

DECONSTRUCTING DEMAND FOR DAIRY:

Investigating decline in Nordic provisioning systems

by Marius Korsnes, Mikael Nurminen, Ray Pritchard & Line Kryger Aagaard

This paper examines the Nordic dairy sector through a comparative, historical, and sociotechnical analysis of milk production and consumption in Norway, Denmark, Finland, and Sweden. While the region shares cultural and institutional similarities, the four countries diverge in per capita milk consumption, product segmentation, and industry structure. Through the lens of systems of provision, we explore how sociotechnical and institutional configurations actively enact and stabilise dairy's central role in Nordic food systems, despite growing concerns about its environmental and ethical implications. We argue that milk's lasting presence in the Nordic countries is not a given cultural fact but is continuously enacted through historically entrenched cooperative models, state subsidies, public health narratives, and corporate consolidation.

Our comparative lens reveals striking institutional synchronicity across the four countries: dairy propaganda offices, low-fat milk variants, and production quotas were introduced at similar times, suggesting a regionally entangled provisioning system, mutually shaped by shared technologies, cross-border industry influence, and common exposure to international trends such as the saturated-fat scare. Our analysis also highlights how dairy's core biophysical inefficiency, converting water, feed, and energy into milk not originally intended for human consumption, is obscured by narratives of innovation and value creation, and that intensification and product diversification do not by themselves yield sustainability gains. By making visible the enactments that sustain current demand, the paper contributes to ongoing debates about how Nordic societies might move toward more genuinely sustainable food futures.

Keywords: Systems of provision; Dairy; Nordic countries; Enactment; Strong sustainability

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Introduction

Transforming food systems to meet climate and sustainability goals is one of the most urgent and complex challenges of our time (Zurek et al., 2022). Eating is increasingly accompanied by a growing tension between longstanding production and consumption practices and the ecological boundaries they continually overstep. In this context, animal foods such as dairy are deeply entangled with narratives of national identity, health, and rural life, while also becoming sites of growing environmental and ethical controversy (Loeng & Korsnes, 2023). This paper critically examines milk's enduring centrality in the Nordic region through a sociotechnical, historically informed analysis of dairy production and consumption across Norway, Denmark, Finland, and Sweden.

The Nordic countries have long been considered among the most "dairy-intensive regions" globally (DuPuis, 2002, p. 47). Despite high levels of environmental awareness and comparatively progressive policy environments, current Nordic diets continue to exceed planetary boundaries across most environmental impact categories (Harwatt et al., 2024). Among dietary components that contribute most to this ecological overshoot are meat and dairy products, which account for the largest share of food-related emissions and land use (Trolle et al., 2024). Consequently, we examine both the production and consumption of dairy not only due to their biophysical consequences but also their social, institutional, and cultural embeddedness.

In this paper, we argue that a transition to more sustainable food systems in the Nordic countries requires more than technological efficiency gains or individual behavioural change (Niva et al. 2019). Drawing on constructivist STS scholarship (Woolgar & Lezaun, 2013), we treat dairy's prominence as actively shaped by institutional structures and provisioning systems, and we advocate for a strong sustainability approach that takes this seriously (Spangenberg, 2014; Lorek & Fuchs, 2019). Consumption thus seen as co-shaped by state subsidies, dietary guidelines, school milk programmes, marketing narratives, and the historical evolution of provisioning systems. In essence, by not taking present-day demand for granted, we ask: why is cow's milk consumed in the first place?

In the Nordic region, like in most of Europe, agriculture has undergone significant structural transformation over the past decades, marked by increasing concentration, specialisation, and industrialisation (Giller et al., 2021). Farm numbers have steadily declined, while average farm size and production per unit have increased, reflecting broader trends of mechanisation and capital intensification (Giller et al., 2021; Loeng & Korsnes, 2023). This consolidation is particularly visible in the dairy sector, where fewer but larger farms dominate the landscape, often integrated into cooperative or corporate supply chains (e.g., Almås & Vik, 2015; Rytönen, 2021). Simultaneously, downstream food systems have seen increasing vertical integration, with powerful supermarket

chains and food processors exerting growing control over pricing, marketing, and consumer access to an ever-widening range of highly processed products and composite foods.

While the Nordic countries are often viewed as a coherent cultural and institutional bloc, with foodscapes shaped by similar historical, political, and demographic developments (Gronow & Holm, 2019), differences exist in how dairy is produced, consumed, and understood. As we will outline, per capita milk consumption and industry consolidation vary across the four countries, despite commonalities in welfare regimes, cooperative histories, and public health frameworks (see Table 1 for key figures). These differences invite a comparative perspective, allowing us to examine how distinct national trajectories can illuminate the social and institutional mechanisms that either sustain or challenge entrenched consumption patterns.

We situate this research within broader debates on food system transformation, in which dairy and animal agriculture more generally have come under increasing scrutiny (e.g., Morris et al, 2021; Otter, 2020). Much research has brought awareness to the unsustainability of animal-based diets (Poore & Nemecek, 2018; Springmann et al., 2018; Röss et al., 2022), which is especially salient in the Nordic context characterised by high levels of animal product consumption, despite rising awareness of their environmental consequences (Harwatt et al., 2024). However, understanding why dairy consumption remains resilient in some countries and more amenable to change in others requires attention to historical, institutional, and cultural specificity—something that has received insufficient attention in the Nordic research context.

To address this gap, we ask: How have institutional arrangements, historical developments, and cultural narratives shaped the demand for milk? What explains the changes and differences in dairy demand in the Nordic countries? And what can differences and similarities in demand teach us about the sociotechnical conditions for sustainable food transitions?

We begin this paper by outlining the theoretical framework underpinning the study, drawing on STS and systems of provision, situated within a strong sustainability perspective. Next, we present our methodological approach. Following this, the four national case studies are presented, each providing a historical account of the development of dairy provisioning systems, the role of the state and industry actors, and the cultural narratives that have sustained high levels of dairy consumption. Lastly, we compare the variables identified across the case presentations, arguing that examining these differences deepens understanding of how socio-technical systems shape consumption trajectories. Our analysis highlights how efforts to reduce the environmental impact of food systems must contend not only with technological

and economic factors, but with deeply rooted social imaginaries, policy legacies, and institutional path dependencies.

	Norway	Sweden	Denmark	Finland
Population, 2024	5,509,733	10,589,835	5,973,136	5,626,414
Dominant cow type (hybrid or pure-dairy)	Norwegian Red (hybrid)	Swedish Holstein (50%>), yet significant number of Swedish Red-White	Pre-dominantly Holstein (pure dairy)	Ayrshire and Holstein (pure dairy)

Consumption, kg per capita, 2022, liquid milk	75,5	62,8	68,2	92,7
Raw milk delivered to dairies (in 1000 tons), 2023	1.564	2.869	5.812	2.383
Number of dairy farms, 2023	6500	2600	2312	4364
Dairy farms per 100,000 inhabitants	120	23,6	38,7	77,6

Table 1: Relevant information about the four Nordic countries

Sources: Jordbruksverket (2023), Luke (2025), Mejeriforeningen (2023), Helsedirektoratet (2025), FAOSTAT (2025), CIA (2025).

Provisioning, demand and sufficiency

Since the early 1990s, the commodity chain perspective, particularly the systems of provision (SOP) approach (e.g., Fine and Leopold, 1993), has been influential in studies of food and food systems (e.g., Dixon, 1999; Guthman, 2002). This framework effectively emphasises the 'vertical' dimensions of food systems by examining the food chains that sustain and shape the products ultimately consumed. We adopt a constructivist, sociotechnical perspective, suggesting that current demand patterns are neither inevitable nor natural but have been shaped over time (Rinkinen et al., 2020).

Central to our approach is the idea of enactment: rather than treating dairy's prominence as a pre-existing cultural or nutritional fact, we attend to the practices through which it is continuously brought into being as natural, necessary, and desirable (Woolgar & Lezaun, 2013; 2015). This distinguishes our approach from accounts that see demand as a finished achievement. Enactment foregrounds the ongoing, effortful work required to stabilise consumption patterns that could, in principle, be otherwise. Both human and non-human entities contribute to the assembly and maintenance of networks and their effects on everyday decisions, wants, needs, and habits (Mol, 2010). In essence, therefore, what we eat is influenced by the historical trajectories, histories and performances of everyday practices in situated contexts. Thus, the object of our study concerns the continuous becoming of multi-actor networks, how they are maintained, and how they might be undone.

Our work is inspired by DuPuis' analysis of how cow's milk in the USA was crafted into a 'perfect food', highlighting the various dynamics co-constituting demand for a product never intended for human consumption (DuPuis, 2002). In the American context,

urbanisation and industrialisation enabled the modern practice of daily milk consumption through the industrial food system. As argued by Jönsson (2005), through the concept of 'condensed milk', milk not only represents sustenance: it is a 'condensed' product directly embedded with political, cultural, and societal dimensions, with production and consumption being highly interlinked.

The SOP perspective has served as a valuable analytical framework for studying diverse food systems globally, demonstrating how consumption patterns are shaped by actors across the food chain, beyond what can be explained by individual tastes or price mechanisms (e.g., Jönsson, 2005; Korsnes & Loeng, 2024). Common to many of these SOP approaches is an interest in critiquing the role of capital and profit-seeking in commodity networks (e.g., Guthman 2002). Thus, we also connect our approach to the notion of strong sustainability, which similarly challenges existing production and consumption paradigms and advocates systemic transformation to fully meet the sustainability challenges of our time (Spangenberg 2014; Lorek and Fuchs 2019). We aim to outline the dairy SOPs of the four Nordic countries and compare and contrast them.

We see 'strong sustainability' as an umbrella term for approaches that seeks to address the underlying drivers of unsustainable consumption and to counter accelerating demand and rebound effects associated with efficiency gains. In this way, strong sustainability foregrounds ecological limits and calls for a reorientation of both economic structures and societal norms. To us, sufficiency is a useful operationalisation of strong sustainability, asking not only how production can be made less harmful but whether current levels of consumption are necessary in the first

place: How much is enough? And for whom? (Princen 2005; Sandberg 2021). Sustainability without sufficiency, by contrast, risks remaining growth compatible. Thus, 'weak sustainability' suits existing provisioning systems well, allowing dairy SOPs to pursue efficiency improvements and technological innovation while maintaining or increasing throughput (Farstad et al., 2021; Sandberg, 2021)

In the context of Nordic food systems, where consumption levels are high and dietary impacts on land use and greenhouse gas emissions are substantial, a sufficiency lens is particularly useful. From a SOP

perspective, strong sustainability and sufficiency together help interrogate how provisioning systems, through infrastructures, technologies, policies, and cultural narratives, actively construct demand that often exceeds both physiological needs and environmental limits. Incorporating sufficiency principles into such systems remains rare, as they are typically designed to generate abundance and are ill-suited to addressing decline (Bååth, 2018; Korsnes & Loeng, 2024). Concretely, this means attending to the production and consumption practices through which dairy demand is enacted and stabilised, and to the conditions under which such enactments might become undone.

Methodology

In this article, we draw on Mill's comparative method of agreement, known as Most Similar Systems Design (MSSD) (Moses & Knutsen 2007). This method involves selecting cases that are highly similar in most respects, such as culture, economy, and institutions, while differing in the outcome of interest. The underlying logic is that such similarity helps isolate the factors that explain the variation in outcomes. Of course, we do not assume that the four countries compared here are identical or that similarities can account for all relevant conditions. Nevertheless, the Nordic countries' shared characteristics as longstanding democracies with comparable cultural and institutional contexts provide a useful basis for exploring why dairy consumption and production levels differ.

The Food and Agriculture Organisation of the United Nations publishes statistics on dairy consumption by country, but these are not fully unified across the four countries. This is because once milk is delivered to dairies, it can be processed into a wide range of products, not all of which are human-consumption ready (such as powdered milk), before being exported and further processed in another country. In addition to the different product categories (such as varying fat contents), each country also uses different methods (e.g., some include numbers for direct farm sales, i.e., milk not delivered to dairies) and definitions (e.g., converting numbers to liquid milk equivalents). On the consumption side, we have therefore opted to use country-specific statistics, as they provide a good level of detail on products consumed and also show the diversity of dairy product classifications across the four countries. These numbers are not necessarily directly comparable, but they provide a good overall

indication of changes in the consumption of liquid and solid dairy products. Our comparative argument, therefore, rests primarily on the institutional, historical, and sociotechnical analyses of each provisioning system, with statistical data serving as contextual illustrations rather than as the primary evidence base. This is consistent with the MSSD logic underpinning our design: the comparative leverage comes from examining similar systems under similar conditions, not from achieving full quantitative commensurability across cases.

On the production side, the numbers are more uniform, since milk delivered to dairies is a single, relatively consistent product: liquid milk. Danish cows' milk collection fluctuated from the 1960s to the 1980s before stabilising at approximately 4500 tonnes of raw milk per annum (see Figure 1). Since 2005, this has steadily increased to nearly 6,000 tonnes p.a. in Denmark. Finnish, Swedish, and Norwegian dairy production, on the other hand, appears stable but is slightly decreasing.

Lastly, a note on the numbers: roughly 10 kg of liquid milk is needed to make 1 kg of cheese, and about 20 kg of liquid milk is needed to make 1 kg of butter. Therefore, although per capita consumption levels of liquid milk have declined in all four Nordic countries, the total amount of milk delivered to the dairies might not necessarily decrease as much if cheese and butter consumption increases, or if exports increase, or some dairy products are used as animal feed (as, e.g., in the case of Denmark, see Appendix 1). Production-wise, there is no difference whether a person drinks 200 litres of whole milk, eats 20 kg of cheese, or 10 kg of butter.

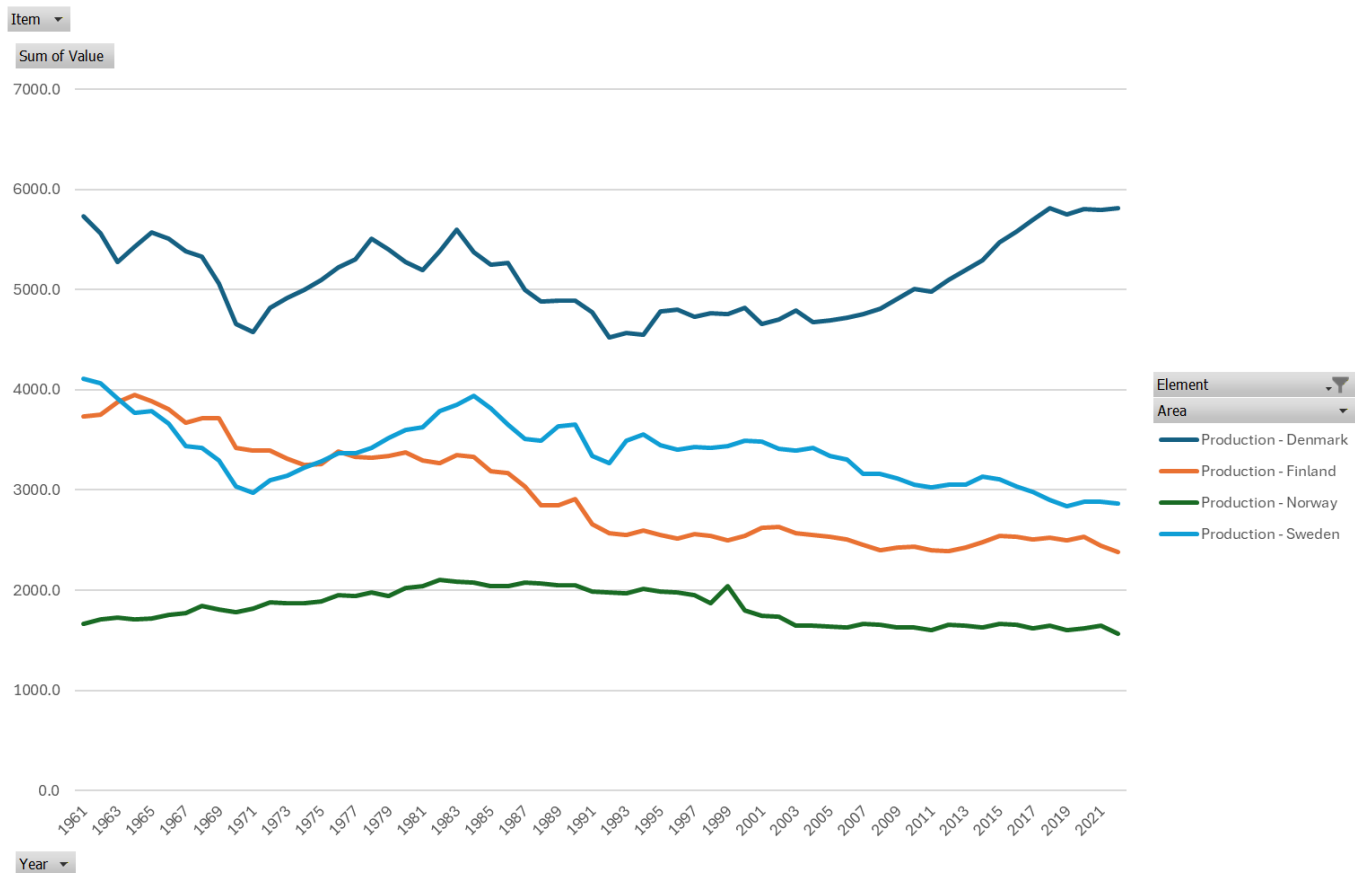


Figure 1: Raw milk delivered to dairies produced in each Nordic country
 Source: FAOSTAT (2025)

The four cases: History of dairy production and consumption until today

Dairy in Denmark

The foundation of the Danish dairy industry was laid during the late 19th century, a period marked by significant agricultural transformation. According to Henriksen et al. (2012), this shift was driven, among other factors, by the diversification of Danish agriculture in response to the grain sales crisis (1876–1894), spurring a transition from grain to animal production, particularly dairy and meat. Technological innovations, such as the mechanical centrifuge for cream separation (invented in Sweden) and improvements in transportation during the 1860s, further enabled this shift by facilitating both production and export. Towards the end of the 19th century, butter accounted for 90% of Denmark's total agrarian exports (Jönsson, 2005).

Equally important was the rise of the cooperative movement, which became a defining feature of Danish dairy production. Local cooperative dairies emerged in the late 19th century, creating a model of collective ownership that remains influential to this day. These cooperatives not only consolidated production but also constructed a narrative that positioned dairy farming as emblematic

of Danish national identity (Mordhorst, 2014). By the mid-20th century, this cooperative ethos had firmly established itself as a Danish model for democracy and the economy. This cooperative structure, with a strong connection between the state and dairy enterprises, also spread to Sweden and Norway (which were in a union between 1814 and 1905) (Jönsson, 2005).

The 20th century saw further consolidation and modernisation within the dairy sector. For example, the establishment of Mejeriselskabet Danmark (MD) in 1963 sought to unify Danish dairies into a single cooperative entity to enhance competitiveness in the European market. Although this initial effort faltered, the company was subsequently adopted through mergers, culminating in the creation of Arla Foods in 1999, a merger between MD Foods and the Swedish cooperative Arla (Sørensen 2012). Today, Arla Foods is one of the largest dairy companies in the world, underscoring both the historical significance and contemporary global reach of Danish dairy production. However, the company has also received severe criticism in subsequent decades, among other concerns,

for a near-monopolistic business model that locks farmers to the soil and employs illegal competition tactics (Mordhorst 2014: 116). While the volume of milk delivered to Danish dairies has increased within the last decade (from 4,915 mil. kg in 2012 to 5,685 mil. kg in 2023), the number of dairies has declined in the same period (from 6,253 to 2,312) (Statista 2024)—showing a further concentration of the production on fewer, but larger farms.

Since the 1960s, dairy products have been central to perceptions of “proper food” in Denmark. Meat and dairy products, including milk, butter, and cheese, have dominated Danish meals, with a recent food-habits survey indicating that 73% of Danes identified meat as the main ingredient in their dinners (Holm et al., 2019). Especially milk has been institutionalised as essential to health and nutrition. National dietary guidelines have long promoted milk as a primary source of calcium, recommending daily consumption of up to 300 ml of milk plus 20 g of cheese for both children and adults (Fødevarestyrelsen 2025b).

Similarly, a nationwide school milk program from MD/Arla has, since 1991, ingrained milk consumption among Danish children from an early age. Marketing campaigns reinforced this, including EU-subsidised promotion that allocated 70% of funding to meat and dairy between 2016 and 2019, compared to only 12% to fruits and vegetables (Klimarådet 2021, p. 56). From 1980 to 2001, MD/Arla also distributed free cookbooks, the *Karoline Kogebøgerne*, to households nationwide, encouraging the use of dairy products in everyday cooking.

The centrality of dairy in Danish culture is also evident in broader structural and discursive narratives. For decades, the idea that “kids must have milk to grow up healthily” or that “you can only get full if you have meat” has dominated public discourse (Freudendal-Pedersen et al. 2026). These narratives reflect deeper cultural values and have been supported by official dietary advice. Until 2021, these guidelines emphasised choosing lean meat and dairy over reducing consumption altogether. Only recently has the Danish government incorporated advice to “eat less meat” into the national dietary guidelines. Lean dairy products still figure in the recommendations (Fødevarestyrelsen 2025a).

The Danish dairy industry faces challenges in a changing food landscape. Global shifts toward plant-based diets and increasing environmental concerns are prompting questions about the sustainability of meat- and dairy-centric food systems. Nevertheless, the strong cultural narratives and institutional frameworks supporting dairy in Denmark suggest that its influence will persist, even as these systems evolve. Recent data on Danish citizens’ food shopping showed that although plant milk sales increased sevenfold from 2007 to 2021, sales of cow milk were still 27 times higher in 2021 (Fagt et al., 2023, p. 4).

Despite the declining trend in domestic dairy consumption (see Figure 2), dairy exports are a significant and growing sector of the

Danish economy. The value of dairy exports grew from 16.8 billion DKK to 28.0 billion DKK between 2014 and 2024, highlighting the sector’s export orientation (Mejeriforeningen, 2023). Denmark is today a key European player in cheese and butter production, while its own raw milk production is insufficient to meet the dairy industry’s ingredient needs. Thus, milk and other ingredients for cheese and butter production are being increasingly imported (see Appendix 1 (import quantity)).

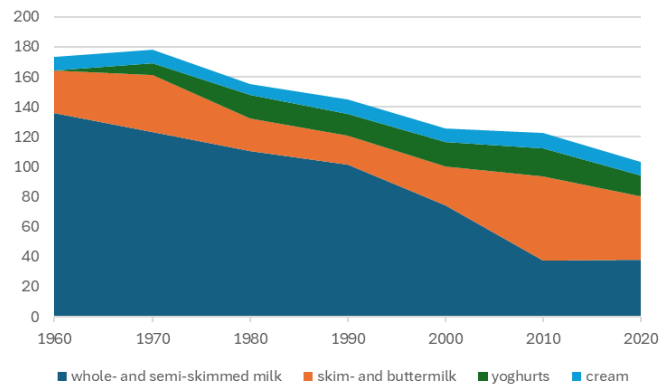


Figure 2: Liquid milk products consumption 1960–2020 (kg/year per capita)
 Source: Compiled from different annual “Landbrugsstatistik” reports at Danmarks Statistik (2025).

Dairy in Norway

Norway also has a long history with milk, a story that, until 1814, was intertwined with Denmark for almost 300 years, as the two countries were unified. Norway’s rugged geography made the dairy cow important for the widely dispersed farms across the country, as a source of nutrition during dark winters (Korsnes & Loeng, 2024). Norwegian farmers were largely lacto-vegetarian, and dairy farming served primarily household needs, providing dairy products for family consumption and fertiliser for crops, with meat as a secondary benefit (Notaker, 2006).

The primary breed in Norway is the Norwegian Red Cattle (NRF), a breed designed to produce both milk and meat (Vangen, 2024). Individual cow productivity has risen sharply, from around 2,800 litres in 1948 to over 8,000 litres today, driven by selective breeding and broader agricultural intensification (Risan, 2003; Vangen, 2024). The number of dairy farmers declined from approximately 150,000 in 1959 to approximately 8,000 in 2015 and to only 6,500 in 2023 (Rognstad et al., 2016; SSB, 2025). Total dairy production is comparable to the 1959 level, at around 1500 million litres, although the number of dairy cows has declined from almost 600,000 in 1959 to 224,000 in 2015 (Rognstad et al., 2016).

Norway’s dairy industry began to organise in the mid-19th century, with the establishment of the first dairy in the 1850s. The sector expanded rapidly until 1905, reaching over 800 dairies nationwide before consolidation and eventual cartelisation with government support in 1930 (Espeli et al., 2006). This organisation guaranteed

farmers stable markets by purchasing all members' milk, creating a monopolistic system that controlled milk distribution through what eventually became the TINE cooperative: Norway's sole dairy until the 1990s. Approximately 90% of Norwegian dairies produced milk in the 1930s–40s, still mostly for domestic use (Espeli et al., 2006).

During the early 1900s, milk came to symbolise food security, cleanliness, nutrition, and rural identity (Kjærnes, 1993). Medical and scientific communities redefined fresh milk from a limited resource to a "wonderful medicine" (Kjærnes, 1993, p. 69). They promoted milk as an excellent source of vitamins that could help defeat tuberculosis, recommending daily consumption of 1 litre of whole milk in the mid-1930s (ibid.). Fresh milk soon symbolised scientific advancement, representing the ideal intersection of nutrition science and agriculture (Wandel, 1997), thereby embodying modernisation (Lyngø, 2007).

As the 1920s brought increased awareness of milk-borne bacteria and infection risks, authorities began to regulate dairy production, leading to larger, more controlled production units (Kjærnes, 1993). Fresh milk was promoted as a 'protective food' (sikringskost) essential to a balanced diet (Lyngø, 2007), and in 1929, Oslo introduced a breakfast for all schools, including up to half a litre of milk (Bugge, 2019). The program later expanded nationally in a simplified form, with children bringing packed meals while schools provided milk, as seen in the Danish case (Bugge, 2023). Since 1971, a national school milk scheme has further cemented milk's role as the default drink for Norwegian children at mealtimes (Bugge, 2022).

Despite high consumption levels, the dairy industry struggled with overproduction from the 1920s through the 1990s, except during World War II. In Sweden, as outlined below, it was particularly hard to sell dairy fats, which sometimes had to be sold at reduced prices abroad (Espeli et al., 2006).

Liquid milk drinking peaked in the 1950s and then declined gradually, accelerating in the late 1980s (see Figure 3) (Korsnes & Loeng, 2024). This acceleration coincided with growing health concerns about cardiovascular disease in Norway (Kjærnes, 1993). A government-appointed committee recommended reducing dairy fat intake in 1963, but the recommendations were not implemented due to concerns about farmers' economic interests (Espeli et al., 2006). The issue resurfaced in a 1975 white paper, concluding that only a limited reduction in fat consumption from meat and dairy was possible, out of concern for farmers and food production (Korsnes & Loeng, 2024).

Both the government and the dairy industry resisted introducing lower-fat milk options, concerned that such products would create surplus fat that could not be sold profitably (Kjærnes & Dulsrud, 1990). Despite Sweden and Denmark introducing lower-fat milk options in 1969 and 1973, respectively, the Norwegian Ministry of Agriculture delayed action. In practice, agricultural interests consistently took precedence over nutritional concerns (Korsnes

& Loeng, 2024). Meanwhile, as Korsnes and Loeng (2024) show, concerns about saturated fats emerged, and consumers began questioning milk's image as healthy, destabilising the dairy SOP.

As whole-milk consumption declined while the popularity of skimmed milk increased in the early 1980s, the introduction of lower-fat milk appeared long overdue (Espeli et al., 2006). Finally, in 1984, lower-fat milk (1.5%) was introduced to counter the declining demand for whole milk (ibid.). In a short time, whole-milk demand was cut in half, largely replaced by the new low-fat milk product. On the production side, however, overproduction stemming from reduced demand led to the establishment of milk quotas in 1983, under which dairies received a lower milk price for milk sold above the quota (Almås & Vik, 2015).

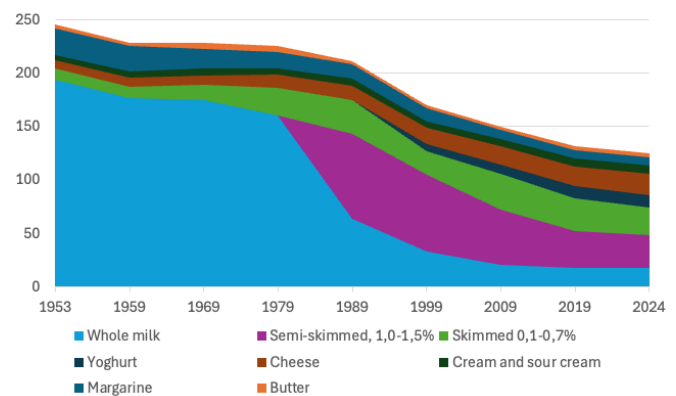


Figure 3: Dairy consumption in annual kg per capita, 1953–2024

Source: Helsedirektoratet (2025). Note: In the period before 1999, yoghurt numbers included were converted to whole milk.

The decline in milk consumption cannot be attributed solely to concerns about fat, as meat products containing similar fats remained popular. Changes in meal composition and the expansion of new beverage options played significant roles. Soda and mineral water consumption doubled between 1983 and 1992, reaching 60 litres per capita annually (Bugge, 2019, p. 403), and increased consumption of apple and orange juices challenged milk's place at the breakfast table (Døving, 2007). At the same time, traditional foods, such as potatoes, declined as Norwegian diets became increasingly continental (Bugge, 2019), with the adoption of Italian pasta and rice dishes (Bugge, 2006). Over the past decade, plant-based milk alternatives have further challenged the consumption of liquid milk (Nofima, 2021).

Dairy in Sweden

As in Norway and Denmark, keeping cows was historically a cornerstone of Swedish agriculture, usually for subsistence but also for manure, draught power, and, more recently, commerce (Martín, 2016). A change began to emerge in the second half of the 19th century, when dairy production and the number of dairy plants increased rapidly, particularly the production of butter for export (Martín, 2008). By the mid-20th century, 90% of farmers were

dairy producers, but by the end of the century, this had declined to 20% (ibid.). As interest in producing dairy for sales increased in the 1920s and 30s, the number of dairy farmers increased, reaching a peak of 271,000 farm holdings in 1946 (ibid.). In 1990, there were 25,000 dairy farmers; in 2023, only 2,600 (Lantbrukarnas Riksförbund, 2025). The increase in the 1920s was largely supported by government policies that supported dairy cooperatives and guaranteed a minimum price for milk (ibid.). An average Swedish cow could produce around 2,200 kg of milk annually in the late 1920s, compared with around 6,000 kg in 1990 and around 11,000 kg today (Lantbrukarnas Riksförbund, 2025).

In the 1920s and 30s in Sweden, milk was heavily marketed by an interest association for dairy producers, known as “The Milk Propaganda” (Jönsson, 2005). The association was active across Sweden, with information campaigns and posters in schools and elsewhere that highlighted the high quality of Swedish milk and the benefits of dairy for hygiene and nutrition (ibid.). The association adopted the slogan “Better milk – increased consumption” (ibid.), urging dairies to produce safe, hygienic milk and convincing consumers that it was indeed safe and healthy. According to Martiin (2010), Sweden was the first among the Nordic countries to establish such a propaganda association in 1923, with Finland, Norway, and Denmark establishing their organisations in 1927, 1928, and 1932, respectively. In this sense, milk represented a materialisation of modernity, producing a “stronger and healthier population and creating a national identity” (Jönsson, 2005, p. 168). Nevertheless, overproduction, low prices, and poor butter exports became problems for Swedish dairies in the 1930s, and soon consuming dairy was not only considered healthy and modern but also a “duty to have butter on the table” (Martiin, 2010, p. 227). In other words, similar to Norway, promoting dairy sales was intended not only to benefit consumers’ health but also, perhaps primarily, to provide employment for farmers (see also Atkins (2005) on this in Great Britain).

Lantmännens Mjölkförsäljningsförening (commonly known as *Mjölkcentralen*, the milk central) was established in Stockholm in 1915. It was a cooperative aiming to ensure dairies’ profitability, prevent competition among them, and provide consumers with healthy, safe products (Thörnqvist, 2018). *Mjölkcentralen* operated under this name until 1975, when it rebranded as Arla. As mentioned, Arla merged with Danish MD Foods in 1999 to form Arla Foods. Thus, this company has evolved from a Swedish cooperative into a major European dairy corporation ranked among the world’s largest.

Using an STS approach, Jönsson (2005, p. 29) investigates the Swedish and Danish dairy industries, exploring how dairy companies have come to occupy a privileged position, e.g. being the only ones allowed to advertise in schools, while maintaining an image of being “non-commercial and scientifically objective” (author’s translation). He provides a detailed account of the institutional, social, cultural, and political processes through which milk has been continuously rebranded since the early 20th century. These rebrandings have been shaped by evolving notions of modernity, wartime ideals of what was considered “wholesome, pure, and Swedish” (p. 176),

as well as understandings of health, sensuous pleasure, and the importance of the farmers and the economy.

Swedes, on average, consumed approximately 250 litres of fresh milk per capita in 1910, around 225 litres in 1946, and 150 litres by 1990 (Martiin, 2016). From 1990 to 2024, consumption has more than halved again to about 60 litres (jordbruksverket.se, 2025, online). Free school milk was introduced in Sweden in 1946, and dairy representatives and the Dairy Propaganda were allowed to promote milk consumption in schools (Thörnqvist, 2018). Lower-fat milk was introduced to the Swedish market in the mid-1960s, but it did not have the same significant impact on overall milk consumption as it did in Norway. In fact, after lower-fat milk was introduced, full-fat milk remained relatively stable, and overall milk consumption increased between 1966 and 1980 (see Figure 4).

The structure of dairy farming changed considerably in the post-WWII era, as the number of dairies declined, yields increased, and more specialised dairy production took hold, rather than combined cattle production with other animals such as pigs (Martiin, 2016). Breeding technologies, particularly artificial insemination, also affected yield per cow, and the Swedish cow types (Swedish red and white, SRB, and the lowland, SLB) grew in size (ibid.).

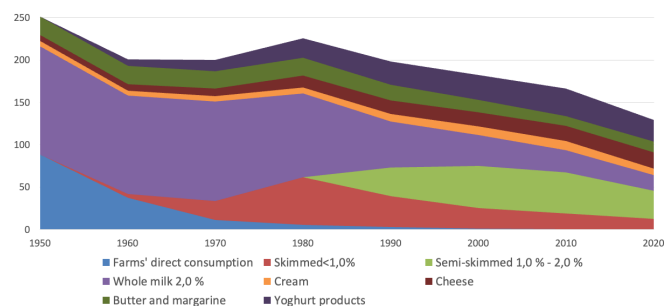


Figure 4: Dairy consumption in kg per capita per year, 1950–2020

Data from: jordbruksverket.se (2025b). Numbers until 2010 are from “*Jordbruket i siffror – åren 1866–2007*”, and from 2010: “*Direktkonsumtion av vara. År 1960–2024*”, both from jordbruksverket.se (2025b).

Sweden has played a significant role in dairy technology, with Gustaf de Laval among the early pioneers (Tekniska Museet, n.d.). Today, DeLaval is one of the largest dairy technology companies globally, with a substantial presence in automatic milking machines. Gustav DeLaval’s contributions to dairy technology, notably the development of the cream separator, are recognised as “the most important early innovation for boosting the dairy industry,” speeding up butter production and advancing the mechanisation of the dairy industry (Rytönen et al., 2021, p. 297).

More recently, Sweden has also seen an increase in milk substitutes, particularly from Oatly, a company founded in the 1990s that, after 2015, quickly gained global attention as an alternative to cow’s milk (Sonesson, 2017). In 2014, the Swedish dairy industry sued the company for what they perceived as unfair slogans, such as “Wow,

no cow” and “No Milk. No Soy. No Badness” (Sonesson 2017:2). Oatly lost the court case and had to change its slogans.

Dairy in Finland

Over the past century, Finnish dairy has undergone a considerable transformation. The number of dairies, farmers, and cows has declined sharply, while the average milk output per cow has nearly tripled since 1963 (from 3,074 to 9,043 litres) (Luonnonvarakeskus, 2024). Liquid milk consumption has plummeted from 379 litres per person in 1956 to 89 litres in 2024 (Luonnonvarakeskus, 2024), though Finland remains the third-highest consumer of liquid milk per capita in the EU after Ireland and Estonia. Despite this decline, milk remains central to Finnish agriculture and food.

Finland’s historically high milk consumption reflects a combination of environmental and socio-economic factors. The cold northern climate with occasional summer frosts favoured cattle over grain farming, making dairy a more reliable food source (Kovalainen et al., 2024). Technological improvements such as pasteurisation, improved fodder, and cooperative dairies enabled year-round industrial production, while dairy propaganda offices established from the 1920s promoted milk as essential to health and nutrition (Kaarlenkaski, 2024).

As elsewhere in the Nordic region, farmer cooperatives became central to the dairy industry, though in Finland the movement was also tied to nation-building politics and resistance to Russification under the late Russian Empire (Sørensen & Mordhorst, 2024). During the interwar period, cooperatives became the backbone of the agricultural sector, including the dairy sector. The number of cooperative dairies peaked in the 1930s, after which smaller dairies began consolidating into larger units (Peltonen & Rasila, 2004).

After territorial losses to the Soviet Union in WWII, Finland resettled 11% of its population, and a 1945 land reform established tens of thousands of small farms, shaping post-war Finland into a smallholder-based agricultural economy (Pihkala, 1999). To support smallholders, the state heavily subsidised farm products, including milk, keeping production artificially viable (Markkola & Rasila, 2004). This, combined with mechanisation, led to severe overproduction. Because subsidised Finnish dairy was not competitive internationally, the state introduced milk quotas (1985–2015) to address overproduction and support farmers’ livelihoods (Markkola & Rasila, 2004).

Finland began offering free school meals—usually porridge—in the 1940s, and the free school milk system gradually expanded to include milk and vegetables (EC, 2025). Through the EU School Fruit, Vegetables and Milk Scheme, municipalities are compensated for offering milk in schools, with subsidies actively steering consumption: since 2009, only low-fat (1%) and skimmed milk have been eligible, and from 2017, only skimmed milk and no-fat buttermilk, with organic skim milk receiving double subsidies (Ruokavirasto, 2025). What began as a programme to increase children’s fat intake has thus become a vehicle for reducing it. These shifts have provoked resistance, with some parents successfully demanding the return of

fat-containing milks in schools despite higher municipal costs (YLE, 2017). Actual school milk consumption is nonetheless declining: in 2023, almost 37% of 4th–5th graders reported not drinking milk at school, up from 22% in 2017 (YLE, 2025), suggesting that the downward trend in liquid milk consumption will continue into the next generation.

The gradual shift from whole milk to lower-fat options gained momentum in the 1970s through the North Karelia Project, which investigated unusually high rates of cardiovascular disease in eastern Finland and attributed them to high intakes of saturated fat from butter, whole milk, and meat (Puska et al., 1976). After targeted interventions, cardiovascular mortality in the region declined to national levels (Vartiainen, 2018). Semi-skimmed milk had been introduced in 1969, and by the 1980s, pre-packaged skimmed milk was widely available in grocery stores; by 1993, whole milk accounted for only around 17.5% of total liquid milk consumption, stabilising at around 12% in 2023 (Luonnonvarakeskus, 2024). Since the early 2010s, however, the steepest decline has been in skim milk itself: between 2013 and 2023, skim milk consumption fell by 46%, while semi-skimmed and whole milk fell by 24% and 17%, respectively (Luonnonvarakeskus, 2024). Avoiding saturated fats is no longer the main driver of declining milk consumption; instead, dairy demand is shifting toward solid products such as cheese and yoghurt.

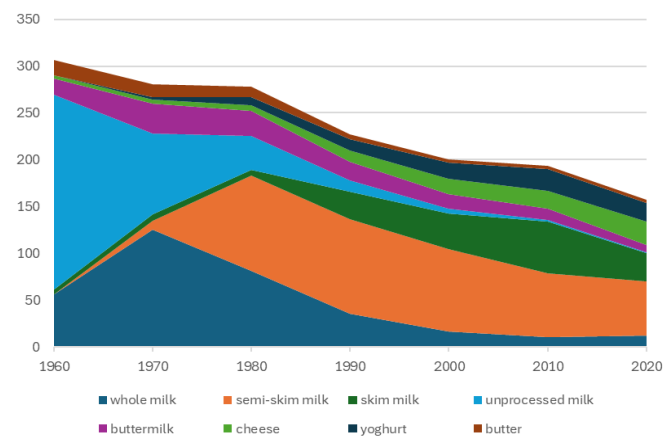


Figure 5: Dairy consumption in Finland 1960–2020 (kg per capita/year)

Source: Balance Sheet for Food Commodities 2024. Natural Resource Institute of Finland, Luke (2025). Note: Unprocessed milk shows the amount of milk that farmers consume directly.

Over the last decade, the market for milk substitutes has grown rapidly, yet in 2023 consumption of milk substitutes was still very low compared to milk (in 2022: 2.3 kg vs. 87.9 kg) (Statista, 2025). However, the dominant dairy industry actor, Valio, has taken significant steps towards plant-based food products by acquiring meat-substitute companies (2022 Nyhtökaura and 2025 Härkis/BeanIt) and exporting its oat-milk products (Oddlygood) to neighbouring countries. While animal product substitutes are clearly a threat to big industry names like Valio, their investments suggest a strategic recognition of where demand might be heading.

Comparing and contrasting the four Nordic countries: the elusive nature of milk

The four cases above show that per capita dairy consumption has declined in all four Nordic countries. Nevertheless, production levels have remained stable or increased, partly due to exports and animal feed (as in Denmark), population growth, or increased consumption of solid products such as cheese and butter. These latter trends can be explained by broader changes in food cultures and daily routines, such as the decline in the practice of drinking milk with breakfast or lunch (Gronow & Holm, 2019; Korsnes & Loeng, 2024). For instance, Gronow and Holm (2019, 28) show that between 1997 and 2012, breakfast milk consumption declined by 20 and 11 percentage points in Norway and Sweden, respectively, while it was relatively constant in Denmark and Finland. Furthermore, the rise in yoghurt consumption for breakfast may be connected to evolving practices around convenience and minimal preparation (*ibid.*). Milk consumption at lunch decreased by about 10 litres per capita across all four countries between 1997 and 2012 (Gronow & Holm, 2019).

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Despite these shifts, dairy remains central to Nordic food systems. Our comparative analysis suggests that its continued prominence cannot be attributed solely to cultural tradition or consumer preference. Instead, it is embedded in historically developed provisioning systems, including cooperative institutions, state subsidies, and discursive framings of dairy as nutritious, modern, and essential. These systems have been remarkably effective in adapting to changing consumption patterns—such as promoting product diversification, which became necessary as liquid milk continued to decline—while maintaining dairy's structural dominance in national diets and agricultural economies.

We also note that the decrease in liquid milk consumption has been somewhat smaller in Finland and Norway, while per capita consumption levels in Denmark and Sweden appear sharper. In all four countries, including Denmark, where production levels have

been increasing, the number of dairy farms continues to decline. This means that individual farms are increasing in size, and each farmer is gaining greater economic influence. Nevertheless, we also identify a negative correlation between lower farm density and lower per capita milk consumption (see Table 1 above). This indicates that Norway and Finland, which have been able to keep a larger number of (smaller) dairy farms in the countryside, have also been more successful in convincing consumers to drink milk. We should also note that the beef industry has been indirectly supported, particularly in countries where combined cows have been used (such as Norway and Finland) (see Table 1 above), providing incentives for both dairy and meat consumption (Farstad et al., 2021).

In essence, however, we find striking similarities across the four Nordic countries, and the reasons behind the declining demand in these countries are equally important to explain. Korsnes and Loeng (2024) argued that the Norwegian dairy SOP failed to adapt to declining demand, partly because the system was primarily designed for growth (see also Farstad et al., 2021), and partly because the dairy industry adapted too slowly to shifts in consumption trends, such as fears about saturated fats. Similar trends can be recognised across all four Nordic countries in the case presentations above. Nevertheless, some differences exist. Lower-fat milk types were introduced much earlier in all the other Nordic countries, making this factor less important for the Norwegian explanation of declining demand. Thus, contrary to what Korsnes and Loeng (2024) argue, it appears that the *timing* of introducing lower-fat dairy alternatives is not necessarily important to stemming the decline in demand.

What this could mean, nevertheless, was that the early introduction of lower-fat milk varieties led to a new problem: a surplus of fat that needed to be marketed. In this sense, Sweden, Finland and Denmark, which introduced lower-fat milk earlier (although Finland introduced a higher, 2.5% variant), had to find new ways to sell the surplus fat. Denmark and Sweden, for instance, have a long tradition of exporting butter and cheese internationally. In Finland's case, the Soviet Union (and later Russia) long provided a convenient export market for butter and cheese. In each case, the industry and government sought to solve the surplus fat problem through outward expansion rather than voluntary or planned reductions in production. Production caps were imposed only in the 1980s, when there was no other way out.

Taking a step back, and as Table 2 highlights, the institutional responses across the four countries are remarkably synchronised: dairy propaganda offices were established within a single decade (1923–1932), low-fat milk variants between 1969 and 1984, and production caps and quota systems almost simultaneously between 1983 and 1985. This suggests that the Nordic dairy SOP operates not

as four parallel national systems but as a regionally coordinated one, responding to threats with collectively similar moves. The key factors behind both the rise and decline of dairy demand are similarly shared: the cold climate that made dairy a reliable nutritional source, the discovery of micronutrients in the 1920s, and active institutional promotion all helped to solidify milk's place at the Nordic breakfast and lunch table, while fear of saturated fats, overproduction, and changing meal habits drove its later decline. Corporate strategies to address overproduction have included marketing products suitable for global trade, making innovations such as milk powder and higher levels of processing crucial to the industry.

	Norway	Sweden	Denmark	Finland
Dairy propaganda institution established	1928	1923	1932	1927
Introduction of low-fat milk	1984	1969	1973	1969
Production cap and quota system introduced	1983	1984	1984	1985
School milk	Yes, introduced 1930s	Yes, part of free school meals	Yes, parents pay for a subscription. Free from 1991	Yes, part of free school meals since the 1940s

Table 2: A few key matters across each country

Drawing these threads together, our comparison points to four variables that most clearly shape cross-national differences in dairy provisioning trajectories, and that illustrate how SOPs, though structurally similar across the Nordic region, have diverged in consequential ways. First, farm density and structure: Norway and Finland, with higher densities of smaller, often combined-breed

dairy farms, have maintained denser networks of actors with combined interests in both dairy and meat consumption (Farstad et al., 2021), sustaining demand longer than Denmark and Sweden. Second, export orientation: Denmark's historically strong export focus enabled the SOP to decouple domestic consumption from production volumes, enrolling international markets as stabilising actors when home demand fell.

Third, cooperative structure and corporate consolidation: while cooperatives were foundational in all four countries, the pace of consolidation, most extreme in Sweden/Denmark with Arla, more gradual in Norway with TINE, shaped how flexibly each SOP could re-enrol consumers around new products as liquid milk declined. Fourth, product diversification strategies: all four SOPs eventually shifted from liquid milk to solid products, but the extent to which this was driven by surplus fat management versus proactive market-building varied: Denmark and Sweden leveraged existing export infrastructure, while Norway and Finland relied more heavily on domestic demand. Notably, EU membership has further shaped these divergences, as accession accelerated export orientation and introduced supranational regulatory frameworks.

Lastly, we should mention that shifts (e.g., from liquid milk to solid dairy products) within the dairy ecosystem are issues the industry can address, but the real long-term threat seen from the industry is consumption exiting the SOP: plant-based products and changing (non-dairy) diets. In all four countries outlined above, we have identified an increase in consumption of plant-based milk alternatives, which, albeit small, indicates a future direction of demand. In Finland, the largest dairy company, Valio, is involved in the milk and meat substitute business and is therefore trying to manage shifts in demand. In fact, Valio has introduced its own dairy-based meat substitute (Mifu), bringing meat substitutes back into the dairy ecosystem (Valio, 2025). Compared to the Swedish case, where Oatly was sued by the dairy industry, this represents a different strategy: absorption rather than suppression. Both are faces of the same defensive logic.

Conclusions

Through an STS and systems of provision (SOP) perspective, motivated by 'strong sustainability' concerns, we argue that the endurance of dairy is not a passive legacy of the past but is actively sustained by ongoing technological innovation, efficiency discourses, and institutional reproduction. Narratives of value creation and modernisation can obscure the biophysical inefficiencies of dairy production, particularly its poor energy and land-use conversion ratios and limit the scope of what counts as "sustainable" innovation. Like current critiques of techno-optimism in sustainability debates (Alexander & Rutherford, 2021), our analysis highlights how faith in technological innovation and efficiency gains can displace more fundamental questions of sufficiency and the biophysical limits of

current provisioning systems. As we have shown, a comparative lens clarifies the dynamics of demand formation. It illuminates not only the reasons for both increases and decreases, but also the sociotechnical work that holds demand in place.

The shape-shifting nature of milk after it is delivered to dairies makes it difficult to trace changes in overall dairy demand. Our STS- and SOP-informed lens, which connects production to consumption, reveals a more fragile and contested reality: although liquid milk consumption has declined steadily across all four Nordic countries, the industry has partly compensated by re-enacting milk in denser forms, e.g., cheese and butter, that require significantly more milk

per kilogram consumed, keeping production levels stable. Making these enactments visible is itself a contribution to studies of sustainability transformation, as it unsettles narratives of dairy's naturalness and reveals the ongoing institutional work required to stabilise a system that could, in principle, be otherwise. In other words, milk is not *one thing* but is constantly re-enacted alongside changing food preferences, dietary norms, and institutional arrangements. This capacity for re-enactment allows the industry to maintain production volumes and obscure the underlying biophysical inefficiencies of dairy at the systems level. Behind these shifting enactments, largely absent from narratives of efficiency and innovation, are the cows themselves; fewer in number but each producing ever more milk under intensifying conditions.

Looking ahead, the trajectory of Nordic dairy systems will be shaped by at least three intersecting pressures. First, continued farm consolidation and intensification will likely maintain or increase production volumes even as domestic liquid milk consumption

continues its structural decline, deepening the reliance on export markets and product diversification. Second, the growing market for plant-based alternatives, currently small but expanding in all four countries, represents the most significant structural challenge dairy SOPs have faced, precisely because it threatens to move consumption outside the provisioning system entirely rather than merely shifting it between products. Emerging sufficiency imaginaries among professional stakeholders suggest some awareness of this trajectory, even if a systemic reorientation remains politically contentious (Aagaard & Christensen, 2024). Third, EU-level policy, including agricultural subsidy reform and the Farm to Fork strategy, will increasingly shape the conditions under which national dairy systems operate, creating both pressures and opportunities for sufficiency-oriented interventions. Whether these pressures converge toward genuine transformation or are absorbed through further technological adaptation will, we argue, depend on whether institutional actors move beyond efficiency discourses to engage with the deeper question of how much dairy Nordic consumers actually need.

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The authors declare no competing interests.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors have used ChatGPT, CoPilot, Claude, and Grammarly to assist with language checking, content phrasing, and reference formatting. The authors reviewed and edited the content as needed and take full responsibility for the publication's content.

References

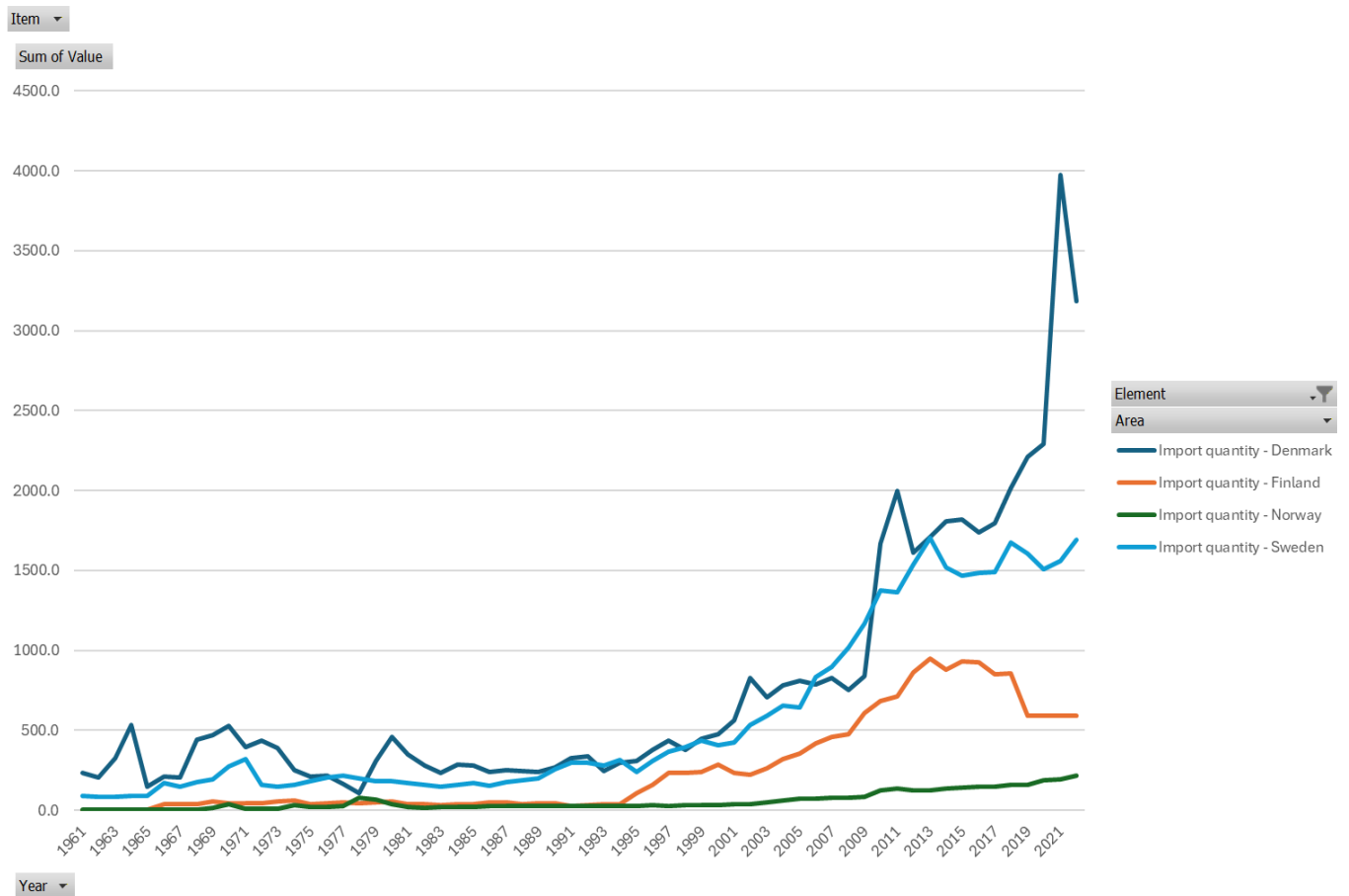
- Aagaard, L. K., & Christensen, T. H. (2024). Provide or prevent? Exploring sufficiency imaginaries within Danish systems of provision. *Buildings & Cities*, 5(1).
<https://doi.org/10.5334/bc.433>
- Alexander, S., & Rutherford, J. (2021). A critique of techno-optimism: Efficiency without sufficiency is lost. In A. Kalfagianni, D. Fuchs, & A. Hayden (Eds.), *Routledge handbook of global sustainability governance*. Routledge.
- Almås, R., & Vik, J. (2015). Kap 11. Strukturelle og institusjonelle endringsprosesser i den norske melkesektoren. In H. Bjørkhaug, R. Almås, & J. Vik (Eds.), *Norsk matmakt i endring* (pp. 267–287). Fagbokforlaget.
- Atkins, P. J. (2005). Fattening children or fattening farmers? School milk in Britain, 1921–1941. *The Economic History Review*, 58(1), 57–78.
<https://doi.org/10.1111/j.1468-0289.2005.00298.x>
- Bååth, J. (2018). *Production in a state of abundance: Valuation and practice in the Swedish meat supply chain*. Department of Sociology, Uppsala University.
- Bugge, A. (2006). *Å spise middag: En matsosiologisk analyse*. Tapir akademisk forlag.
https://urn.nb.no/URN:NBN:no-nb_digibok_2013103006018
- Bugge, A. (2019). *Fattigmenn, tilslørte bondepiker og rike riddere: Mat og spisevaner i Norge fra 1500-tallet til vår tid*. Cappelen Damm akademisk.
- Bugge, A. (2022). Skolemelk [School milk]. In *Store norske leksikon*.
<https://snl.no/skolemelk>
- Bugge, A. (2023). Oslofrukosten [The Oslo breakfast]. In *Store norske leksikon*.
<https://snl.no/oslofrukosten>
- CIA. (2025). *The world factbook*.
<https://www.cia.gov/the-world-factbook/countries/>
- Danmarks Statistik. (2025). *Landbrugsstatistik* [Agricultural statistics].
<https://www.dst.dk/da/Statistik/nyheder-analyser-publ/Publikationer/VisPub?cid=19725>
- Dixon, J. (1999). A cultural economy model for studying food systems. *Agriculture and Human Values*, 16(2), 151–160.
<https://doi.org/10.1023/A:1007531129846>
- Døving, R. (2007). *Merkevarer: 45 korreksjoner*. Cappelen.
https://urn.nb.no/URN:NBN:no-nb_digibok_2012042406012
- DuPuis, E. M. (2002). *Nature's perfect food: How milk became America's drink*. New York University Press.
<https://doi.org/10.18574/nyu/9780814785423.001.0001>
- Espeli, H., Bergh, T., & Rønning, A. (2006). *Melkens pris: Perspektiver på Meierisamvirkets historie*. Tun forlag.
- EC. (2025). *EU school scheme explained*.
https://agriculture.ec.europa.eu/common-agricultural-policy/market-measures/school-scheme-explained_en
- Fagt, S., Langwagen, M., & Biloft-Jensen, A. P. (2023). *Mere bæredygtighed i hverdagen? Det går langsomt med at købe mere grønt og mindre kød og mælk* [More sustainability in everyday life? Buying more greens and less meat and milk is going slowly]. Department of Food, Danish Technical University.
- Farstad, M., Vinge, H., & Stræte, E. P. (2021). Locked-in or ready for climate change mitigation? Agri-food networks as structures for dairy-beef farming. *Agriculture and Human Values*, 38(1), 29–41.
<https://doi.org/10.1007/s10460-020-10134-5>
- Fine, B., & Leopold, E. (1993). *The world of consumption*. Routledge.
- FAOSTAT. (2025). *Food balances (2010–)* [Data set]. FAOSTAT.
<https://www.fao.org/faostat/en/#data/FBS>
- Fødevarestyrelsen. (2025a). *De officielle kostråd 2025: Anbefalinger til sund kost for børn og voksne* [The official dietary advice 2025: Guidelines for a healthy diet for children and adults].
<https://foedevarestyrelsen.dk/kost-og-foedevarer/alt-om-mad/de-officielle-kostraad/kostraad-til-dig>
- Fødevarestyrelsen. (2025b). *Vælg planteolier og magre mejeriprodukter* [Choose plant oils and lean dairy products].
<https://foedevarestyrelsen.dk/kost-og-foedevarer/alt-om-mad/de-officielle-kostraad/kostraad-til-dig/om-de-officielle-kostraad/vaelg-planteolier-og-magre-mejeriprodukter>
- Freudendal-Pedersen, M., Gram-Hanssen, K., Halkier, B., Samson, C., & Christensen, T. H. (2026). Institutional material arrangements: An approach for identifying the conditions for the transition to sustainable consumption. *Consumption and Society*, 1–18.
- Giller, K. E., Delaune, T., Silva, J. V., Descheemaeker, K., Van De Ven, G., Schut, A. G. T., Van Wijk, M., Hammond, J., Hochman, Z., Taulya, G., Chikowo, R., Narayanan, S., Kishore, A., Bresciani, F., Teixeira, H. M., Andersson, J. A., & Van Ittersum, M. K. (2021). The future of farming: Who will produce our food? *Food Security*, 13(5), 1073–1099.
<https://doi.org/10.1007/s12571-021-01184-6>
- Gronow, J., & Holm, L. (Eds.). (2019). *Everyday eating in Denmark, Finland, Norway and Sweden: A comparative study of meal patterns 1997–2012*. Bloomsbury Publishing.
- Guthman, J. (2002). Commodified meanings, meaningful commodities: Re-thinking production-consumption links through the organic system of provision. *Sociologia Ruralis*, 42(4), 295–311.
<https://doi.org/10.1111/1467-9523.00218>
- Harwatt, H., Benton, T. G., Bengtsson, J., Birgisdóttir, B. E., Brown, K. A., Van Dooren, C., Erkkola, M., Graversgaard, M., Halldorsson, T., Hauschild, M., Høyer-Lund, A., Meilä, J., Van Oort, B., Saarinen, M., Tuomisto, H. L., Trolle, E., Ögmundarson, O., & Blomhoff, R. (2024). Environmental sustainability of food production and consumption in the Nordic and Baltic region: A scoping review for Nordic Nutrition Recommendations 2023. *Food & Nutrition Research*, 68.
<https://doi.org/10.29219/fnr.v68.10539>
- Helsedirektoratet. (2025). *Utviklingen i norsk kosthold 2025* [Developments in the Norwegian diet 2025].
<https://www.helsedirektoratet.no/rapporter/utviklingen-i-norsk-kosthold-2025/matvarer/melk-og-meieriprodukter>
- Henriksen, I., Lampe, M., & Sharp, P. (2012). The strange birth of liberal Denmark: Danish trade protection and the growth of the dairy industry since the mid-nineteenth century. *The Economic History Review*, 65(2), 770–788.
<https://doi.org/10.1111/j.1468-0289.2010.00595.x>
- Holm, L., Lauridsen, D. S., Gronow, J., Kahma, N., Kjærnes, U., Lund, T. B., Mäkelä, J., & Niva, M. (2019). The food we eat. In J. Gronow & L. Holm (Eds.), *Everyday eating in Denmark, Finland, Norway and Sweden: A comparative study of meal patterns 1997–2012*. Bloomsbury Academic.
- Jönsson, H. (2005). *Mjök: En kulturanalys av mejeridiskens nya ekonomi*. B. Östlings bokförlag Symposion.



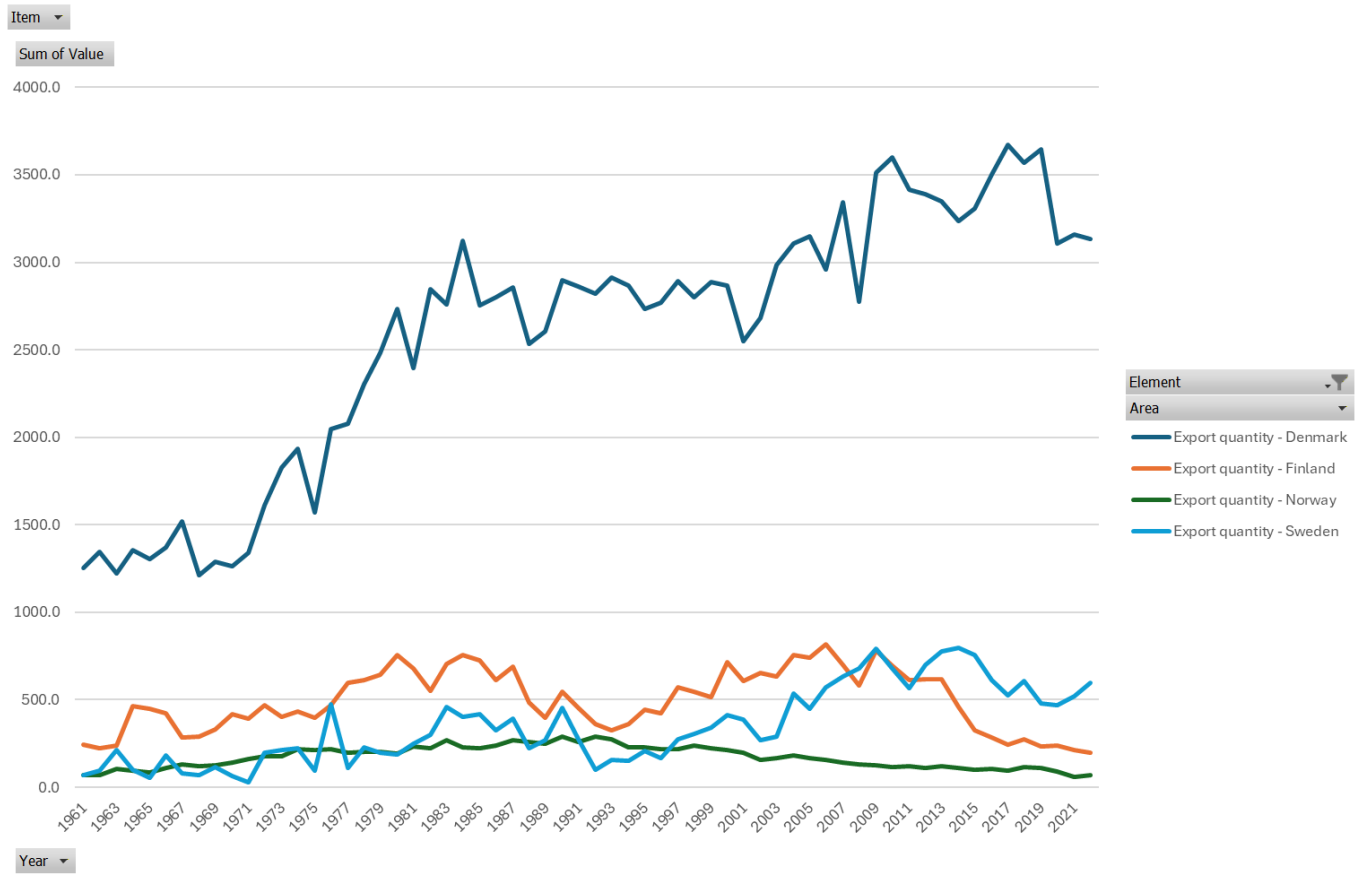
- Jordbruksverket. (2023). *Livsmedelskonsumtion av animalier: Preliminära uppgifter 2022* [Food consumption of animal products: Preliminary figures 2022]. <https://jordbruksverket.se/om-jordbruksverket/jordbruksverkets-officiella-statistik/jordbruksverkets-statistikrapporter/statistik/2023-03-17-livsmedelskonsumtion-av-animalier.-preliminara-uppgifter-2022>
- Jordbruksverket. (2025a). *Livsmedelskonsumtion av animalier: Preliminära uppgifter 2024* [Food consumption of animal products: Preliminary figures 2024]. <https://jordbruksverket.se/om-jordbruksverket/jordbruksverkets-officiella-statistik/jordbruksverkets-statistikrapporter/statistik/2025-03-19-livsmedelskonsumtion-av-animalier.-preliminara-uppgifter-2024>
- Jordbruksverket. (2025b). *Jordbruken i siffror, åren 1866–2007 och direktkonsumtion av vara, år 1960–2024* [Agriculture in figures, 1866–2007 and direct consumption of goods, 1960–2024] [Data set]. <https://jordbruksverket.se/om-jordbruksverket/jordbruksverkets-officiella-statistik>
- Kaalenkaski, T. (2024). Exploring the roots of high milk consumption in Finland. In T. Syrjämaa, M. Jalava, T. Kaalenkaski, O. Latva, E. Nikkilä, & T. Räsänen (Eds.), *Animal industries* (pp. 45–62). De Gruyter. <https://doi.org/10.1515/9783110787337-004>
- Kjærnes, U. (1993). En hellig ku: Det politiske spillet om melken. *Sociologi i dag*, 23(1), 67–85. https://urn.nb.no/URN:NBN:no-nb_digittidsskrift_2015020382146_001
- Kjærnes, U., & Dulsrud, A. (1990). *Landbruken og forbrukerne på kollisjonskurs?* Statens institutt for forbruksforskning. https://urn.nb.no/URN:NBN:no-nb_digibok_2018042648020
- Klimarådet. (2021). *Klimavenlig mad og forbrugeradfærd: Barrierer og muligheder for at fremme klimavenlig kost i Danmark* [Climate-friendly food and consumer behaviour: Barriers and possibilities in the promotion of climate-friendly food in Denmark]. https://klimaraadet.dk/sites/default/files/imorted-file/klimavenlig_mad_og_forbrugeradfærd_1.pdf
- Korsnes, M., & Loeng, M. (2024). The making and unmaking of demand for dairy and chicken in Norway: A systems of provision perspective. *Sustainability: Science, Practice and Policy*, 20(1), 2406067. <https://doi.org/10.1080/15487733.2024.2406067>
- Kovalainen, N., Niemi, J., & Huan-Niemi, E. (2024). *Review of food security in Finland from the 17th to 21st century*. Natural Resources Institute Finland.
- Lantbrukarnas Riksförbund. (2025). *Svensk mjölk i siffror* [Swedish milk in figures]. <https://www.lrf.se/las-mer/svensk-mjolk-i-siffror/>
- Loeng, M., & Korsnes, M. (2023). Unravelling the Norwegian meat reduction controversy: Navigating contested sustainabilities and the role of meat. *Consumption and Society*, 2(2), 281–299. <https://doi.org/10.1332/CXSI8930>
- Lorek, S., & Fuchs, D. (2019). Why only strong sustainable consumption governance will make a difference. In O. Mont (Ed.), *A research agenda for sustainable consumption governance* (pp. 19–34). Edward Elgar Publishing. <https://doi.org/10.4337/978178817814.00010>
- Luke. (2025). *Elintarvikkeiden kulutus henkeä kohti (kg/vuosi): Maito* [Data set]. https://statdb.luke.fi/PxWeb/pxweb/fi/LUKE/LUKE_maa_o2%20Ravintotase/01_Elintarvikkeiden_kulutus.px/
- Luonnonvarakeskus. (2024). *Maitoalalla tuotanto ja kulutus ovat kokeneet isoja muutoksia*. <https://www.luke.fi/fi/uutiset/maitoalalla-tuotanto-ja-kulutus-ovat-kokeneet-isoja-muutoksia>
- Lyngø, I. J. (2007). Et melkedrikkende folk: Melkens nye status i mellomkrigstidens Norge. *Arr – Idéhistorisk Tidsskrift*, 19(2–3), 27–40.
- Markkola, P., & Rasila, V. (Eds.). (2004). *Suurten muutosten aika: Jälleenrakennuskaudesta EU-Suomeen*. Suomalaisen Kirjallisuuden Seura.
- Martiin, C. (2008). Milk as payment for farm labour: The dairy economy of a Swedish estate, 1874–1913. *Agricultural History Review*, 56(2), 167–188.
- Martiin, C. (2010). Swedish milk, a Swedish duty: Dairy marketing in the 1920s and 1930s. *Rural History*, 21(2), 213–232.
- Martiin, C. (2016). Specialisation in dairying: A rapid transformation in Denmark and a drawn-out process in Sweden. In A. Antoine (Ed.), *Rural history in Europe* (Vol. 12, pp. 213–232). Brepols Publishers. <https://doi.org/10.1484/M.RURHE-EB.5.112269>
- Mejeriforeningen. (2023). *Mejeristatistik 2022* [Dairy statistics 2022]. Danish Agriculture & Food Council. <https://mejeri.dk/mejeribranchen/mejeribranchen-i-tal/mejeristatistik/>
- Mol, A. (2010). Actor-network theory: Sensitive terms and enduring tensions. *Kölner Zeitschrift für Soziologie und Sozialpsychologie. Sonderheft*, 50(1), 253–269.
- Mordhorst, M. (2014). Arla and Danish national identity: Business history as cultural history. *Business History*, 56(1), 116–133. <https://doi.org/10.1080/00076791.2013.818422>
- Morris, C., Kaljonen, M., Aavik, K., Balázs, B., Cole, M., Coles, B., Efstathiou, S., Fallon, T., Foden, M., Giraud, E. H., Goodman, M., Kershaw, E. H., Helliwell, R., Hobson-West, P., Häyry, M., Jallinoja, P., Jones, M., Kaalenkaski, T., Laihonon, M., ... White, R. (2021). Priorities for social science and humanities research on the challenges of moving beyond animal-based food systems. *Humanities and Social Sciences Communications*, 8(1), 1–12. <https://doi.org/10.1057/s41599-021-00714-z>
- Moses, J., & Knutsen, T. L. (2007). *Ways of knowing: Competing methodologies in social and political research*. Palgrave Macmillan.
- Niva, M., Mäkelä, J., Kahma, N., & Kjærnes, U. (2019). Eating sustainably. In L. Holm & J. Gronow (Eds.), *Everyday eating in Denmark, Finland, Norway and Sweden: A comparative study of meal patterns, 1997–2012*. Bloomsbury Publishing. <https://doi.org/10.5040/9781350080454>
- Nofima. (2021). *Salgsutvikling for nye plantebaserte produkter*. Nofima. <https://nofima.no/publikasjon/1971051/>
- Notaker, H. (2006). *Mat og måltid*. Aschehoug. https://urn.nb.no/URN:NBN:no-nb_digibok_2014071406005
- Otter, C. (2020). *Diet for a large planet: Industrial Britain, food systems, and world ecology*. University of Chicago Press.
- Peltonen, M., & Rasila, V. (Eds.). (2004). *Kasvun ja kriisien aika: 1870-luvulta 1950-luvulle*. Suomalaisen Kirjallisuuden Seura.
- Pihkala, E. (1999). The political economy of post-war Finland, 1945–1952. *Scandinavian Economic History Review*, 47(3), 26–47. <https://doi.org/10.1080/03585522.1999.10419817>
- Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*, 360(6392), 987–992. <https://doi.org/10.1126/science.aaq0216>
- Princen, T. (2005). *The logic of sufficiency*. MIT Press.
- Puska, P., Koskela, K., Pakarinen, H., Puumalainen, P., Soininen, V., & Tuomilehto, J. (1976). The North Karelia Project: A programme for community control of cardiovascular diseases. *Scandinavian Journal of Social Medicine*, 4(1), 57–60. <https://doi.org/10.1177/14034948760040011>

- Rinkinen, J., Shove, E., & Marsden, G. (2020). *Conceptualising demand: A distinctive approach to consumption and practice*. Routledge.
<https://doi.org/10.4324/9781003029113>
- Risan, L. C. (2003). *Hva er ei ku? Norsk rødt fe som teknovitenskap og naturkultur* [PhD thesis, Universitetet i Oslo].
https://urn.nb.no/URN:NBN:no-nb_digibok_2009070804078
- Rognstad, O., Løvberget, A. I., & Steinset, T. A. (2016). *Landbruket i Norge 2015* [Agriculture in Norway 2015]. Statistisk sentralbyrå.
<https://www.ssb.no/jord-skog-jakt-og-fiskeri/artikler-og-publikasjoner/landbruket-i-norge-2015>
- Röös, E., Mayer, A., Muller, A., Kalt, G., Ferguson, S., Erb, K.-H., Hart, R., Matej, S., Kaufmann, L., Pfeifer, C., Frehner, A., Smith, P., & Schwarz, G. (2022). Agroecological practices in combination with healthy diets can help meet EU food system policy targets. *Science of The Total Environment*, 847, 157612.
<https://doi.org/10.1016/j.scitotenv.2022.157612>
- Ruokavirasto. (2025). *Koulujakelutuet*.
<https://www.ruokavirasto.fi/tuet/elintarvikkeet/koulujakelutuet/>
- Rytkönen, P., Ragnar, M., & Lönnborg, M. (2021). Patterns of collectivization and de-collectivization in the Swedish dairy sector from 1900 to 2015 (pp. 297–321). Södertörns högskola.
<https://urn.kb.se/resolve?urn=urn:nbn:se:sh:diva-44684>
- Sandberg, M. (2021). Sufficiency transitions: A review of consumption changes for environmental sustainability. *Journal of Cleaner Production*, 293, 126097.
<https://doi.org/10.1016/j.jclepro.2021.126097>
- Sonesson, L. B. (2017). Got milk? Sustainability transitions in culturally embedded institutions [Bachelor's thesis, Lund University, Department of Political Science]
- Spangenberg, J. H. (2014). Institutional change for strong sustainable consumption: Sustainable consumption and the degrowth economy. *Sustainability: Science, Practice and Policy*, 10(1), 62–77.
<https://doi.org/10.1080/15487733.2014.11908125>
- Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B. L., Lassaledda, L., de Vries, W., Vermeulen, S. J., Herrero, M., Carlson, K. M., Jonell, M., Troell, M., DeClerck, F., Gordon, L. J., Zurayk, R., Scarborough, P., Rayner, M., Loken, B., Fanzo, J., ... Willett, W. (2018). Options for keeping the food system within environmental limits. *Nature*, 562(7728), 519–525.
<https://doi.org/10.1038/s41586-018-0594-0>
- Statista. (2024). *Dairy industry in Denmark*.
<https://www.statista.com/study/37263/dairy-industry-in-denmark-statista-dossier/>
- Statista. (2025). *Plant-based food in Finland*.
<https://www.statista.com/study/172553/plant-based-food-in-finland/>
- SSB. (2025). *Husdyrhold* [Livestock].
<https://www.ssb.no/jord-skog-jakt-og-fiskeri/jordbruk/statistikk/husdyrhold>
- Sørensen, A. T. (2012, October 8). *Mejerirationaliseringer siden 1960* [Dairy rationalisations since 1960]. Danmarkshistorien.dk – Aarhus Universitet.
<https://danmarkshistorien.dk/vis/materiale/mejerirationaliseringer-siden-1960>
- Sørensen, E. B., & Mordhorst, M. (2024). Being strong together. In A. Brink-Lund, H. Byrkjeflot, & S. Christensen (Eds.), *Associative governance in Scandinavia* (pp. 120–150). Routledge.
<https://doi.org/10.4324/9781003382775-6>
- Tekniska Museet. (n.d.). Gustaf de Laval: The milk-cream separator. Retrieved December 30, 2025, from
<https://www.tekniskamuseet.se/en/learn-more/swedish-inventors/gustaf-de-laval-milk-cream-separator/>
- Thörnqvist, L. (2018). *A conversation with milk: Exploring Swedish milk history on Arla's milk panels* [Master's thesis, Uppsala University]. Department of Archaeology and Ancient History.
- Trolle, E., Meinilä, J., Eneroth, H., Meltzer, H. M., Þórsdóttir, I., Halldorsson, T., & Erkkola, M. (2024). Integrating environmental sustainability into food-based dietary guidelines in the Nordic countries. *Food & Nutrition Research*, 68.
<https://doi.org/10.29219/fnr.v68.10792>
- Valio. (2025). *Valio keittiön MiFU* [Valio kitchen MiFU].
<https://www.valio.fi/brandit/valio-mifu/>
- Vangen, O. (2024). Norsk rødt fe. In *Store norske leksikon*.
https://snl.no/norsk_r%C3%B8dt_fe
- Vartiainen, E. (2018). The North Karelia Project: Cardiovascular disease prevention in Finland. *Global Cardiology Science and Practice*, 2018(2).
<https://doi.org/10.21542/gcsp.2018.13>
- Wandel, M. (1997). *Mat og helse: Forbrukeroppfatninger og strategier* [Food and health: Consumer views and strategies]. Statens institutt for forbruksforskning.
https://urn.nb.no/URN:NBN:no-nb_digibok_2017021048503
- Woolgar, S., & Lezaun, J. (2013). The wrong bin bag: A turn to ontology in science and technology studies? *Social Studies of Science*, 43(3), 321–340.
<https://doi.org/10.1177/0306312713488820>
- Woolgar, S., & Lezaun, J. (2015). Missing the (question) mark? What is a turn to ontology? *Social Studies of Science*, 45(3), 469–475.
<https://doi.org/10.1177/0306312715584010>
- YLE. (2017, September 22). *Osa lapsista kieltäytyy juomasta maitoa koulussa, kun tarjolla on nyt vain rasvatonta*.
- YLE. (2025, June 2). *Koululaiset juovat yhä viisi miljoonaa litraa maitoa vuodessa, vaikka muutakin on tarjolla: "Maistuu paremmalta"*.
<https://yle.fi/a/74-20136911>
- Zurek, M., Hebinck, A., & Selomane, O. (2022). Climate change and the urgency to transform food systems. *Science*, 376(6600), 1416–1421.
<https://doi.org/10.1126/science.abo2364>

Appendix 1



Dairy imports in the four Nordic countries, 1961–2021
 Source: FAOSTAT (2025)



Dairy exports in the four Nordic countries, 1961-2021

Source: FAOSTAT (2025)