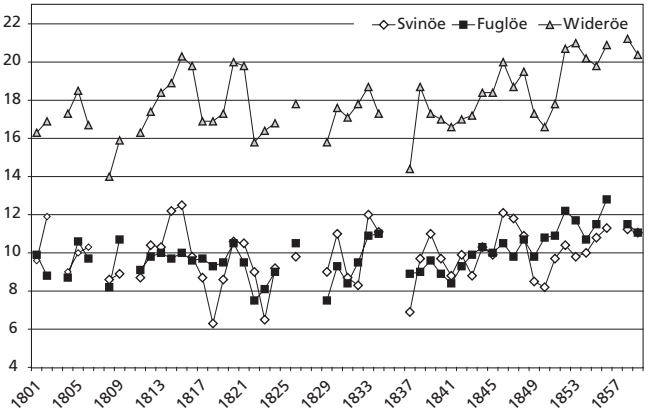

Figure 4: *Number of cows 1801-1859 in the three eastern parishes of Norderöe Syssel according to the King's tithe.*

though they are less pronounced for the eastern area. This difference stems from the fact that the variations are, as a whole, less in the eastern parishes than in the western, (Figure 3 and 4). In several cases the numbers drop suddenly over one or two years by 20 - 25 %, as in 1821-23 and 1849-51. The largest decrease is between 1835 and 1838, where it falls by 34 %. How can these sudden and severe falls, as well as the subsequent increases, be explained?

The Sheriff's reports about the conditions of the cows
As described earlier, the number of cows depends first of all on the quantity and quality of the hay for winter fodder. From Figure 2 we can select a relatively short period containing some sharp fluctuations, i.e. 1848 to 1851. In Table 2 an extract of statements from the Sheriff's Reports is shown.

In summary, the stock of cows was in a good condition in the summer 1848, but the conditions for grass growth

had been bad during the season, presumably because of low temperatures and little sunshine. Furthermore, the autumn was also bad for the drying of the hay. The result was a low yield of poor quality. The outcome was that the number of cows had to be reduced by 10 %.

The following winter (1848-49) was severe, so there was no chance of letting the cows graze earlier than usual. On the contrary, the spring was cold and the grass presumably began to grow later than usual. The report anticipates a situation of fodder shortage in the Spring. As the summer of 1849 was cold too, grass growth was poor once again, so when the cows were grazing in the outfield during the summer, there was insufficient grass to ensure their good condition. The haymaking period was dry, however, so the result was a little hay, but it was of good quality. This was still not enough to avoid a further reduction in the number of cows from 98 to 89.

The conditions for the summer of 1850 are reported to be average, but as the haymaking period was dry, it must be concluded that the winter fodder situation was considerably better than for the two preceding years. Even if the condition of the cows is reported to be only mediocre, it is better than before, so the number of cows rises by 17 % from 89 to 104 in 1851.

The mechanism determining the number of cows

The contents of Table 2 and the description in the following passage bring us closer to the mechanism and complex of conditions that determine the variation in the number of cows which can survive the winter. As a hypothesis I suggest to point out the external metabolism of the cows, or just eating grass and hay, as the basic mechanism. It precedes and is a condition for the internal or physiological metabolism. The external metabolism is working under the influence of a number of conditions. The most important of these, when it comes to an understanding of the events, which are the fluctuations in the number of cows registered in the tithe lists, is the production process of winter fodder. It can further be divided into two segments: the grass growing and the haymaking.

For grass growing, an area with suitable soil is needed and it must be protected by a fence or dyke as in the infield (bøur), so the grass is not eaten or trampled before it can be cut. In the growing season the infield can, with a technical term from Marx, be categorized as an 'instrument of production'. This infield area cannot be expanded freely, because the available areas outside are linked to other elements or subsystems of the land-use; they are e.g. used for summer grazing for the cows and winter grazing for the sheep. So if the infield area is expanded then the outfield grazing area decreases. Good weather in summer, i.e. suitable temperatures, humidity and sunshine, promotes the

Table 2: *Selected statements from the Sheriff's reports on grass growth and the state of the cows, as well as the number of cows from the tithe lists, King's third. Norderöe Syssel.*

	Cows	Statements on weather	Statements on the grass growing	Statements on the cows
1848 summer	109	Bad growing conditions. Wet haymaking period	Little grass. Haymaking was late. Hay not well dried	The stock in good condition, but must be reduced
1848-49 winter		Severe winter, sustained frost and ice		In a less good state, number was reduced. Shortage of hay expected
1849 summer	98	Spring and summer cold, autumn dry	Bad conditions for grass growing	Not in a good state, the hay was too little and too bad. The number must be reduced
1849-50 winter		No report	No report	No report
1850 summer	89	Average summer, autumn dry	Grass growth as in an average year. Haymaking good	Mediocre state
1850-51 winter		Winter very mild		No fear of hay shortage
1851 summer	104	Early summer cold, August dry	Grass growth was poor, but the hay was of good quality	In good state, but reduction in number must be expected

process. While cold, cloudy or foggy weather impedes it, and, even if infrequent in the Faeroe Islands, drought also can impede the process, as reported in 1857. Fertilizing the soil increases the yield, but traditionally only two sources were available: dung and seaweed. The amount of seaweed depended on the location of the village, and the dung came from the cows. Moreover the manuring was an element in the system of grain growing (cf. Christiansen 1996).

When it comes to the haymaking season the infield changes category from an 'instrument of production' to a 'subject of production' when the grass is cut and dried to hay. The most important condition in this phase is dry weather. If it is rainy and humid, the process is drawn out and the quality of the hay decreases or it can rot away. In some years it is reported that storms had ruined large parts of the hay away in several villages, as was the situation in 1859. The haymaking process usually takes place in the second half of August, but if it is prolonged it impinges on the next important task, namely the grain harvest.

The cows were usually stalled in byres from late October to the beginning of May - six months or more. But it is reported that in some years the climate was so mild that the cows were grazing until December. On the other hand, the time of release from the byre varied a great deal, from the beginning of April to the end of May. Therefore, the time spent indoors, consuming the available winter fodder, can be shortened or prolonged depending on the weather conditions.

Thus, there is no guarantee that even a good quantity of hay will suffice. The reports tell us that in some protracted winters the cows were given grain, usually reserved for human consumption, to eat, as in spring 1877, 1882 and 1891 when there was no hay left. At the end of the century when saithe fishing with seine nets was practiced in some villages and was producing good catches, the cows had dried saithe as emergency fodder when there was no more hay available; this happened in 1889 and 1903. Furthermore, in 1903 dried meat from pilot whales "saved the creatures". In years with fodder shortage - and they appeared frequently- the cows became emaciated, sometimes some dying in the byre, as in 1887. In other years they survived, but had to be carried into the open.

The last situation that influences the byred cows during the winter, is that where the sheep flocks that have to survive in the outfield throughout the winter are threatened by mass death. To avoid such a catastrophe, it may be noted that in a few years part of the winter fodder for the cows was given to the sheep, as was the case in spring 1881 when a third of the sheep died. All these different and complex situations are gathered in Table 3 below, after the information on sheep has been analyzed.

This Table should help to bring a little order to the complex systems of mechanisms, conditions and interactions of the different processes. This can be helpful when trying to use the information as proxy data for the reconstruction of former climatic situations. For instance a declining number of cows from one year to the next can be caused by several things. Firstly, in the grass growing

Table 3: *Basic mechanism and conditions that determine the number of cows that can survive the winter.*

Mechanism and conditions	**Description**
Basic mechanism	The cow's external metabolism
Necessary conditions to create the sufficient organic material for the metabolism	**The natural process of grass-growing** Necessary conditions for this process: sufficient light, temperature, nutrition, water
Necessary conditions to secure the winter fodder	**The production process of haymaking** Necessary conditions for this process: Dry weather Labour: people to work Instruments of production: scythe, rake, hayfork, carrying equipment, hay barn Subject of production: grass in the infield
Contingent conditions that determine the duration of the stay in the byre as well as other possible fodder sources or other unforeseeable situations.	Weather in the autumn: beginning of frost and snow. Weather in the spring: beginning of grass growth. Availability of emergency fodder: grain, saithe, whale meat. Hay given to sheep as emergency fodder.

process, it could be a cold summer, foggy weather with little solar radiation, drought or storms destroying the grass. In the haymaking period it could be excessive rain which made the hay rot, or a storm that blew the hay away; and furthermore the survival rate depends on the length of the winter, which could begin early or end late or both. This confirms that in an open, complex system, predictions of events are not possible.

The variation in the number of sheep

The second group of statistical data drawn from the tithe lists relates to the sheep that, as mutton and tallow, produced 20-25 % of the calorific needs of the human population. The sheep delivered wool that was spun and knitted to a standard commodity: woollen stockings that were the principal export commodity from the Faeroe Islands. This was the basis for the wealth of the large land-owners and King's tenants (copyholders) who produced a surplus that could be sold to the Royal Trade Monopoly in Thorshavn in exchange for imported necessities and luxury goods. In some documents the woollen stockings are even called "krambodpenge" or shop-money (FLS-b).

Figure 5 shows the development and variation in the number of sheep and lambs slaughtered each year from 1801 to 1859 in Norderöe District, divided into an eastern and western area, based on the accounts of the King's tithe. In other words, the numbers given here are, as indicated above, just 1/3 of the real numbers. The stipulated trend lines are parallel and slightly increasing, but this seeming increase can be due to the fact that in the beginning of the period there are several extremely bad years

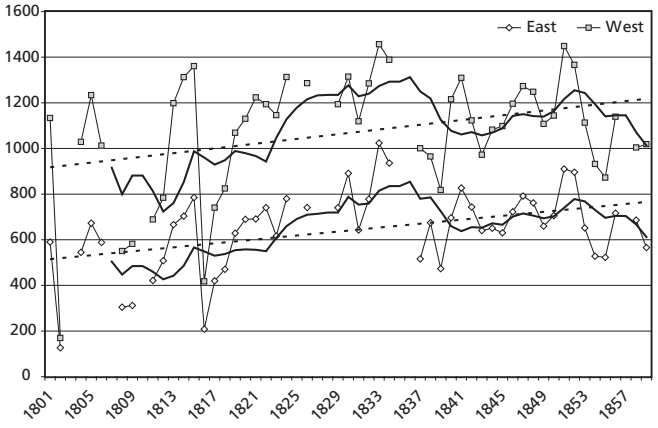

Figure 5: *Number of sheep slaughtered 1801-1859 in the eastern and western parishes of Norderë Syssel according to the King's tithe. Trendline and 7 years moving average are added.*

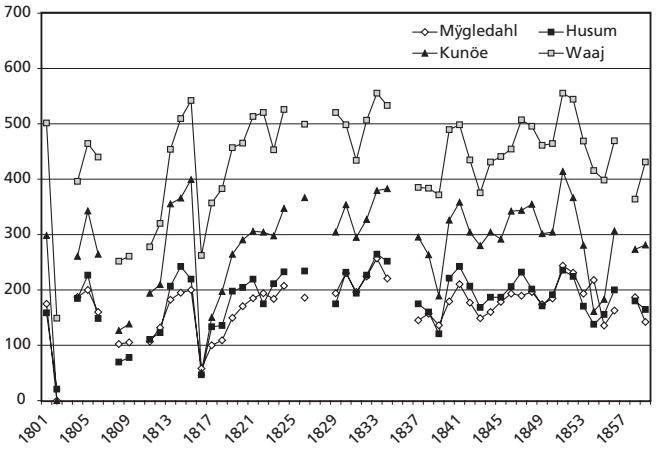

Figure 6: *Number of sheep slaughtered 1801-1859 in the four western parishes of Norderë Syssel according to the King's tithe.*

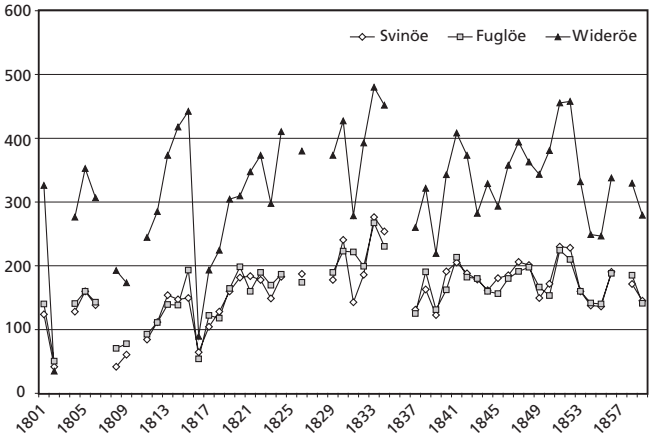

Figure 7: Number of sheep slaughtered 1801-1859 in the three eastern parishes of Norderë Syssel according to the King's tithe.

with excessive mortality. Therefore, the trend lines shall not be understood as a general improvement in the sheep rearing. The lines for the 7-year moving average are nearly congruent, indicating that the variations in the conditions in both areas are identical. The most striking difference between the course of events exhibited in Figure 2 and 5, are the disastrous drops in the number of sheep slaughtered, caused by excessively high death rates in the preceding winter. While the number of cows fell by 20 to 33 % over a period of a year or two, we see for the sheep catastrophic decreases from 1801 to 1802 and from 1815 to 1816. In the first mentioned winter in western area of Norderöe District from 1133 to 196, i.e. 937 or a 83 % loss, and in the second winter from 1360 to 417, i.e. 943 or 69 % less. The figure also shows that after the fall in 1816 it takes about 4 to 5 years for the stock to recover.

The Sheriff's report on variation in the number of sheep

Unfortunately the Sheriffs' Reports on the state of the district do not start before 1831, so the events mentioned thus far cannot be examined further. But there is a marked development from 1838 to 1843 when sheep numbers fall to a minimum (in 1839). The following two years are better with increasing numbers, but then come two years with bad winters and decreasing numbers of sheep being slaughtered.

The events portrayed in Table 3 start with a summer that evidently was below the average, though the output was better than in the preceding year. But the following winter was severe and caused a high mortality among the sheep. As the two winters following were mild the number of sheep rose again, even if the summers were both wet and cold. A maximum number of 2136 sheep was slaughtered in the autumn of 1841. The expectation, mentioned in the fourth column, about the number of sheep to be slaughtered proved to be rather accurate.

To sum up these as well as other information from the Sheriff's reports, it is firstly the winter conditions that are crucial to an understanding of the variation in the number of sheep slaughtered that can be read in the tithe lists. This is in contrast to the situation for cows that depends on the summer conditions for haymaking, which determines the quality and quantity of hay available as winter fodder. The results of lining up the basic mechanisms and different conditions, which activate the mechanism for variations in number of sheep, are collated in Table 5.

Mechanisms determining the number of sheep

The basic mechanism determining the possibilities for the sheep to survive the winter is related to the access to grass to support the external metabolism that is a precondition for the internal metabolism. It depends on several conditions, not least the sheep's condition in the beginning of the winter, or if they are fat or lean. If the snow and frost continues for long periods, one or two months, the sheeps solely depend on their fat deposits. In April 1866 the sheriff reports:"The sheep are in a miserable condition. In many places half of the flocks is dead, and the part that is left is - because continuous snow has covered the ground and the sheep have got nothing to eat in two months - unable to rear the lambs". In another severe winter, 1878-79,

Table 4: *Selected statements from the Sheriff's report on the winter weather, grass growth in the summer and the conditions of sheep and lambs. Number of sheep from tithe lists, King's third. Norderöe Syssel.*

	Sheep slaughtered in the autumn	**Weather in the winter and grass-growing conditions in the summer**	**Condition of sheep and lambs**
1838 Summer	1639	Grass growth was not good	Number slaughtered was higher than last year
1838 - 39 Winter		Continuous severe winter. Avalanches. Storm caused damage of houses	Considerable mortality expected
1839 Summer	1291	Better grass than the last years	In worse condition than last year. Stock and number slaughtered smaller.
1839 - 40 Winter		Continuous good weather	In good condition
1840 Summer	1912	Summer extremely wet. Grass growth was not good	In better condition than last autumn. The number 1/3 higher, but not fatter
1840 - 41 Winter		Mild winter and spring	Not many sheep missing
1841 Summer	2136	Cold summer, bad growing conditions. Very little grass	In rather good condition. Number of sheep slaughtered is expected to be 1/8 higher
1841- 42 Winter		Hard winter with snow and avalanches	A considerable number lost in avalanches
1842 Summer	1866	Mild spring and good summer. Good grass-growth everywhere	In average condition. The number slaughtered will be less, but the quality better

Table 5: Mechanism and conditions that determine the number of sheep that survive the winter.

Mechanism and conditions	Description
Basic mechanism	The sheep's external metabolism
Necessary condition to support the metabolism during the winter	Physiological condition in the beginning of the winter (fatness). Possibilities for grazing during the winter: Snow-free periods, access to plant material
Contingent conditions	Lethal situations such as: avalanches, black ice, storm, excessive snow. Landscape forms, more or less exposed and dangerous in winter.

it is reported, that many sheep died, because they had eaten the wool off each other's skin. During the Faeroese winter, there can be snow free periods with ground temperatures above 6 ºC especially in the lower parts of the outfield near the ocean, which keeps a temperature of 7-8 ºC, bringing about growth in the grass. On the other hand, many different situations can be lethal to the sheep. Usually it is said, that the sheep were never fed with hay during the winter, but in some cases in extremely severe winters, the sheriff's reports tell us that hay was given to the sheep, as in 1860 and 1881.

Discussion

To decide which of these 7-8 factors or processes are decisive, we must use some kind of methodological triangulation where we look at the same problem from different viewpoints, using different sets of data. For example, it will be shown how the yield of grain (data drawn from Guttesen 2001) in Figure 9 to a large degree co-varies with the number of cows in Figure 8. When the data are smoothed to 7 years moving average the course of curves show a nearly congruent figure. These figures show three maxima and two minima, but these events are delayed by a year or two on Figure 8 concerning the cows. It can not be a surprise, as one of the conclusions above on the cows was that the number that survived the winter depended on the grass growth and haymaking the predeeding year. This can be interpreted to indicate that the main reason for the variation in the number of cows is to be found in the natural process of grass growing, cf. Table 3, if the underlying hypothesis that grass growing and grain yield depend on the same natural conditions during the summer. In other words, it is the summer weather, sufficient temperatures, radiation and water in the preceding year that is decisive for the number of cows that survive the winter. For the sheep, on the contrary, as shown above it is the winter weather that is decisive, and the contingent conditions of avalanches, black ice, periods of snow cover

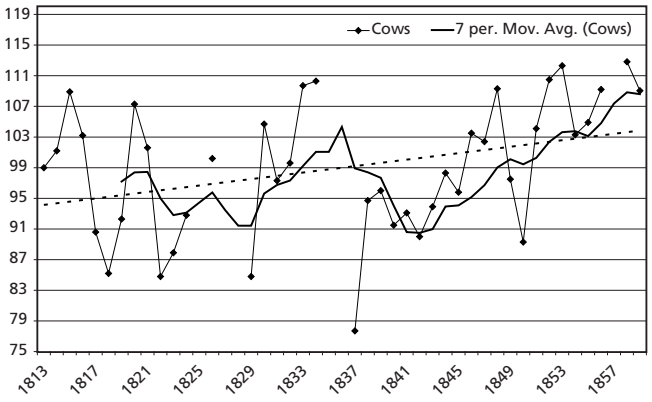

Figure 8: *Yield of grain 1813-1859 for the Uppistovu farm at Nordöre in Norderöe Syssel according to the Matras Diaries (FLS-a). Trendline and 7 years moving average are added.*

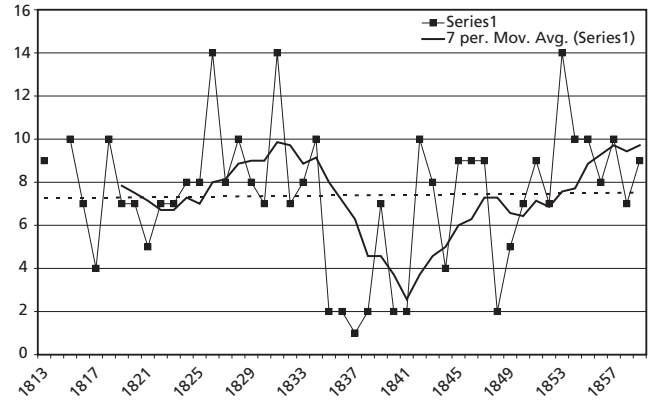

Figure 9: *Number of cows 1813-1859 for Norderöe Syssel as a whole according to the King's tithe. Trendline and 7 years moving average are added.*

and storm that play a conspicuous role.

The use of causal relations or mechanisms to explain the empirical data describing the fluctuations in nubmer of cows and sheep has produced some results that could not have been reached with a deductive-nomologic approach, as there are no confirmed "covering" laws covering these subsystems of agriculture.

The tithe lists, as well as the Sheriff's reports, have proven to be extremely valuable in the efforts to reconstruct the material and climatic conditions for agriculture in the traditional Faeroese peasant society that still was prevalent in the 19th century. The prospects of finding more continuous time series, which possibly will cover all the Faeroese districts, are anticipated with excitement.

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