

A catalyst for modern agriculture? The importance of peatland cultivation in the adoption of inorganic fertilizers in Sweden, 1880–1920*

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Abstract

This article shows that peatland cultivation was, in an initial phase from the 1880s to the 1930s, an important catalyst for the adoption of fertilizers in Sweden. The most important agency promoting this development was the Mosskulturföreningen, the Swedish Peatland Cultivation Association, established in 1886. Through its scientific work, sponsorship of field trials, and dissemination of knowledge, the Mosskulturföreningen resulted in fertilizers being made available over a large geographical area and gaining acceptance amongst farmers. The take up of fertilizers involved not only the adoption of new techniques but also new ways of thinking.

The formation of the Swedish Peatland Cultivation Association, Svenska Mosskulturföreningen, in 1886, is closely tied to the introduction of inorganic fertilizers to Swedish agriculture. Peatland cultivation was not a new phenomenon in the last quarter of the nineteenth century. From the eighteenth century, public debate in Sweden had looked to the time when the country's vast peatlands could be cultivated and used to the advantage of the nation's economy and society. These hopes were especially focused on the peatlands in the central highlands of southern Sweden and in the northern part of the country, the Norrland, where peatlands covered 20 and 25 per cent of the total land area respectively. It was only after the introduction of inorganic fertilizers that these ambitions became realizable. Advances in soil chemistry showed that the peatland soil lacked several essential plant nutrients, which at about the same time, became available for purchase on the market. It was on the basis of these optimistic scenarios that the Mosskulturföreningen was founded.

Peatland cultivation in the form that the Mosskulturföreningen promoted was, in its own time, an extremely modern project, conducted with knowledge of the latest scientific findings and with innovative technology. A peatland farmer was to be an entrepreneur who acted

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rationally by constantly seeking information, making efficient use of all available resources, and planning and recording his activities. By the beginning of the twentieth century, the Mosskulturföreningen had established itself as one of the country's most prominent institutions for agricultural research, with advanced laboratories, experimental fields and trial bogs.

In this article it will be argued that Mosskulturföreningen's work for peatland cultivation was not only a modern project but also that its activities were of importance for the more general modernization of Swedish agriculture during a formative period. This took place on several planes, through scientific work, practical experiments, and the dissemination of technology and knowledge. The Mosskulturföreningen was an organization with many tentacles, and it had an impact throughout the country on farmers' ideas and practices. This paper will show the association between the advocacy of peatland cultivation by the Mosskulturföreningen and the widespread adoption of artificial fertilizers by Swedish farming in the last decades of the nineteenth and the first of the twentieth century.

I

The consumption of fertilizers increased dramatically after the Second World War. Both before and immediately after the war, global annual consumption was about seven or eight million tons, which may be compared with the first few years of the century, when about two million tons were used. By the mid-1960s, consumption had rocketed to nearly 45 million tons. For Sweden, the rate of increase in the consumption of artificials is at least as great in the last decades of the nineteenth century as after the Second World War. In the early 1870s, the import of fertilizers and crude rock phosphate amounted to 17,000 tons per year, but by 1910 it had increased to nearly 200,000 tons, that is, it increased more than tenfold over 30 years, as may be seen from Figure 1.¹ This happened at the same time as Swedish agriculture was responding to increasing competition on the international corn market by changing from being predominantly a corn-producing economy to one based on animal production. As a consequence, a great deal of farmland, including peatland, was converted to producing animal feedstuffs, which enabled a larger number of livestock to be kept and more manure produced. In the same period the import of oil cakes for animal fodder increased just as rapidly as the import of fertilizers, which further increased the number of livestock and the supply of natural manure.² In addition, agricultural advisors made great efforts to improve the handling of manure by advocating concrete dunghill bottoms and cesspools for manure.

Thus, the amount of farmyard manure (as well as its quality) must have increased considerably in this period, and this, to a great extent, should have covered the increased demand for plant nutrients, although there was an expansion of the cultivated area about the same time. In addition, green manuring was adopted, a consequence of the discovery that the interplay between bacteria and leguminous plants binds atmospheric nitrogen in the soil. The nitrogen balance could thereby be improved on many arable lands. These Swedish developments are not unique. In the Netherlands, for instance, where the use of fertilizers also increased rapidly and

¹ *Historisk statistik för Sverige*, III, *Utrikeshandel*, 1732–1970 (1972), pp. 200, 223.

² *Ibid.*, pp. 199, 223.

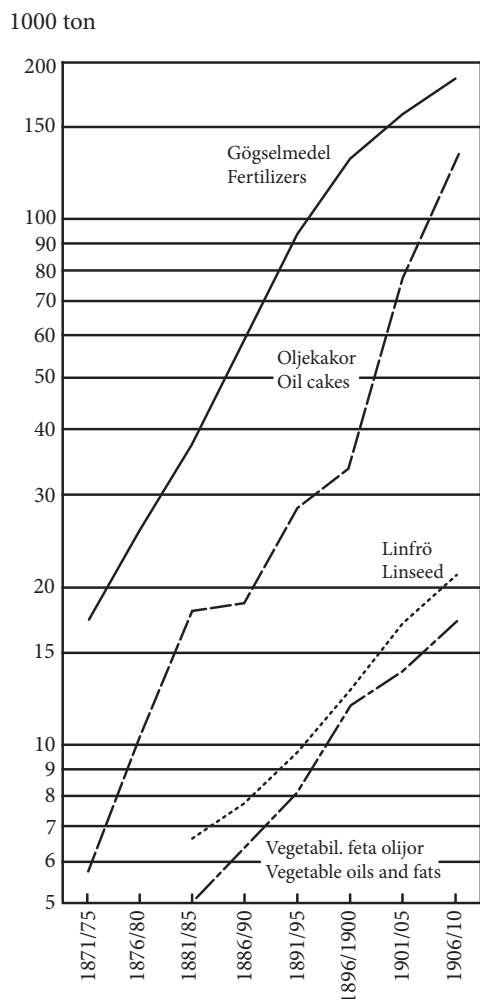


FIGURE 1. Imports of fertilizers, oil cakes, linseeds and vegetable fats and oils to Sweden, 1871/75 to 1906–10.

Source: *Historisk statistik för Sverige III, Utrikeshandel, 1732–1970* (1972), p. 223.

where the consumption per cultivated hectare was the largest in the world at the end of the nineteenth century, the consumption of farmyard manure was four to five times greater than that of fertilizers. Merijn Knibbe has argued that, despite the rapidly increasing imports of artificials, it was the growing supply of farmyard manure that accounted for the larger part of the increased consumption of nutrients by Dutch agriculture up to the 1920s.³

Where were the fertilizers used? One important large-scale consumer was sugar beet cultivation, whose breakthrough in Sweden proceeded in parallel with the introduction of industrially-produced fertilizers. In Skåne in southern Sweden, where the sugar-beet cultivation was most extensive, the average use of fertilizer was 131 kilos per hectare of cultivated land

³ Merijn T. Knibbe, 'Feed, Fertilizer, and Agricultural Productivity in the Netherlands, 1880–1930', *Agricultural Hist.* 74 (2000), p. 51. Paul Brassley has drawn roughly the same conclusion for England and Wales. Only in the supply of phosphate were artificial fertilizers more important than farmyard manure. Paul Brassley, 'Plant Nutrition', in E. J. T. Collins (ed.), *The Agrarian History of England and Wales*, VII (i), 1850–1914 (2000), pp. 531–47.

in 1911, some 75 per cent higher than the average for the whole country.⁴ Another form of agriculture that required fertilizers – and the one which concerns us here – was peatland cultivation. Here the demand was mainly for phosphate fertilizer and potash salts. As a result, Sweden was a disproportionately large importer of potash when compared to other countries. In a statistical survey made by the German potash industry and published in the Journal of the Swedish Peatland Cultivation Association, *Mosskulturföreningens tidskrift*, in 1891, it was stated that Sweden was the fourth largest importer of potassium in the world after Germany, USA and Great Britain and it explained this by saying that the country had a lot of peatland soil.⁵ When the secretary to the Royal Swedish Academy of Agriculture, Herman Juhlin Dannfelt looked back at the introduction of fertilizers to Sweden in 1925, he emphasized the importance of peatland cultivation:

This adaptation of fertilization to the type of soil and plants was made possible through the use of fertilizers as a complement to farmyard manure or instead of it, which in particular became common on marshes and bogs, for which reason the strongly increasing peatland cultivation from the 1880s also resulted in a considerable increase in the consumption of fertilizers.⁶

There is thus a great deal of evidence that, after sugar-beet cultivation, peatland cultivation was a prime stimulus to the rapidly increasing consumption of fertilizers in Sweden in the last decades of the nineteenth and the first few decades of the twentieth century. A circular of 1897, stated that fertilizers, ‘for some types of cultivation, namely for peatland cultivation and for the intensive cultivation of root vegetables, in particular sugar beets, they are without doubt a *conditio sine qua non*’.⁷ This is also the conclusion Mats Morell came to in the fourth volume of the Swedish agricultural history, *Jordbruket i industrisamhället, 1870–1945*, where he shows that that acid peatland soil was capable of dissolving and using fertilizers that could not be used successfully elsewhere.⁸

Unlike sugar beet, the cultivation of marsh and bog soil was conducted over the whole of Sweden – from Skåne to Lapland. It was also undertaken by large-scale as well as middle-sized farmers and smallholders. The Mosskulturföreningen played an important role by spreading the usage of artificial fertilizers to farmers throughout the country, trialling new fertilizers to distinguish between the effective, the ineffective and the merely fraudulent, and publishing recommendations for the use of fertilizers on improved peatland. The association must be seen as one of a number of national agricultural science research organisations established in Europe and North America, with Germany as a model, in the latter half of the nineteenth century. Besides scientific

⁴ Fredrik Björk, ‘Ett energimedel av största värde: Betsockrets genombrott i Sverige’, in E. Mårald and C. Nordlund (eds), *Värna, vårda, värdera: Miljöhistoriska aspekter och aspekter på miljöhistoriska* (Umeå: Skrifter från forskningsprogrammet Landskapet som arena 5, 2003), p. 59.

⁵ ‘De enskilda ländernas andel i kaliförbrukningen under 1888 och 89, beräknadt i kilogram’, *Svenska mosskulturföreningens tidskrift* 1891, pp. 124–5.

⁶ Juhlin Dannfelt Herman, ‘Sveriges lantbruk, 1875–1925’, in *Lantbruket i Norden, 1875–1925: Under senaste halvsekle* (1926), p. 45.

⁷ id., ‘Hvilka konstgödselmedel åtnjuta numera det största förtroendet, och på hvilken jordmån böra dessa lämpligen användas?’, *Kongliga Landtbruks-akademiens handlingar och tidskrift* 1897, p. 204.

⁸ Mats Morell, *Jordbruket i industrisamhället, 1870–1945* (Det svenska jordbrukets historia, 4, 2001), p. 225.

experiments, their task was to control different products and analyse soil samples on behalf of farmers. In addition to the laboratory assignments, the stations functioned as disseminators of scientific findings, and farmers could turn to them for advice and information.⁹

II

The use of chemical assistance to agriculture began to be discussed in Sweden as early as the mid-nineteenth century.¹⁰ Initially, chemical analyses of soil samples and fertilizers were made for a fee by the Royal Swedish Academy of Agriculture's chemist, by the Institutes of Agricultural Sciences at Ultuna and Alnarp and by private chemists. In the early 1870s, it began to be suggested that the government should take the responsibility for making this service available in the whole country. The first four government research stations were established in 1876 and their number increased to eleven by the end of the century.

The first manager of Mosskulturföreningen, Carl von Feilitzen, started his transition from industrialist to agricultural zealot in the early 1880s by setting up a private research station in Jönköping in middle of the southern part of Sweden. After a couple of years, this station became one of the government-financed centres with von Feilitzen as its manager. It was from this platform that von Feilitzen could act when taking the initiative to found the Mosskulturföreningen. Until 1903, when the Mosskulturföreningen secured its own buildings (which included a chemical laboratory), the government laboratory at Jönköping conducted the association's chemical analyses. The boundary between the government-funded station and Mosskulturföreningen was therefore permeable.

One of the Mosskulturföreningen's tasks was the evaluation of the quality of the new products that were constantly appearing on the growing fertilizer market. Some were fraudulent: others were simply substandard. There were also some miracle substances which claimed the support of bogus science and which agricultural science tried to suppress. Via *Mosskulturföreningens tidskrift*, results from the station's analytical and experimental activities were circulated widely, and a large number of articles and news items about new products and their potency were published. One reason why the Mosskulturföreningen disseminated such information was that many of the fertilizer frauds could only be detected by means of chemical analyses. Carl von Feilitzen wrote:

The farmer is however exposed enough to deceit when making these purchases. And this in a way that he cannot possibly control himself, namely by receiving a product inferior to what he is asking for, or even a counterfeit product.¹¹

⁹ David B. Danbom, 'The agricultural experimental station and professionalization', *Agricultural Hist.* 60 (1986); Mark R. Finley, 'The German agricultural experimental stations and the beginnings of American agricultural research', *Agricultural Hist.* 62 (1988); Margaret Rossiter, *The emergence of agricultural science. Justus Liebig and the Americans, 1840-1880* (1975), and Ursula Schling-Brodersen, *Entwicklung und institutionalisierung*

der agrarchemie in 19. Jahrhundert: Liebig und Die Landwirtschaftlichen Versuchstationen (1989).

¹⁰ E. Mårald, 'Jordens kretslopp: Lantbruket, staden och den kemiska vetenskapen, 1840-1910' (Ph.D. Diss. Umeå University, 2000), pp. 66ff, 112-17.

¹¹ Carl von Feilitzen, 'Iakttagelser vid inköp af artificiella gödselämnen', *Svenska Mosskulturföreningens tidskrift*, 1890, p. 395.

It was thus in the best interest of farmers that the chemical stations and the Mosskulturföreningen offered their services. A underlying aim was to build confidence in fertilizers, which were essential to modern agriculture, and thereby encourage the transformation of Swedish agriculture. If individual brands of artificial fertilizers were found to be useless or counterfeit, then they jeopardized the take up of artificials generally.

III

The Mosskulturföreningen's principal work for promoting greater use of artificial plant nutrients consisted, however, of comparative fertilizer field trials. The aim of these activities was to convert the competing theories of agricultural science into practical applications and reliable recommendations through long-term trials. In this way the individual farmers were spared the need to experiment and it allowed them to avoid unnecessary mistakes. In order to attain well-founded and generalizable results, great scientific accuracy was needed, which individual farmers could not attain. Research and advisory work was essential to the Mosskulturföreningen's whole purpose. Without the experimental work, there was no knowledge or advice to spread to the farmers, nor any justification for the government or others to support the association.

The trials were principally conducted at the association's experimental station situated on peatland at Flahult in Småland (Figure 2). This was an area in the highlands of southern Sweden, of vast and unexploited peatland. A large vegetation experimental farm was also built in Jönköping in 1890 for exact experiments to be conducted in concrete-lined test beds (Figure 3). It was close to this facility that the Association's new headquarters building was erected in 1903. Trials were also conducted at the association's branches at Torestorp and Gisselås, the latter in Jämtland in the forest region of northern Sweden. In addition, the association successively established a nationwide network of local trial and demonstration fields. The Mosskulturföreningen's experimental work thus became extensive over time. In 1909 the vegetation farm consisted of 851 experimental containers, 173 experimental vessels and 67 plots on outdoor soil. At Flahult there were 36 cultivated hectares with 1360 plots, among other things; at Torestorp a little more than seven hectares were cultivated, and round the country there were 226 trial fields on an area of 62 hectares divided into 4010 plots.¹² This experimental work continued expanding until it reached its peak in the 1930s, with new experimental farms on peatland at Svartökärr close to Flahult and at Sörbyn in Västerbotten (in northern Sweden), and with more than 400 smaller local trials round the country.¹³

The fertilizer trials made up a considerable part of the experimental work. Different fertilizers were tested to discover the soils to which they were best suited, the optimum requirements of each crops, how different fertilizers should be combined and when, and in what amounts they should

¹² Hjalmar von Feilitzen, 'Hvilka erfarenheter hafva under senare tider vunnits på mosskulturens område?', *Svenska Mosskulturföreningens tidskrift* 1911, p. 623; Hjalmar von Feilitzen, *Några praktiska erfarenheter i mosskultur vunna under Svenska Mosskulturföreningens 23-åriga försöksverksamhet (1887-1909)* (1911), pp. 4-9, and Hugo

Osvald, 'Svenska mosskulturföreningens verksamhet, 1886-1926', *Svenska Mosskulturföreningens tidskrift*, 1926, pp. 245ff.

¹³ Gerhard Rappe, 'Svenska mosskulturföreningens verksamhet, 1886-1936', *Svenska Mosskulturföreningens tidskrift*, 1936, pp. 291-303, 305.



FIGURE 2. The experimental farm at Fluhult. Photo: Hjalmar von Feilitzen.

Source: Mosskulturföreningen archive, Swedish National Archive, Stockholm.

be used. Although there was a very positive attitude to fertilizers, the Mosskulturföreningen did not advocate the inappropriate or uncritical use of artificials. The experimental work was aimed instead at creating scientifically-informed and economically-rational consumption, where the farmers themselves learned how (and how not) not to fertilize. There was a revision of the optimistic view of cultivation that existed when the association was founded. It was realised that even with fertilizers, not all peatlands could be cultivated profitably. This was especially true of sphagnum bogs, which were only profitable to cultivate as pastures. The trials at Flahult showed that it was possible to transform a sphagnum bog into fertile farmland, but this was too expensive for the individual farmer, and where there were unexploited but fertile marshlands, it was judged to be better to exploit these first.¹⁴

What practical results did the experimental work produce? The plant nutrients lacking in most peatland soils were phosphorus and potassium. Large amounts of lime also had to be used as a soil improver in order to neutralize its acidity. Phosphorus could be added primarily in the form of bone manure, superphosphate or basic slag. Which of these substances was preferable depended on its price and the particular circumstances in which they were to be used. The use of bone manure had been questioned in the 1890s because it was held to be difficult to dissolve. Later results from the Mosskulturföreningen's trials showed that in acid peatland soil the phosphorus became available to be taken up by plants. Superphosphate and basic slag were, however, found to be the best substances. There was some predilection for basic slag in the advice given, as this type of phosphate was held in the soil longer and

¹⁴ Hjalmar von Feilitzen, 'Hvad har Svenska Mosskulturföreningen uträttat under de gångna 25 åren?', *Svenska Mosskulturföreningens tidskrift*, 1905, pp. 373–4.



FIGURE 3. The vegetation experimental farm in Jönköping. Photo: Hjalmar von Feilitzen.

Source: Mosskulturföreningen archive, Swedish National Archive, Stockholm.

basic slag also contained lime. Moreover, potassium had to be imported as there was no local source. Only German Stassfurter potash salts were on the whole recommended, irrespective of type. Although there was nitrogen in most peatland soils, the application of Chilean saltpetre, lime saltpetre or calcium carbide could be used to get quick harvest results or to maintain the quality of grazing grounds. After the First World War, the attitude to nitrogen fertilizers changed. This coincided with their becoming cheaper, and their regular application to peatland soils began to be recommended.¹⁵

Fertilizers were not the only means of improving peatland. Initially there had been hopes that peat soils could be cultivated entirely without using farmyard manure, since the peatlands were rich in nitrogen and humus. The rapid development of the understanding of soil bacteriology in the late nineteenth century changed the picture. It led to the insight that soil bacteria played a decisive role in fertility, even though there was no understanding at that time of how this worked. Through a large number of practical cultivation experiments, the Mosskulturföreningen showed that these organisms had an important role in allowing plants

¹⁵ Hjalmar von Feilitzen, 'Hvad har Svenska Mosskulturföreningen uträttat under de gångna 25 åren?'; id., 'Hvilke erfaringer hafva under senare tider vunnits på mosskulturens område?'; id., *Några praktiska*, and Hugo Osvald, *Myrar och myrödling* (1937), pp. 267–307.

to assimilate the nutrients in the soil. The chemist Hjalmar von Feilitzen, who had succeeded to the position of manager after his father, wrote,

... newly cultivated peat soil is on the other hand rather poor in bacteria, and it is only when these are present in large numbers that the transformation in the soil can proceed undisturbedly, and the organic plant nutrients be released.¹⁶

By experimentation, von Feilitzen was able to demonstrate that the addition of even a small amount of farmyard manure, rich in micro-organisms, put 'life in the soil'. In order to be able to carry out 'green manuring', in which nitrogen-fixing leguminous plants that were first sown and then ploughed in, the peatlands needed enriching with the essential nitrogen bacteria. Hjalmar von Feilitzen was able to prove that the so-called soil grafting, when soil from land on which clover and vetch were already established was spread on peatlands, was an effective method in improving the bacteriological content of the peat soils.¹⁷

The changes in Swedish agriculture with the transition to livestock production also affected the advice given to farmers. Before the Mosskulturföreningen had been founded, a great deal of newly exploited peatland soil and land produced by the drainage of lakes had been used for cultivation of oats, for which there was then a ready export market to Britain. Oats were grown on the same ground year after year, which led to the harvests decreasing because weeds progressively took hold. To counteract the problem with weeds, the Mosskulturföreningen advocated a crop rotation consisting of grain, root vegetables, pasture grass and fallow. Pasture cultivation of grass and clover came, however, more and more to be described as the most important form of cultivation on the peatlands. As regards feedstuff production on peatlands, fertilizers also played a decisive role. A clear connection was seen between fertilizers and farmyard manure, peatland and conventional soils, and between the cultivation of land and livestock breeding. A translated German article in *Svenska mosskulturföreningens tidskrift* in 1891 about the importance of basic slag in agriculture, stated, for example:

The basic slag thus starts a beneficial cycle running through all phases of agriculture, because it makes it possible to introduce more cultivation of feedstuff, green manuring, a larger stock of cattle, hence a larger amount of manure, and at the same time further improvement of the manuring.¹⁸

So, the fertilized peatland soil came to be used for production of feedstuffs for an increasingly large stock of cattle, which in turn could increase the supply of farmyard manure. Mats Morell has summarised the changes that this brought about. 'The cultivation of peatlands and waterlogged meadow contributed to larger crops on firm-ground arable, and the fertilizers contributed to more farmyard manure to the crops that could utilize them the best.'¹⁹ The use of fertilizers on peatlands was seen as a way of generating more resources which could be deployed on land which could not otherwise be utilized at its optimum efficiency. In this way the farmers

¹⁶ Hjalmar von Feilitzen, 'Hvad har Svenska Mosskulturföreningen uträttat under de gångna 25 åren?', p. 376. See also id., *Några praktiska*, p. 35.

¹⁷ id., *Några praktiska*, pp. 24–35, 45f.

¹⁸ 'Meddelanden från 1891 års konstgödselmarknad', *Svenska Mosskulturföreningens tidskrift*, 1892, p. 145.

¹⁹ Morell, *Jordbruket i industrisamhället*, p. 225.

could accelerate the turnover of the whole system, in the soil as well as economically, in order to get a larger, safer and quicker yield.

IV

Even if the Mosskulturföreningen, like the other institutes for agricultural science, strived to be objective and impartial, there were close connections between its scientific and external activities, commercial interests and the government. The boundaries between these spheres were maintained, but there were unifying interests and a shared view of many issues. This was a prerequisite for the Mosskulturföreningen's existence. Its membership never exceeded about three thousand and their subscriptions were insufficient to support the whole range of the association's activities. It was therefore dependent on government financial support and the subventions of supporters in order to be able to function and expand. Conversely, the association's organization and activities could be used to promote commercial or government interests. Mosskulturföreningen's work aimed at modernizing agriculture, decreasing social problems and involving farmers in economic and scientific exchange in order to strengthen the nation.

The Mosskulturföreningen was given public grants at an early stage, but it was not until 1906 that the government became its major funder.²⁰ There was a constant struggle to secure increases in grant aid and induce the government to support peatland cultivation. It is far from self-evident that there was a consensus amongst politicians and agricultural specialists that peatland cultivation was a solution to the country's future needs. This controversy was particularly evident in the debate about the so-called Norrland issue, about whether the northern half of Sweden was best developed for agriculture or industry.²¹ The debate between the advocates of industrial and agricultural development existed within all the political parties. The advocates of an agrarian future for the country held the upper hand for a long period in the twentieth century. Support for the Mosskulturföreningen was thus to be found among the agricultural zealots, and peatland cultivation can be placed in a political context, in which the modernization of agriculture was seen as the way to improve living standards.

The Mosskulturföreningen persistently lobbied the government over a variety of issues including its support for facilitating the use and dissemination of soil improvers. As early as 1886 the Association wrote to the Crown urging a reduction in freight charges for lime and fertilizers on the state-owned railways. This was an issue that the association pursued with support from the regional agricultural societies. At length its lobbying was successful, and in 1907 a 40 per cent reduction in the freight charge for lime was conceded. In the words of the Ministry of Agriculture, the facilitation of the supply of lime was seen as 'an important governmental interest', in particular for those parts of the country that were deficient in lime and where there was much peatland that had been improved.²² The First World War also caused problems for the supply of fertilizers and forced the implementation of a policy of strict rationing. According to

²⁰ Rappe, 'Svenska mosskulturföreningens verksamhet, 1886–1936', p. 325

²¹ Sverker Sörlin, *Framtidslandet: Debatten om Norrland och naturresurserna under det industriella genombrottet* (1988), pp. 156–253.

²² von Feilitzen, 'Hvilka erfarenheter hafva under senare tider vunnits på mosskulturens område?', pp. 619ff, and 'Fraktlindringarna å kalk för jordbrukets behof', *Svenska Mosskulturföreningens tidskrift*, 1917, pp. 202–05.

the Mosskulturföreningen, this was particularly hard on the peatland plantations, which were completely dependent on the supply of imported phosphorus and potassium. The association maintained that the peatland farmers ought to get a larger allocation than other farmers and that its distribution needed to be expedited so that the fertilizers would reach the farmers in time to be of benefit. To some extent, the Mosskulturföreningen had their demands implemented.²³

The Mosskulturföreningen's advocacy for greater use of fertilizers also involved making direct or indirect propaganda for various commercial products. Particular companies or brands were seldom mentioned, but a recurring piece of advice to farmers was that fertilizers should be purchased from reputable firms. Swedish products were preferred, for example, basic slag under the brand names Wiborghsfosfat and Palmaerfosfat from the ironworks in Domnarvet and Norrbotten, which were in operation around 1900. Hjalmar von Feilitzen wrote two booklets on the potash mines in Stassfurt, Germany, and the phosphate industry in Sweden respectively, in which the Swedish suppliers were described.²⁴

Mosskulturföreningen had a particularly long and close connection to the fertilizer importer Moritz Fraenckel and his eponymous company.²⁵ Fraenckel belonged to a German merchant family and came from Saxony, not far from the centre of the potash industry. Early in life he moved to Sweden, and in 1876 he started Moritz Fraenckel & Co in Gothenburg. In the early 1880s he imported the first consignment of Stassfurter potash salts, and shortly afterwards his firm became the general sales agent in the Nordic countries for the newly established German Potash Syndicate.

When the Mosskulturföreningen started its cultivation experiments, it was Fraenckel who provided all the fertilizers that were used. For many years the Association also received from him 'a not insignificant sum' in support of its experimental work. Furthermore, the firm purchased and gave to the Mosskulturföreningen the land on the outskirts of Jönköping where its new headquarters were erected and partially funded the buildings there. Fraenckel also carried the largest part of the cost of the buildings at the experimental field at Torestorp (Figure 4). If there was a shortfall in funding for wall charts, special editions or leaflets, the association could also always rely on him to help out. In addition to its patronage of the Mosskulturföreningen, which, according to the Association itself, was Fraenckel's most important commitment, the firm also assisted nearly all the institutes of agricultural sciences in Sweden. From 1891 up to his death, Fraenckel was also an active member of the association's board. A proposal partly made on Fraenckel's initiative was the introduction of a new sack marking system for fertilizers, which brought some order to the trade.²⁶

²³ 'Skrifvelse till Kungl. Maj:t rörande tillgodoseende af mossodlingarnes behof af konstgödsel', *Svenska Mosskulturföreningens tidskrift*, 1917, pp. 513–5; 'Skrifvelse till Kungl. Maj:t rörande import af konstgödsel för mossodlingar och möjligast snabb distribution af inkomna partier', and 'Frågan om import och distribution af konstgödsel', both *Svenska Mosskulturföreningens tidskrift* 1919, pp. 80–1, 154–5.

²⁴ Hjalmar von Feilitzen, *Ett besök vid kaligrufvorna i Stassfurt: Föredrag vid Tekniska föreningens i Jönköping-*

sammanträde den 16 maj 1903 (1904), 29 pp., and Hjalmar von Feilitzen, *Några ord om fosfatindustrien och dess nuvarande ståndpunkt i vårt land: Föredrag vid Tekniska föreningens i Jönköping sammanträde den 27 april 1912* (1912), 40 pp.

²⁵ 'Moritz Fraenckel', *Svenska Mosskulturföreningens tidskrift*, 1911, pp. 107–10.

²⁶ Hjalmar von Feilitzen, 'Hvilka erfarenheter hafva under senare tider vunnits på mosskulturens område?', p. 620.

good return, and Fraenckel's firm had a virtual monopoly on the sale of potassium fertilizers in Scandinavia. Disseminating information to farmers about the importance of fertilizers via the Mosskulturföreningen's organization and contacts increased the sales and trust in the firm as well as its scientific legitimacy. At the time of the firm's fiftieth anniversary, the Mosskulturföreningen wrote about Moritz Fraenckel's ability to combine idealism and financial activities. '[He] ... succeeded, to an exceptional degree, in combining a far-sighted business principle with an idealistic interest in agriculture in the Nordic countries.'²⁷ Hence, representatives of the Association did not regard the close contacts they had with the firm as producing any conflict of interest between them. The Mosskulturföreningen and Fraenckel had a shared interest in the growth of fertilizer usage. The close connection between the Association and the company guaranteed such a development. After Moritz Fraenckel's death in 1911, his son Gösta took over the firm and continued his father's membership of the board of Mosskulturföreningen: thus the close co-operation was continued into a second generation.

V

The Mosskulturföreningen's attribute *Svenska* (Swedish), as well as the government's support and the backing of the country's agricultural societies and county councils all reflected a national ambition and endeavour to bring Sweden's peatlands into profitable cultivation. Peatland cultivation and the utilization of fertilizers did not, however, disseminate by themselves – at least not at the rate that the association sought. In order to induce farmers to undertake peatland cultivation in accordance with the latest scientific findings, the association had to develop an organization and establish information channels and contacts, in which an increasing number of people, institutions and resources became involved. As we described earlier, the Mosskulturföreningen was in this way linked to the government, and to commercial interests and other agrarian organizations. Through its external activities, farmers were also directly included in the network. This contact with the local level was important for the dissemination of the findings of agricultural science but also for the gathering of the experiences of individual farmers as a part of the association's acquisition of knowledge.

The Mosskulturföreningen was not alone in disseminating the benefits of peatland cultivation and fertilizers. In the late nineteenth and the early twentieth century, an 'agricultural science infrastructure' was developed which encompassed the institutes of agricultural science and their branches throughout the country, farm schools, agricultural associations and their experimental sites.²⁸ The regional agricultural societies played an important role in this network. Through their hierarchical organization, with both nationwide links and regional and local responsibilities, they were the ideal means by which information and new technology could be disseminated. In order to publicise these innovations, an increasing number of agrarian experts were employed with the aid of governmental funding, as agricultural consultants, local advisors, county agronomists, drainage foremen, etc. In 1925 the agricultural societies employed about 350 advisors, and by the late 1930s this number had risen to

²⁷ 'Firman Moritz Fraenckel & C:o 50 år', *Svenska Mosskulturföreningens tidskrift*, 1926, pp. 168–9.

²⁸ Mårald, 'Jordens kretslopp', pp. 139–45.

about 700.²⁹ It is therefore difficult to distinguish the Mosskulturföreningen's contribution from that of other participants in the agricultural science infrastructure, but it was far from insignificant. In addition, the association's perspective and knowledge came to be taught and conveyed by the other actors.³⁰

The Mosskulturföreningen's external activities, performed for the most part by its advisory officers, took several forms. Its first advisory officer was employed in 1888; it was not until 1904 that the second was appointed, and a third in 1910. Their duties were to offer practical advice to the peatland farmers, give public lectures and manage the experimental trials. The sources indicate that there was a shift in the character of those who drew on the advisors. Initially they were consulted by the more well-to-do farmers, but after the turn of the century, smallholders came to predominate and they were encouraged to seek advice by the offer of free consultations. The association also distributed its message through its journal, booklets and leaflets. It compiled demonstration materials for agricultural training and education and participated regularly in exhibitions. Every year a summer meeting was arranged, which moved around the country. In this way the Mosskulturföreningen could develop its contacts with the regional agricultural society that had assisted in the arrangements and its members could make excursions to interesting peatland enterprises in the vicinity. From 1906 onwards a peatland course was held annually in Jönköping which attracted several hundred participants and from 1924 onwards, courses were also arranged at Gisselås in order to explore conditions in the north.³¹ In addition, the Association's manager and its botanist gave lectures at the agricultural institutes to impart knowledge of peatland cultivation to the next generation of agronomists.

The most effective method of reaching the farming community was the local trial and experimental fields (Figure 5). These were carefully located so as to be easily accessible and readily visible to the largest number of people. The regional advisory officer organised the trials and took charge of the demonstrations, which were attended by anything from ten to a couple of hundred spectators. The day-to-day supervision of the trials was conducted by slightly more than a hundred trial hosts who were selected as competent and careful farmers capable of acting as local ambassadors for peatland cultivation. All the other institutes of agricultural science and agricultural societies conducted similar trials, often in collaboration. For example in Norrbotten, the northernmost part of Sweden, the Kemisk-växtbiologiska anstalten (Chemical and Plant Biological Institute) carried out about 150 fertilizing trials annually, both on farmland and on peatland plantations. Each field consisted of 15 to 20 meter square seed plots, where completely unfertilized plots were compared with fully fertilized (nitrogen, phosphorus, potash and lime) ones, and with plots where one of the plant nutrients was omitted. The idea was the fields would speak for themselves and prove that the use of different types of fertilizer yielded

²⁹ *Betänkande med förslag angående hushållningssällskapens organisation och verksamhet m.m.* SOU 1942:32, p. 13, and Kirsti Niskanen, 'Godsägare, småbrukare och jordbrukets modernisering: Södermanlands län 1875–1935' (Ph.D. Diss. Stockholm University, 1995), pp. 121–55.

³⁰ See also Nicholas Goddard, 'Information and

innovation in early-Victorian farming systems', in B. A. Holderness and M. Turner (eds), *Land, labour and agriculture, 1700–1920. Essays for Gordon Mingay* (1990), pp. 165–90.

³¹ Hernfrid Witte, 'Svenska mosskulturföreningens första norrländska mosskurs', *Svenska Mosskulturföreningens tidskrift*, 1924, pp. 372–81.

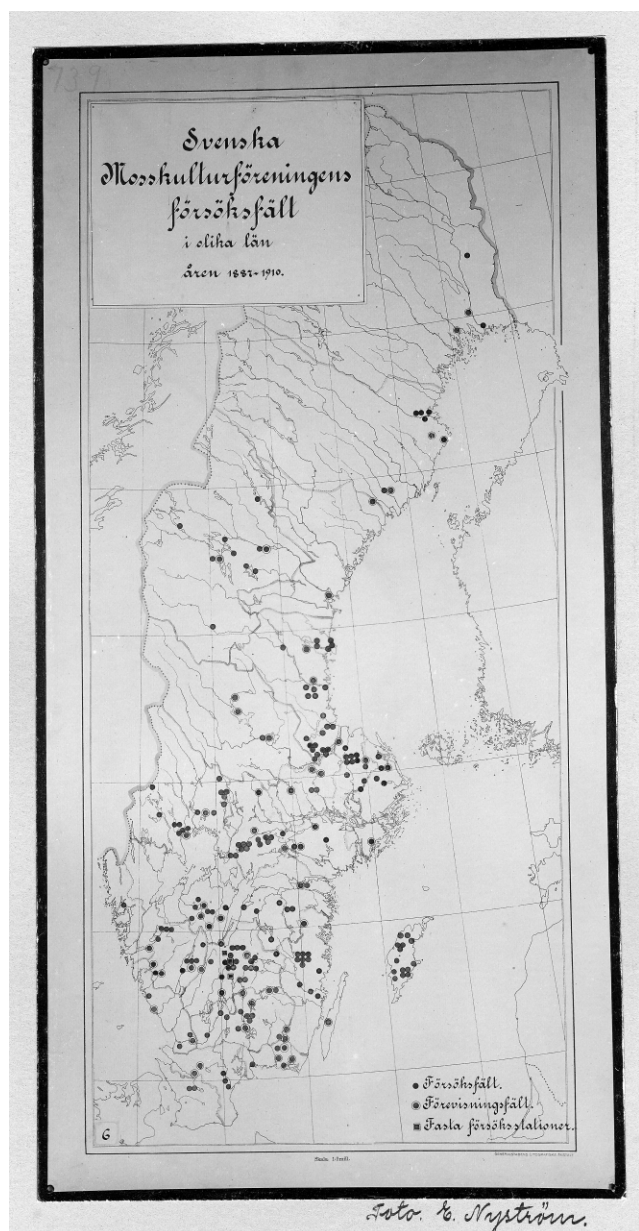


FIGURE 5. Map over Mosskulturföreningens local trail and demonstration fields, 1887–1910.

Source: Mosskulturföreningen archive, Swedish National Archive, Stockholm.

a greater return and was economically profitable. The association's manager, Paul Hellström, noted that the external work produced positive results:

Many a farmer, who some years ago with badly concealed doubt and almost contemptuous ridicule, saw how the Institute's officers strewed fertilizers on the small trial field on his peatland plantation, is now using considerable amounts of fertilizer annually on his bog.³²

³² Paul Hellström, 'Sveriges nordligaste försöksanstalt: En 10-års översikt', *Landtmannen* 1905, p. 598.

The importance placed on the field trial, both as a demonstration of the power of fertilizers but also as a scientific experiment, confirms Henke's assessment that the trial field as a 'place' has a central function in agricultural science research.³³ It combined the laboratory's ambition to attain abstract results with the objective of field research to elucidate the special properties of places. Moreover, the trial field had a twofold aim. Trials were conducted not only to produce facts but also to change the landscape itself and the attitude of farmers in its surroundings. With its clear demonstrative pedagogy and numerical presentations, the trial field had the capacity to persuade.³⁴ Everybody could see with their own eyes that modern agricultural methods were superior. If the farmers could not see this, the demonstrations could still teach them to see what they were expected to achieve. Henke criticizes the idea that the field trial was merely a matter of disseminating information from the centre to the periphery. It was, instead, a place for the exchange of knowledge and for negotiation. In order to be successful, the trials must be adapted to local conditions and the farmers' own interests. They were often conducted on the farmers' own land and utilised their practical skills. Without the trial hosts' practical know-how, it would have been very difficult to produce the amount of standardized data that was needed for the rigorous assessment of new products. In other words, farmers participated in the scientific gathering of knowledge via the trial fields.

Finally, one explanation of the Mosskulturföreningen's impact and the rapid dissemination of fertilizers was that society's political objectives coincided with those of the association up to the 1930s. Expansion of the cultivated area, the improvement of peatlands, the creation of new smallholdings and proliferation of smallholders were seen by many as a solution to the social problems of emigration, rural unemployment and the flight from the countryside. In order to stimulate improvement projects, a large number of different loans and grants were established, including loans for improvement, grants for frost reduction, drainage grants, premium bond loans, grants for the handling of manure and fertilizers, drainage grants and state mortgages for the purchase of holdings.³⁵ The Mosskulturföreningen advocated the establishment of such grants and through its advisory service showed farmers how they could be used to bring the greatest benefit. In order for a farmer to secure a loan or a grant, he had to manage his newly cultivated peatland or smallholding with modern methods and with approved cultivation plans, in which the use of fertilizers was a necessary part. The loans and grants functioned both as a kind of educational tool but also served to enforce compliance with the new agricultural thinking and methods.

The improvement of peatlands was not merely a matter of compulsion and control. Many farmers took initiatives of their own to cultivate them, to purchase fertilizers or seek help from the agrarian experts. Farmers also united in co-operative societies in order to lower the costs of fertilizers and other goods or to pay consultants to examine the quality of their products and suggest improvements. Some of the farmers' reasons for adopting modern agricultural methods were certainly different from the aims of the government

³³ C. R. Henke, 'Making place for science: The Field Trial', *Social Studies of Science* 30 (2000), pp. 483–511.

³⁴ See also Mårald, 'Jordens kretslopp', pp. 88–91.

³⁵ Herman Juhlin Dannfelt, 'Sveriges lantbruk, 1875–1925', pp. 38–48.

and the Mosskulturföreningen.³⁶ While the government held the overall responsibility and Mosskulturföreningen disseminated knowledge of the new agricultural methodologies, the farmers acted out of self-interest. For them, the introduction of new technology was a means by which heavy and never-ending toil could be reduced. Modern agricultural methods also promised a safer yield and a more secure existence. Farmers were also interested in gaining access to cash, which gave them an entry to the world of consumer goods and a more modern lifestyle. Hence, the farmers themselves were a driving force behind the increasing use of fertilizers. In this way peatland cultivation was an area where several different actors could meet in order to attain their respective goals.

VI

As this article has tried to show, peatland cultivation, in an initial phase from the 1880s to the 1930s, played an important role in the adoption of fertilizers by Swedish agriculture. However, there are no direct figures showing the proportion of total fertilizer consumption that was devoted to peatlands. There is, nevertheless, a great deal of evidence that, through its special requirements, the cultivation of peatlands led to a greater use of fertilizers. What is also uncertain is how much importance we should attribute to this increase in consumption. Knibbe, in the article referred to before, thought that artificial fertilizers were of relatively little importance in increasing agricultural production in the Netherlands up to the interwar period. Instead, it was the increasing amount of farmyard manure that had the greatest importance for the growing productivity of farming. But Knibbe also acknowledged that industrially-produced fertilizers had a great influence on the practice of agriculture in the nineteenth century. They allowed the awkward and time-consuming recycling of urban waste to be decreased drastically, the need for labour in agriculture to diminish, and allowed Dutch farmers to specialize. The impact was thus more on an organizational and a social plane.³⁷

Much of this analysis also seems to apply to Sweden. We have noted, for instance, how the use of fertilizers released the innate fertility of the peatland, allowed more fodder to be grown and so generated more manure by allowing larger cattle herds to be maintained. Admittedly, Swedish peatland cultivation can hardly be said to have led to agrarian specialization or increases in the productivity of labour, as in the case of the Netherlands: by allowing the creation of smallholdings, it may even have acted as a drag on overall levels of productivity. On the other hand, the use of fertilizers on peatland plantations resulted in altered practices and allowed farmers to free themselves from regimes of locally-oriented and self-subsistence production. As we have seen, the Mosskulturföreningen had an important function in connecting farmers with commercial interests and new products.

Peatland cultivation and the Mosskulturföreningen's efforts resulted in fertilizers being adopted

³⁶ For a discussion of how science and various groups in society cooperate in order to gain access to facts and resources, see Susan Leigh Star and James R. Griesemer, 'Institutional Ecology, "translation", and boundary objects: amateurs and professionals in Berkeley's Museum

of Vertebrate Zoology, 1907–39', in M. Biagioli (ed.), *The Science Studies Reader* (1999), pp. 505–24.

³⁷ Knibbe, 'Feed, fertilizer, and agricultural productivity', pp. 39–56.

over a large geographical area and gaining acceptance among the broad mass of farmers. This was not only a matter of spreading fertilizer usage and making available knowledge of how to use them. It was also a matter of conveying a way of thinking. In place of the self-sufficient holding, a farm became a production unit drawing on external resources and knowledge in order to increase its turnover and profitability. It was important that the farmer did not rest on his laurels but constantly strove to improve his methods and hence achieve improvements in yields. Agrarian societies, advisors and technical journals all played a part in disseminating this mode of thought. It may be though that they were engaged in a single, gigantic educational project. The Mosskulturföreningen and its sponsorship of peatland cultivation was one of the catalysts that speeded up the modernization of agriculture.

We might end with a glance forwards. By the time new technologies (which involved a much greater consumption of fertilizers), and new thinking about the role of agriculture in the Swedish economy and society coalesced after the Second World War, peatland cultivation and Mosskulturföreningen had disappeared from the scene. In 1939 it merged with the merged with the Svenska betes-och vallföreningen (The Swedish association for fodder and pasture cultivation). At the same time the responsibility for its experimental work was passed to the state-managed agricultural research stations. The new association continued to operate at a low level until 1971 when it was formally dissolved. Rationalization of agricultural practices and a more effective use of land led to the abandonment of cultivation on marginal soils, amongst them the peatland plantations. Instead, it was increasingly felt that the cultivation of peatland, which required high inputs but offered the prospect of poor yields, was mistaken. It was held to be more rational to afforest this land, and so much of it was given up by conventional agriculture. The sponsorship of government was withdrawn, and the economic rationality of farmers, which the Mosskulturföreningen had helped to inculcate, finally and fatally undermined its own project.