Christian Keller
The Northern Frontier - North Atlantic Farming during the Viking and Middle Ages

Abstract: Christian Keller: The Northern Frontier – North Atlantic Farming during the Viking and Middle Ages. During the ninth and tenth centuries AD islands in the North Atlantic; the Faroes, Iceland, and South Greenland, were colonized by Norse settlers. The communities established were based on fixed farms, a dairy-economy, limited crop production, and maritime hunting and fishing. Animal husbandry in sub-arctic regions may seem a clumsy solution compared to the elegant adaptation displayed by high-arctic hunting cultures, but the Norse use of livestock permitted the utilization of vegetation resources that were otherwise useless to humans. This allowed larger and more complex communities. Summer pastures, and improved home-fields for production of winter fodder supported the livestock around the year; and the dairy economy was far more energy-effective than an equivalent meat-based economy would have been. The farm produce was supplemented with fish, marine mammals, and waterfowl. This paper argues that the Norse farm, in addition to being a socio-economic production unit, was the single most important ideological and religious entity in Norse society. Over the later decades paleo-environmental investigations and archaeology have cooperated in gaining a modern understanding the Viking and medieval Norse communities in the North Atlantic, and their adaptation to diverse and shifting environments. The concept ‘Economic Man’ may be a useful term for studying the human / environment interface, but the aims, goals, and decisions of the medieval Norse were crafted within a mental universe. Culturally, the Norse were conditioned to a life where the farm was the axis mundi, and where all auxiliary economic activities ultimately served to protect the core.

Key words: Agriculture, dairy economy, environmental degradation, farm, Faroes, Greenland, Iceland, landnám, Little Ice Age, livestock, Medieval Warm, Medieval, Norse, North Atlantic, pastoral economy, Scandinavia, Viking.

1. Introduction
In 2007 the most enthusiastic member of the EARTH Steering Committee Sofus Christiansen passed away. During his career Dr. Christiansen authored several papers on North Atlantic agriculture (Christiansen 1990; 1991; 1996; Christiansen and Guttesen 1987). To pay tribute to him the present paper revisits his 1991 article ‘North Atlantic Farming Culture in a Comparative Ecological Perspective’ (The originally Danish title is translated by the present author).
Books addressing the Norse expansion into the North Atlantic are numerous and easily accessible (Fitzhugh and Ward 2000; Graham-Campbell 2001; Gulløv 2004; Seaver 1996; Marcus 1980). This aim of the present paper is not to celebrate the Viking achievement, but to discuss the spread of dairy agriculture across the North Atlantic and its growth and adaptation during the Viking and Middle Ages.

A frequently addressed issue in the literature is the ability, or inability, of the Norse to adapt to North Atlantic conditions, and subsequently to handle the environmental hazards posed by the Little Ice Age. The disappearance of the Norse Greenlanders in the fifteenth century is a frequently cited show-case in environmentalist literature, demonstrating ‘failure to adapt’ (as in Diamond 2005, 248-276, but see Seaver 1996 for balance).

The spread of European agricultural economy to the North Atlantic islands was part of what is sometimes called the Norse Diaspora; the expansion by the Scandinavian Norse as far east as Byzantine, and as far west as Newfoundland. This happened during the Viking Period (AD 750-1050); so named to indicate the infamous Norse raids on churches, monasteries, and towns in the Christian world (Sawyer 1982; Konstam 2002/2005; Graham-Campbell 2001; Sawyer and Sawyer 1993; for Eastern expansion see Franklin and Shepard 1996; Noonan 1998).

The later decades have seen research efforts in the Faroes, Iceland and Greenland dedicated to understanding the mechanisms of the Norse colonization, its impact on the pristine eco-systems, and the human response to the subsequent environmental challenges posed by a cooling climate and environmental degradation. Numerous tephra-layers (i.e. layers of volcanic ash from eruptions) form isochrones over the Icelandic landscape, and provide a detailed chronology on a level which surpasses conventional dating methods. This facilitates high-resolution diachronic studies (Pórarinsson 1944; 1970; 1981; Grønvold et al. 1995; Dugmore et al. 2000). The present paper focuses on the economy and social values of the Norse farming communities, seen against a backdrop of climate change.

The famous medieval Icelandic literature in the vernacular (often imprecisely called ‘sagas’) has a strong focus on the ‘Commonwealth Period’ in Iceland (ca AD 870-1260), and has been studied for centuries by philologists and historians (Ólafsson 1998). The interaction between Man and Nature is a frequently addressed subject in this research, but it has mainly been studied as a spiritual matter. Ecology does not enter into it (Dumézil 1977; duBois 1999; Näsström 2001; and 2002; Steinsland 2005).

Recent paleo-environmental investigations suggest the Norse should indeed be seen as environmental agents: decisions concerning land-management, live-stock investment, and rules of ownership, had both short-term and long-term implications for the landscape and its resources.

Iceland in particular has been exposed to man-induced landscape degradation; hence it is sensible to study not only the effects of past decisions upon the environment, but also the social and ideological framework within which these decisions were made.

It is the view of this author that the farm was the cultural core of Norse society, both in a social, economic, and spiritual sense. The survival of this core was an absolute prerequisite for survival of the society; hence it was buffered from environmental threats by all kinds of auxiliary economic activities. The nature of these activities varied with the local access to wild resources, and involved fishing, egg-collecting, hunting of sea-mammals, and catching of waterfowl (Norrevang 1979; McGovern et al. 2006; McGovern et al. 2007).
In a historical perspective certain ‘wild’ resources such as walrus ivory from Greenland, and stockfish from Iceland and the Faroes (and indeed from Norway) were favoured for export. The farm economy has traditionally been seen as the mainstay of daily subsistence, but recent isotope analyses of skeletal material bear witness that in most farms people depended on ‘wild’ resources as a substantial part of their diet. Unlike the situation in medieval Norway, hunting and fishing in the North Atlantic was organized as farm chores. Hence all decisions concerning economic activities in the North Atlantic ultimately originated in the social context of a farm.

2. Prelude and ‘landnám’.
The Norse ‘landnám’ (Old Norse ‘taking of land’, i.e. colonization) of the North Atlantic Islands would not have been possible without the preceding development of the farm in Scandinavia during the Iron Age. The long and harsh winters required indoor stabling and feeding of livestock. Manure from the stables was spread on the home-fields, which in turn produced food and fodder for man and beast. By the time of the Migration Period (AD 550-750) the fixed farm had long since become the basic social institution of the Norse world, both in a physical and mythical sense. Hence it was well established in the minds of the North Atlantic settlers from the ninth century. In principle the North Atlantic farm was a single family farm of a type commonly found in Sweden and Norway, although they come in many shapes and forms. The organization of the society in relatively small units was a typical adaptation to the limited and patchy resource distribution, but it was also a convenient way to organize a kin-based society.

The vertical aspect was also important: lowlands and valleys had good conditions for early plant production, but the productive areas were limited. Mountain pastures were abundant, but the growing-season was short, so maximum utilization during the summer months was essential. To minimize transport, a system of milking stations or more elaborate shielings were established away from the farm, to make use of the more remote resources. The shieling system characterizes the decentralized farming needed in areas with patchy resource distribution (Hitzler 1979; Albrethsen and Keller 1986; Mahler 1989; 1990; 1991a; 1991b; Sveinbjarnardóttir 1989; Hastrup 1989; also in Laws of Early Iceland (Grágás) K § 182 in Dennis et al. 2000, 11-112).

As mentioned, farms could only contribute part of the resources needed by their occupants; a plethora of ‘wild’ resources were also needed. The coasts, lakes, rivers, forests, and mountain-sides were harvested for what they could offer; leaves and seaweed were used for fodder and for soil improvement, peat and firewood were collected for cooking, heating, and charcoal-production, bog-ore was taken for iron extraction, driftwood and grass turf for construction purposes (McGovern et al. 2007; Simpson et al. 2003; Vésteinssson and Simpson 2004; Sveinbjarnardóttir et al. 2007; 2008). Fish were caught, seals and whales hunted, eggs collected, and birds caught. There was, in other words, a steady trickle of biomass from the surroundings of the farm to its centre, and it was all part of the farm economy.

Combined with a cool climate, the biomass accumulation favoured farm-mound formation. A farm-mound is a classic archaeological formation in the North Atlantic; like a miniature tell consisting of turf and midden material, normally with good archaeological preservation conditions.

The northern frontier for agriculture runs across the North Atlantic on a diagonal course from the south west to the north east. Hence the temperature drops dramatically as one moves west from the west coast of Norway, on a course to Greenland.
This is due to the North Atlantic Drift which moves warm water on a diagonal course from the Gulf of Mexico to Scandinavia. This ensures favourable climatic conditions along its axis (Figs. 1 and 2 from Christiansen 1991, 46-47). The drift also brings warm, humid Atlantic air from the south-west to collide with cold, dry polar air from the Arctic. This creates the North Atlantic Polar Front, which propels a constant stream of low-pressures on an easterly track, carrying rain and wind to Britain and Scandinavia.

Despite Scandinavia’s northerly location the North Atlantic drift permits fully fledged agriculture except in the most northerly parts. The capitals of Stockholm and Oslo lie on the same latitude as Cape Farewell in Greenland, and Hudson Bay in arctic Canada, but are surrounded by pleasant agricultural landscapes. Agriculture in these parts started more that four thousand years BC. The North Atlantic islands were technically a wilderness until they were colonized by the Norse, i.e. their landscapes had never been subject to agriculture (Marcus 1980; Fitzhugh and Ward 2000; Vésteinsson et al. 2002). In Iceland a sophisticated society developed during the Viking Period; a commonwealth based on ‘gōð’ (i.e. regional chiefs), a national law, and a hierarchic system of ‘Ping-sites’, (i.e. assembly sites). Christianity was introduced around AD 1000 (Sawyer et al. 1987; Sanmark 2004; Vésteinsson 2000; Kristjánsdóttir 2004), and Iceland soon became a literate society which produced a wide range of books, both in Latin and in the vernacular (Nordal 1952; 1954; Byock 2001).

The Norse ‘landnám’ in the Faroes is normally set to AD 825 (which is debated, see Arge 1991; Arge et al. 2005), the ‘landnám’ of Iceland to ca AD 870 (Hjálmarsson 1993; Byock 2001; see also Fríðriksson 1994). Greenland was colonized from Iceland ca AD 985 (Greenow 2004, 221-434; Seaver 1996,14-43).

The environmental impact of the ‘landnám’ is evident from the pollen records; the original Birch forests and Salix shrubs were cut down and the stubs were burnt to create a grass-covered rangeland for livestock (Fredskild 1973; Einarsson 1963;
All buildings were made from turf, or a combination of turf and stones. Wood was a scarce commodity which was reserved for roof construction, and for boats, hence drift-wood beaches were highly valued assets. Other farm-owned assets were boat-houses and fishing- and hunting-stations on the outer coast (Rieck 2002; Edvardsson 2005).

The farm-land consisted of fertilized home-fields for grass production (Sveinbjarnardóttir et al. 2007; and 2008; Thomson et al. 2005; Thomson and Simpson 2007), and shielings (Hitzler 1979; Albrethsen and Keller 1986; Mahler 1989; 1990, 1991a; 1991b; Sveinbjarnardóttir 1989). There was also rangeland which in some regions was split by a sophisticated system of turf-built boundary walls (Einarsson et al. 2002). These walls are also mentioned in the early Icelandic laws, called Grágás. (See K § 181, K § 205, and § 206 in Dennis et al. 2000, 113-138).

In the pollen records of Iceland and Greenland the environmental footprint of the colonists is strong and clear from the start; the ‘landnám’ manifests itself as a sudden impact rather than a slow trickle, suggesting the colonizers were well organized with a substantial maritime lifting capacity for people and livestock (Dugmore et al. 2000; Dugmore et al. 2005; Dugmore et al. 2006; Dugmore et al. 2007a; Dugmore et al. 2007b).

The manipulation of the original vegetation came at a price which was not immediately apparent; today it is reckoned that 90 percent of the original forests and 40 percent of the soils of Iceland have disappeared since ‘landnám’, partly due to grazing, partly due to volcanic activity. 73 percent of the present-day surface is affected by erosion. The Icelandic landscape has a large proportion of andisols, i.e. volcanic soils, which are particularly vulnerable to erosion (Arnalds et al. 1997; McGovern et al. 2007; Dugmore et al. 2009). The moraine soils of Greenland are more robust, but tectonic movement caused a loss of coastal plains perceivable even during the time of settlement (Mikkelsen et al. 2008).

Ecologically, it may seem like the North Atlantic communities had overreached. During the mid thirteenth century the Faroes, Iceland and Greenland were included in the Scandinavian kingdoms through a series of political events, and by the mid fifteenth century Norse Greenland was deserted (Seaver 1996; McGovern 1980; 1981; 1986; 1994; 2000; McGovern et al. 1988; Buckland et al. 2008). In 2005 Jared Diamond argued that the Norse Greenlanders failed to survive because they were unwilling to adapt to the arctic environment (Diamond 2005, 248-276). Perhaps it is better to say that the Norse abandoned Greenland when they saw that it was no longer possible to uphold society as they knew it. Norse communities consisted of farms, and farms consisted of livestock. If the livestock succumbed, there were no farms, and no society...

3. Cereal cultivation and the northern frontier
The colonization of the North Atlantic took place in a favourable climatic period known as the MW (Medieval Warm), which was challenged by the thirteenth to fourteenth century onset of the LIA (the Little Ice Age) (Grove 1988; Fagan 2000), Fig. 8.

On a gradient from ‘warm’ to ‘cold’ the Faroes lie in the ‘warm’ zone, Iceland hangs in the balance, while Norse Greenland is ‘cold’ (Fig. 1).
Fig. 3
‘Grass day-degrees’ (red, rear) and ‘cereal grade-degrees’ (blue, front) from 15 meteorological stations in the North Atlantic, according to Christiansen’s calculation (Christiansen 1991, 47). The stations are ranged from the North West (left) towards the South East (right). Greenland = Nuk and Ivigtut; Iceland = Reykjavík; The Faroes = Tórshavn.
See Fig. 4 for the geographical location of these stations.
Christiansen argued for a minimum of 750 cereal-day-degrees (750 ‘cereal day-degrees’ marked with black line in the diagram). Christiansen’s concept ‘cereal-day-degrees’ was a closer fit with the agricultural reality than standard day-degrees (below).

This is in line with the descriptions of in the medieval manuscript ‘Konungs skuggsjá’ (i.e. ‘The King’s mirror’) from the mid thirteenth century, which states that ‘most people in Greenland have never tasted bread’. Cereal cultivation in the Faroes, on the other hand, is well known from recent historic times, and goes back to the early stages of settlement (Mairs 2007, 67-83).
In his 1991 article Sofus Christiansen addressed the climatic frontier of agriculture in the North Atlantic by examining the temperatures required for grass- and cereal production, and the temperatures across the North Atlantic. In these days of computer modelling Christensen’s approach seem terribly dated, but his effort is worth revisiting both to commemorate him and because it is a quick approach to basic facts about the North Atlantic and agriculture.
Normally, the climate conditions for farming are presented as a sum of day-degrees per year. Christiansen wanted to get a more close-up picture, so he designed his own conceptual framework: he explained that the minimum temperature for grass-growth is ca 2 centigrade, while the minimum temperature for cereals is ca 5 centigrade. Days with temperatures above 2 day-degrees made what he called 'grass-day-degrees’, and days with more than 5 day-degrees he called ‘cereal day-degrees’ (centigrade). Such days were counted at each meteorological station to indicate the conditions for grass- and cereal-production across the North Atlantic, see Fig. 3. In principle he simply ‘sliced off’ the number of days where the temperature did not exceed 2 respectively 5 day-degrees at each station.

Christiansen argued that a steady reproduction of cereals require a minimum of 100 – 120 days with temperatures above 10 centigrade, preferably exceeding 15 centigrade towards the end of the growing-season. He also suggested that cereals need at least 750 ‘cereal day-degrees’ to ripen (loc. cit).

Unfortunately it is not so easy to compare Christiansen’s ‘cereal day-degrees’ with data-sets based on standard day-degrees, even though such comparisons are indeed relevant: In Northern Scandinavia the northern limit for cereal production lies close to the historical ethnic boundary between the Sámi and the Norse populations. Lars Ivar Hansen has given the following information about cereal production in these areas based on standard day-degrees, see Fig. 5 (from Hansen1990, 63 with reference to Fjørvoll 1961).

<table>
<thead>
<tr>
<th>TYPE OF CEREALS</th>
<th>DAY-DEGREES</th>
</tr>
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<tbody>
<tr>
<td>Early strands of barley</td>
<td>1170</td>
</tr>
<tr>
<td>Other strands of barley</td>
<td>13-1400</td>
</tr>
<tr>
<td>Medium to late strands of oats</td>
<td>13-1500</td>
</tr>
<tr>
<td>Medium to late strands of spring wheat and spring rye</td>
<td>1600</td>
</tr>
<tr>
<td>(Based on Hansen 1990, 63)</td>
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Table Fig. 5
The minimum number of day-degrees for a selection of cereals, according to Lars Ivar Hansen 1990, 63. Hansen’s original table is simplified here.
Fig. 6
The cultivation sequence of the typical Faroese type of hoe agriculture called ‘reinavelta’.

The cultivation was often made in a seven years rotation system with cereals one year and grass for the six consecutive years. Hence there were often seven such terraced fields per lot. (From Joensen 1980, 22-33).
Fig. 7
Faroese farming implements: ‘Ristari’ or ‘forskeri’ (left), pitchfork (middle), and ‘haki’ (right). The ‘haki’ looks suspiciously like it has Celtic ancestors, but the name for it is in Old Norse.
(Figure from Joensen 1980, 23).

The frontier for cereal agriculture lies in the range of 1200–1600 standard day-degrees. (For calculation of standard ‘growing degree days’ and examples, see http://en.wikipedia.org/wiki/Growing_degree_day).
Growing conditions for grasses and cereals do of course depend on other variables such as water, soils, nutrients, wind, and not the least exposure to summer frost. A detailed environmental simulation program from University of Sterling, the ‘Búmodel’, was developed to model agricultural production in the North Atlantic isles (Thomson 2003; Thomson et al. 2005; Thomson and Simpson 2007). The program is available at http://www.sbes.stir.ac.uk/research/environmental_modelling/)
Historically the northern limit for cereal cultivation in North Norway was at Malangen, near the town of Harstad in North Norway. Despite its location above the Arctic Circle the area has as much as 1250-1275 standard day-degrees (Hansen op. cit. 56-77).
The northern frontiers for agriculture, whether it is the ‘cereal boundary’ or the ‘grass boundary’, are indeed stress zones for agriculturalists; the weather in these regions is unstable and the climatic predictability is low. Farming everywhere is exposed to environmental hazards, but in high altitudes and on northern frontiers the risks are higher than usual: both cereals and grass may be ruined by rain, hail, or frost. Such mishaps may force farmers to slaughter or sell livestock because they cannot be supported through the winter. An unlucky decision in the spring may lead to abandonment in the fall.
There is not necessarily a one-to-one relationship between local agricultural conditions and global temperature fluctuations. Hence the fate of unsuccessful communities in the North Atlantic cannot be explained simply by referring to
temperature diagrams. Incoming drift-ice to fjords with agriculture may cause severe temperature drops in South Greenland and North Iceland, even during otherwise benign temperature regimes (Ogilvie 1992; 1998; Ogilvie and Jónsson 2001). In the Faroes the temperatures from the period 1961 – 1988 were compared to the temperatures in the preceding 30-year period 1931 – 1960. Despite the global warming which occurred 1961-1988 (see Fig. 8) the temperature in the Faroes dropped in this period, due to increased cloud cover. The clouds were caused by more evaporation from the sea. In the same period the windiness increased from an average of 5.1 to 5.9 meters/second (Søgaard 1996, 24-26). The Faroes featured a special cultivation system for cereals based on hoe agriculture, a bit like the lazy bed systems of Ireland and the northern British Isles, but terraced. There were several cultivation techniques; the most important is called ‘reinavelta’, see Fig. 7 (Joensen 1980, 22-40).

In Iceland a handful of sites with terraces and lazybed-like formations have been located archaeologically (Guðmundsson and Snaedottir 2001; Guðmundsson et al. 2004; Simpson et al. 2002). Place-names with the prefix ‘Ákr-’ (Old Norse ‘cereal fields’) support the notion that cereals were indeed cultivated in favourable spots in medieval Iceland.

As mentioned, there is no evidence of cereal cultivation in Norse Greenland. This does not mean that Greenland was totally without crops: in the archaeological record in the North Atlantic feature small, walled-in ‘gardens’ which are known historically as ‘kólgarður’ (cabbage gardens) or ‘hvöngarður’ (i.e. gardens for Angelica Archangelica, a rhubarb-like plant rich in vitamin C). It is safe to assume that cabbage and root-crops were cultivated in these gardens, even in Greenland. In addition to wild berries, the crops must have been important to prevent vitamin-C deficiency.

Fig. 8
Mean temperature curve for the last 2000 years in the Northern Hemisphere, based on high resolution tree-ring data, low resolution proxies from sediments, and instrumental records from the last two centuries. The curve is presented as deviations from the 1961-1990 average. (From Lagerås 2007, 30 referencing Moberg et al. 2005; see also Ogilvie 1992; Ogilvie and Jónsson 2001).
4. Farming economy
As already stated, the farm is seen as the basic building block in the Norse society; it was essential in all the Norse settlements, even in Greenland. Zoo-archaeological evidence suggests that the colonists all over arrived with much the same 'starting kit' of livestock, consisting of cattle, sheep, goats, pigs, horses, and dogs (McGovern et al. 2001; McGovern et al. 2007). Crops, animals, technology, skills, and social organization constituted the 'cultural capital' which was introduced to the islands by the Norse (Mairs 2007, 39). As things developed, they would design their flocks, land, and economic strategies to suit the local conditions. Pigs were important initially, but their popularity waned after the first centuries. Their ability to reproduce fast would have been essential at 'landnám', as would their capacity for digging up roots in the cleared areas; but the same properties ultimately made them hard to control (McGovern et al. 2007; Arge et al. 2009; also in Laws of Early Iceland (Grágás) K § 207 in Dennis et al. 2000, 139). Cattle was important both as a traditional measure of wealth in Norse society, and as the key to the dairy economy which was the mainstay of the farming economy in the North Atlantic. Cattle are excellent meat producers, but a pure meat economy is highly energy demanding. The dairy economy is less resource demanding: a zoo-archaeological 'dairy-profile' is characterized by a high percentage of neonatal bone fragments in the middens, indicating that a high percentage of calves were culled to maximize milk off-take for humans. The energy gain for dairy production vs. meat production is on the order of four to one, which makes it the most efficient way to utilize a limited fodder supply (From McGovern in Lucas 2009; also Halstead 1998; Hambrecht 2006).
It is an interesting side issue that the surplus of calves in the dairy economy may have been the direct prerequisite for the Icelandic medieval literature by making cheap vellum available for parchment production. This is not a marginal issue: today ca 700 vellum manuscripts from Iceland are preserved, corresponding to ca. 35,000 hides, or 10,000 calves per century. (Hallór Hermannssón 1929 referenced in Nordal 1952; and 1954). These represent the preserved manuscripts only; the initial book production would have been much larger. Literature was a spiritual undertaking, but books were agricultural products.
Given the hierarchic organization of Norse society, it is hardly surprising that zoo-archaeology shows more of a 'meat-production profile' at the high-status farms, i.e. most of the cattle at these farms were allowed to live beyond the peak of their growth curve before they were butchered (McGovern et al. 2007; McGovern in Lucas 2009). Sheep was a necessary component in the 'starting kit' as the main contributor to clothing. From the thirteenth century zoo-archaeological investigations show a clear increase in the number of sheep relative to cows (McGovern et al. 2007; see also Mainland and Halstead 2005). This may have several reasons; cattle are extremely labor demanding and need indoor feeding for a better part of the year (nine months in Greenland), and consume a lot of home-field grass during this period. The relative increase of sheep in the sheep / cow ratio may be explained by two different (but not mutually exclusive) models: one environmental and one fiscal. In the face of a cooling climate sheep would be a better option than cattle because they are less demanding in terms of winter feed; and on the pastures they can dig up grass even under the snow. The graph in Fig. 8 shows that the Little Ice Age reached its coldest in the sixteenth century; but a close inspection will reveal that the decline
of the Medieval Warm starts in the thirteenth century. In regions as marginal as the
North Atlantic this could be significant (Mainland and Halstead 2005). A shift of
emphasis from cattle to sheep would be a sensible response to a cooling climate.
Alternatively, Iceland produced two commodities of commercial value; fish and
woolen cloth (Perdikaris and McGovern 2008). In the thirteenth century each
Icelandic farmer paid a tax of 20 ells of ‘vaðmál’ (homespun cloth) to the Norwegian
king. ‘Vaðmál’ was also used for other pecuniary transactions such as land-rent.
Hence the increase in sheep relative to cattle may reflect a growing interest in wool
as a commercial product (see also Butler 2006, 29-50).
As already mentioned, overgrazing and erosion has been a huge problem in Iceland
(Gerrard 1991; Dugmore et al. 2000; Dugmore et al. 2006; Mairs et al. 2006).
Extensive grazing by free-ranging sheep appears to be to blame, but mechanisms to
prevent overgrazing were in place already by the twelve hundreds, so there is no
saying that overgrazing had to happen (Laws of Early Iceland (Grágás) K § 201 – §
204 in Dennis et al. 2000, 131-137; Simpson et al. 2001, 176; see also Thomson et
In the Faroes, a special system to design flock size on communal grazing was
developed (the concept ‘skipan’). The ‘Seyðabraðvi’ (‘the sheep-letter’) from June 24
AD 1298 introduced rules for eliminating ‘wild’ sheep (Christiansen 1991, 48).
The home-field was the ‘heart’ of the farm. Its size and productivity were closely
linked to the size of the herd: manure from the stables was needed to fertilize the
home-field, which in turn produced the better part of the winter fodder. Additional
fodder was collected from meadows, bogs, and at the shielings (Amorosi et al. 1998),
but still a certain home-field / herd-size ratio had to be maintained. Soil analyses
have showed that all across the North Atlantic the home-fields were cared for and
improved (Adderley and Simpson 2005; Amorosi et al. 1998; Sveinbjarnardóttir et al.
2008).
5. Subsidiary subsistence economies
The farms could not survive without the surplus from ‘wild’ resources. The Faroes are
famous for its pilot-whale drives, where schools of whales (Globicephala melas) are
driven into the shallows and speared (Joensen 1976); but fishing and stockfish
production has always been equally important. Eventually stockfish also became an
important export commodity. Finally there was the bird catching; eggs were collected
and waterfowl netted in the nesting colonies of puffin (Fratercula arctica), common
auk or common murre (Uria aalge), and razorbill (Alca torda), but also fulmar
(Fulmarus glacialis) and the northern gannet (Morus bassanus) were caught
(Joensen 1980, 105-118).
Iceland was first and foremost a place for fishing; zoo-archaeological examination of
middens show that stockfish (dried fish mostly of the gadid stock) was part of the
staple food for both coast- and inland settlers directly after ‘landnám’ (McGovern et
al. 2006; McGovern et al. 2007). From early on the Icelandic Westfjords produced a
surplus of stockfish which was traded to other parts of Iceland (Jón Viðar Sigurðsson
pers. comm.). From the twelfth century stockfish and shark-liver oil became huge
commercial export articles from Iceland (Edvardsson 2005; Amundsen et al. 2005;
McGovern et al. 2007; Perdikaris 1999; Perdikaris and McGovern 2005; and 2008),
together with woolen cloth. The size of the Icelandic stockfish export is hard to
estimate, as much was sold in violation of rules imposed by the Norwegian king, but
by the fourteenth century Icelandic stockfish was a well-known commodity on the
European market (Wubs-Mrozewicz 2008).
Salmonidae (trout and arctic charr) for local consumption were caught in lakes and rivers, and in the Lake Myvatn region thousands of eggs from ca. 40 nesting duck species were harvested (McGovern et al. 2006; McGovern et al. 2007). Finally, seals were caught in some areas, mostly by net (Laws of Early Iceland (Grágás) K § 212 in Dennis et al. 2000, 142 and footnote 282). Like in the Faroes, waterfowl were caught at the nesting colonies.

Norse Greenland was the only area with a land mammal of some size; the caribou (Rangifer caribou) was hunted both in the Eastern and in the Western settlements, but appears to have ended up selectively on the table at the richest farms (McGovern et al 1996). The largest source of staple-food was the migratory seals; the harp (Pagophilus groenlandicus) and the hooded (Cystophora cistata) seals which pass the West Coast of Greenland on their way north in the early spring. The Norse Greenlanders caught them in huge numbers in some sort of communal effort, possibly organized in manners that resembled the Faroese pilot-whale drives (McGovern 1986; Diamond 2005, 231; McGovern et al. 2007).

Rhetorically Jared Diamond (2005, 240) asked why the Norse Greenlanders did not learn from the Thule Inuit to hunt ringed seal (Pusa hispida) with toggle harpoons. The answer is probably that they needed seeds in such quantities that communal net catching of the migratory species was the only option.

Another issue – why the Norse Greenlanders did not eat fish (1) – was also raised by Diamond (2005, 229-230). The question is based on negative evidence: it is true that fish-bones are rarely found in Norse Greenland middens, while similar middens in Iceland are teeming with fish-bones, but this is not proof that the Greenlanders did not eat fish. Analyses of stable isotopes in human skeletal material show that the Norse Greenlanders did indeed eat both fish and marine mammals; they must simply have disposed of the fish-bones in ways which, at least this far, has made them invisible in the archaeological record. Most likely, they were utilized in some way as an energy source.

The stable isotope analyses on the skeletons of Norse Greenlanders show that the population started out with a diet consisting of some 30 % marine food at ‘landnám’ around AD 1000. By the fifteenth century the maritime component was in the range of 50 – 80 % (Arneborg et al. 1999; Dugmore et al. 2007, 26). This is normally seen as an ecological adaptation to a more marine diet in the face of the oncoming Little Ice Age.

Norse Greenland was famous for its export of walrus ivory, which was acquired in the region known in the written sources as ‘Norðurseta’ (the Northern hunting-grounds) which most scholars identify with Disko Bay (Gulløv 2004, 212). ‘Arctic exotica’ such as falcons, polar bears, fox pelts, narwhale- and walrus tusks, were cash-crop aimed for export. These commodities fetched good prices on the European market, but it is doubtful whether the hunters in Greenland benefited. More likely, the ‘arctic exotica’ brought status and luxury to the elite.

Even though the Norse Greenland export came to an abrupt halt around in the mid-fourteenth century, the wool- and stockfish-industries of Iceland and the Faroes continued to grow in the centuries after that. This is indeed a paradox, as the export was increased during adverse climate conditions (the Little Ice Age).

The combined effects of cooling climate and increased export represented a double stressor to the North Atlantic communities: in addition to the adverse climate conditions more and more of the local products were diverted to be consumed somewhere else (see O’Sullivan 2008, 48; Lambin 2005). Often this kind of development is associated with increased social complexity (see O’Sullivan loc. cit.).
This was the situation in Iceland, but it is also clear that during the Middle Ages the North Atlantic communities (except Greenland) came more and more under the influence of the European merchant economies. The European populations needed food, and the North Atlantic cod could be harvested in seemingly unlimited amounts. What is more, the cod was not vulnerable to the cooling of the Little Ice Age. To the Norse, this was a welcome subsidy to a diminishing farm production.

6. Farmers, fishermen or hunters?
How should the Norse in the North Atlantic be understood? Were they farmers who went fishing, or fishermen who went farming?
The traditional approach has been to see them as farmers, simply because farms and farming activities are omnipresent in the written sources: in the land registers, in the tax cadastres, and in family sagas. Hunting and fishing has not received even a fraction of that attention, despite the obvious importance of marine food. The ‘agrarian approach’ to the Norse farm has been deemed biased by some scholars who argued that the farm did not represent the ‘real’ subsistence economy. The ‘real’ economy, they argued, was hunting and fishing (e.g. Bertelsen 1998, 261; 1999; and 2005; Edvardsson 2005).

‘The big problem is whether we should consider the mixed economy [i.e. farming and fishing] as a strategy to cope with the marginality of farming or if we should think of it in terms of a structural dichotomy…’ (Bertelsen 1999, 264-265).
The semantics are less relevant – the farm stands out as the single most important social and economic institution in the Norse world. This was true for the North Atlantic islands, and it was true for North Norway way into the Middle Ages. The Late Iron Age chieftain’s hall at Borg in Lofoten in North Norway has a length of more than 80 meters; it is the largest hall ever excavated in Scandinavia, and a powerful symbol of the importance of farms (Munch et al. 2003).

It is easy to get lost in the various types of adaptation to the local resources, and to forget that Norse adaptation was about more than just staying alive. The European merchant economy evolved rapidly during the Middle Ages, as did the social complexity of the Norse societies. With the introduction of Christianity and the Roman Catholic Church, the complexity and the social stratification increased. The development from charismatic kingship in the Viking Period to states in the High Middle Ages added to the complexity.
The Norse communities were a fringe which at first supplied Europe (and the Middle East) with ‘arctic exotica’. Soon, however, they were engaged in the European food trade as major suppliers of marine protein. The distribution was taken care of by European traders; the Hansards, the English, and the Dutch (Wubs-Mrozewicz 2008).

There has been a tendency to forget that events on the European scene (and market) had consequences at the northern margins of the world. Commercial fishing in the north Atlantic was not only about local climate and environment; it was increasingly about events that affected the European markets.
The value of farms was not only estimated on the bases of their agricultural qualities. The ‘lunner’ (i.e. privately owned assets such as driftwood beaches, egg- collection sites, drying-racks for stockfish etc) were seen as taxable farm resources.

As noted above, the Norse Greenlanders based much of their subsistence on migratory seals (McGovern 1986; Diamond 2005, 231; McGovern et al. 2007). Stable isotope analyses show that when the environmental conditions deteriorated they
increased their intake of marine food up to around 50 - 80 percent of the total (Arneborg et al. 1999; Dugmore et al. 2007, 26; Dugmore et al. 2007).

Ragnar Edvardsson describes how only 20 – 30 percent of the farm value in the Icelandic West fjords was based on agriculture, while 50 – 60 percent came from fishing. In more benign regions in Iceland the farming represented 60 – 80 percent of the value (Edvardsson 2005, 53; also Krivogorskaya et al. 2005).

For North Norway Reidar Bertelsen argues that some of the Iron Age sites based 75 percent of their subsistence on cattle and sheep, while others based 75 percent on marine resources (Bertelsen 2005, 22-23), although Perdikaris (1998, 104-108) concludes differently from the same material.

It is safe to state that fish was important, but this does not make the agrarian approach to the Norse communities ‘wrong’, nor does it make the hunting-and-fishing approach ‘right’.

The farm aspect is a question of social organization: in the ‘Landnámabók’ (‘the Book of Settlement’ written in Iceland in the twelfth to fourteen century) and in the Icelandic law code ‘Grágás’ (Dennis et al. 2000) practically all legal rights and all access to resources are somehow linked to farms. So from an ideological as well as a judicial point of view, the Norse communities were farming communities. The farm was the common denominator; whether people de facto lived from farm produce (local or imported), or whether they lived from fishing, seal-hunting, whaling, and bird-catching. They still belonged to a farm.

In a cultural perspective it may be argued that the Norse expansion into the North Atlantic was the extension of an idea; the idea of the farm-based society. In some respects this may sound strange since it was the ship and the maritime capabilities of the Norse that made the expansion across the North Atlantic possible, and to a great extent secured the survival of the Norse. But the purpose, the incentive, the whole utopian idea of a new society was based on the idea of the farm.

In their ‘real economy’ the Norse communities depended heavily on ‘wild’ resources. In this perspective, the amount of labour and energy invested to keep the domestic animals alive over the winter may look completely out of proportion. Still, it is obvious that they did go that extra mile, again and again. This is hard to explain unless the farm also was essential also for social, non-economic reasons.

Fig. 9
Coastal settlement and trade-routes in Northern Fennoscandia ca. A.D. 900-1000. The coastal strip with permanent farm-based settlement (diagonal hatching) was the Norse ‘Hålogaland’. The ‘Sámi’ settlement areas (horizontal hatching) was called ‘Finnmork’. (From Årseth 1982, 10).
Fig. 10
Finnmork ca. AD 1300 – 1500. Note the expansion of Norwegian fishing-villages (black dots) on the outer coast of the ‘Sámi’ homeland ‘Finnmork’ in this period. The fortress at ‘Vardøhus’ was raised by Norwegian King Håkon V. Magnusson AD 1307 to guard the Norwegian sphere of interest, i.e. both the commercial fishing and the taxation of the ‘Sámi’. In the interior the ‘Sámi’ were taxed by Norwegians; by ‘Birkarlar’ on behalf of Sweden; and by Karelians on the behalf of Novgorod (From Aarseth 1982, 14).

The commercial fishing which developed in the Lofoten region from the twelfth century triggered a Norwegian expansion to the north, into Sámi territory (Fig. 9). Pure fishing villages with no agrarian potential were established on the outer coast. It was a commercially driven expansion, a direct response to the growing market for stockfish in Europe. This particular settlement pattern could only have developed under the umbrella of the Norwegian king: After the rise of the Lofoten stockfish trade in the twelfth century, the town of Bergen in West Norway was established as a royal and clerical fiscal point. Foreign traders to Norway were not allowed beyond this point, and this benefited a new class of North Norwegian ‘big-men’ who provided the logistics between the fishermen up north, and the foreign merchants in Bergen; lifting fish one way and agricultural produce the other.

It was this royal protection which allowed the establishment of specialized fishing-villages in North Norway. When commercial fishing developed in Iceland, it was without permanent fishing-villages; the Icelandic fishermen always retained their association with a farm; hence they had something to sustain them in periods of ‘black sea’.

The picture which emerges of the ‘northern frontier for agriculture’ in the North Atlantic is complex. Norse societies appear as bundles of farm-based communities, but with a built-in economic duality; hence the term ‘the green and the blue foot’ of the Norse economy. This duality provided the Norse with alternative strategies; in times of agrarian crisis they could turn to the sea, and in case of ‘black sea’ they could turn to their farms.

Despite its dual resource base, the population in the North Atlantic islands suffered a double exposure which challenged their very existence: the stress of a rapidly cooling climate during the Little Ice Age coincided with a socio-political development from chiefly, ranked societies in the Viking Age to stratified societies in the High Middle Ages. This development was not home-grown, but reflected socio-political changes all over Europe. In a stratified society there are less people taking part in the actual production, and so the remainders have to produce more to maintain the social order.
This development must have been amplified by the fact that the climate was deteriorating. (See Vasey 1996 on population and ecology). O'Sullivan explains that the environmental impact of stratified societies is inherently greater *per capita* than that of ranked societies (O'Sullivan 2008, 48). He writes: “The more complex the society, the greater the inequality and the greater the surplus required (Harris 1988). In that more and more local production is diverted to support non-local consumption (as opposed to local need), in strict ecological terms, the more complex a society, the more it lives beyond its (local) means.” (O'Sullivan loc. cit.; also Lambin 2005; Holling and Gunderson 2002; Dugmore et al. 2007b).

The historic events that played out in the different areas and regions of the North Atlantic are many and complex, and cannot be understood simply by pointing to a few economic and environmental ‘triggers’. Reality is always more complex than the theoretical models; but on a larger scale, this is the environmental and socio-political framework within which the farming in the North Atlantic existed.

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