

Chapter 8

Agriculture and Nutrition: The Food Revolution



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Abstract The chapter analyses the fundamental changes in the agriculture and foods supply chain between 1850 and 1910 and investigates the consequences for the food supply, in particular for the poor.

Initially, agriculture profited from the liberalisation of international trade. The mixed crop tillage farms in the region of the large rivers and on the sand grounds commercialised and specialised themselves. After 1880, cheap, especially American, grain imports cast Dutch agriculture into a profound crisis. In part because of this crisis a number of innovations were introduced, like the use of artificial fertiliser and the founding of agricultural cooperatives. In addition, common lands were to disappear and large tracts of heathland were to be reclaimed.

The 1860s proved a turning point for the food processing industry. The revival of the domestic market in these years was a key factor. Also, a number of sectors oriented to foreign markets like the potato starch and the sugar beet industry flourished. The steam engine gained ground at the cost of horse-mills and windmills. Moreover new sectors like the margarine and the dairy-processing industry were established.

The modernisation of agriculture and the food processing sector had contributed to the improvement of the food situation. That also resulted from changes in the tax structure, whereby taxes on food were lowered and from increased welfare.

Quantitatively there was sufficient food at the beginning of the twentieth century, also for the poor. Potatoes and grain were still the main menu of the majority of the populace. The problem now shifted to food quality.

Keywords Innovation · Modernisation · Agriculture · Artificial fertiliser · Cooperatives · Commons · Agricultural crisis · Foods

8.1 The First Flour and Bread Factory¹

In 1851 the Amsterdammer Samuel Sarphati left for a study trip to Brussels, Paris and London.² As physician to the poor he had seen much poverty and misery at first hand and with this trip he wanted among other things to acquaint himself with the magnitude of poverty in those cities, their public hygiene, education, public health care and their struggles against poverty. In this endeavour he was supported by Thorbecke. Sarphati was an admirer of Thorbecke. Thorbecke, for his part, had great sympathy for the ideas and forcefulness of this kindred spirit. In London, Sarphati visited the first World Exposition and was deeply impressed by all those robust machines and technical innovations from foreign countries. He was particularly interested in the set of machines for milling grain and baking bread: steam engines, grain purifiers, bucket conveyors, air-cooled millstones, kneading machines, baking ovens etc. Upon his return he joined forces with the Delft professor S.A. Bleekrode and the agronomist W.C.H. Staring to found the 'Association for Public Diligence' in order to stimulate national industry and improve popular well-being.

During one of the meetings, Sarphati proposed to set up what would be the first flour and bread factory in the Netherlands. The goal was to bring good and cheap bread to market and hence to improve the nutrition of the poor and the workers. Amsterdam's philanthropists and industrialists found common ground in a new joint stock company. In 1857 the factory with steampower began production. By means of this and other projects, Sarphati mounted the social ladder from his origins in an obscure Portuguese-Jewish family to a place among the social elite of the capi-

¹For this see: H.W. Lintsen et al., *Made in Holland: Een techniekgeschiedenis van Nederland [1800–2000]* (Zutphen 2005), 33–35. The case is based on: H.W. Lintsen and M.S.C. Bakker, 'Meel', in: H.W. Lintsen et al. (eds.), *Geschiedenis van de techniek in Nederland: De wording van een moderne samenleving 1800–1890* (Zutphen 1992), part I, 71–101; J.L. van Zanden and A. van Riel, *Nederland 1780–1914: Staat, instituties en economische ontwikkeling* (Amsterdam 2000), 178–185.

²L. Hagoort, *Samuel Sarphati: Van Portugese armenarts tot Amsterdamse ondernemer* (Amsterdam 2013), 219–225, 231–232.

tal. Amsterdam still honours Sarphati with a Sarphati Street, a Sarphati Square and a Sarphati Park, the latter containing an imposing bust of the man himself.

Amsterdam's example was quickly followed. Eight years later, in 1865, there were already ten mechanized flour mills and eleven flour and bread factories in the Netherlands. This sector was clearly booming business. Whence this sudden upsurge? Was Sarphati the first Dutchman to make acquaintance with the industrial fabrication of flour and bread? That would seem a serious underestimation of the entrepreneurs of the time. Many travelled around the world and had seen similar factories in France, England, America and various other countries. Grain merchants, above all, had been particularly interested but had made no use of their knowledge. The situation was even more curious in view of the fact that the flour and bread factory, as an innovation, was by then about a century old. The origins of the idea lay in Paris in 1760. How was it possible that Dutch industrialists only picked up on the idea after such a long period?

The opening of the first Dutch flour and bread factory had everything to do with a change in the tax laws: in 1855 the Law on Milling was rescinded. History shows that technical development and legislation are closely related. This is certainly a case in point. The Law on Milling regulated taxation of flour. This was an ancient tax, originally in the form of local ordinances. After the founding of the kingdom of the Netherlands in 1813 these were succeeded by national legislation. Every kilo of rye or wheat flour was taxed at the grain mill and the government saw to it that nobody milled without permission.

Of course millers did everything in their power to avoid paying these taxes. The government was therefore compelled to take strict precautions and to maintain a small army of tax officials. Millers were required to submit a detailed floorplan of their mills, sheds, storage facilities and dwellings. In the course of a possible search these would aid the tax official in locating secret storage spaces and possible smuggling routes for grain on which no taxes had been paid. These tax laws not only affected the peace of mind of the miller, but had consequences for the entire conduct of the business.

Large-scale production was impossible, because the law demanded that every sack of grain in every mill had to be traceable. Grain was in fact milled sack by sack. Flour could not be purified, not re-milled for more delicate kinds of bread, not traded by the miller and so on. In short, the stringent milling law was adapted to traditional small-scale production, frustrating for the miller, but equally so for anyone who wanted to start a flour and bread factory. This was openly acknowledged even by the government and parliament.

The law drew criticism for another reason as well: it taxed a staple element of the popular diet. But the tax income was hardly trivial for a national government struggling with big debts and budget deficits. Only after the government succeeded in getting its financial house in order, did it become possible to rescind the law, a decision taken in 1855.

The elimination of the Milling Law in any case affords an explanation for the sudden rise of industrial-scale flour and baking companies: Sarphati had seen and seized the opportunities offered by a liberalising market and had been followed by

others in short order. What remains to be explained is the spectacular growth of this sector in the subsequent decade. We will come back to this below.

The flour and bread factory illustrates the transformation of the Netherlands in the 1840s and 50s. The innovation was the initiative of an emergent midfield of active and socially engaged citizens who had great faith in technology. It was also made possible by a government that was re-inventing itself and that wanted to create conditions for the modernisation of economy and technology.

The new societal context would influence the entire supply chain of agriculture and foods. This supply chain belonged to the core of the Dutch economy. Agriculture had just experienced two decades of reasonable prosperity, but saw itself confronted around 1850 with the potato disease and failed harvests. The food processing industry was to a great extent locally organised and based on a craft system of production. Consumption consisted chiefly of potatoes and cereals and was, for a large part of the population, just adequate to remain alive.

Sarphati's innovation was one of the many innovations that transformed the food supply chain between 1850 and 1910. These would fundamentally alter the food situation. What did these changes mean for the nutrition of the population, in particular for the poor and the workers? The example of Sarphati suggests that this would have improved. Is that so? We shall deal separately with the various links in the supply chain (agriculture, the food-processing industry and food consumption).

8.2 The Modernisation of Agriculture

8.2.1 *Prosperity, Crisis and Innovations*³

Between 1840 and 1870 agriculture profited abundantly from the liberalisation of international trade. Dutch agriculture had clear comparative advantages over that of other countries. Grassland farming had long enjoyed a high level of productivity. Nowhere was milk production per cow as high as in the provinces of Holland and Friesland. This manifested itself in a flourishing export trade especially to industrialising England with its almost inexhaustible demand for 'luxury' foods like butter, cheese and meat. In addition, Dutch agriculture produced several other successful export products like the dyestuff madder.

Trade liberalisation caused the crop farming sector in the area of the big rivers and on the sand grounds to change and become commercialized. The price of grain remained under that of dairy products. It became more attractive to increase the amount of livestock and to transform crop fields into pastures. Up to then, cattle

³See for this subsection: Van Zanden and van Riel, *Nederland 1780–1914*, 248–256; J.L. van Zanden, *De economische ontwikkeling van de Nederlandse landbouw in de negentiende eeuw 1800–1914* (dissertation Wageningen 1985), 246–252; J.L. van Zanden, 'Mest en ploeg', in: H. Lintsen et al. (eds.), *Geschiedenis van de techniek in Nederland. De wording van een moderne samenleving 1800–1890* (Zutphen 1992), part I, 53–69.

husbandry had been part of a circular production process, subservient to the production of manure and grain. Now, crop farming increasingly came to serve cattle husbandry and the production of butter and livestock. Cattle husbandry hence increasingly became part of a linear chain of production and consumption. Cattle fodder was imported in large quantities and imports of grain partly fed to livestock, while the more expensive dairy products were exported. Initially the manure was destined to improve soil fertility, but in the twentieth century the increase in livestock in combination with the introduction of artificial fertiliser would lead to the conundrum of manure surpluses.

Agriculture's international success also had consequences for the domestic market. Agricultural products became more expensive and the domestic demand stagnated. The cost of living in the cities increased. The introduction of flour and bread factories in the 1860s could not reverse this trend. Moreover, not everyone in the countryside profited equally from the agricultural prosperity. Employment increased thanks to the intensification of agricultural production, but it consisted above all of an increase in the number of hired hands, maids, day-labourers and the increasing recruitment of the families of smallholders.⁴ These workers were barely able to pick the fruits of the increased prosperity and lived around or under the poverty line. The large farmers profited first and foremost. Income inequality in the countryside increased. It was one of the causes of increasing poverty in the Netherlands in the 1850s and 1860s.

The large farmers invested the accumulated wealth partly in innovations. On the clay-grounds the Arend-plough was introduced, a new kind of plough that reduced the necessary traction and thus economised on horses. In a number of polders steam-powered pumping replaced wind-powered pumping, a change that improved the manageability of groundwater levels. Other mechanical innovations, originating chiefly in Great Britain and the United States, included sowing and mowing machines, hay bailers and mechanical churns. They spread slowly, but did contribute to the increase of production per labourer and per hectare.

Around 1880 the agricultural prosperity came to an abrupt end only to terminate in a crisis that would last about two decades. It started with crop farming. Cheap cereals flooded the Netherlands and Europe. The United States had opened up vast tracts of agricultural land in its interior on which it cultivated wheat and corn. The costs of production were low because the land was in fact being over-exploited. Railways and steamships assured competitive transport. The railways connected the agricultural regions with the coast and steamships transported the grain to Europe. Similar developments took place in Russia and Argentina.

Dairy farming also ran into trouble. Dutch butter increasingly faced international competition from Denmark, France and Germany as did cheese from American suppliers. Moreover, butter began to be replaced by a cheaper substitute, margarine. Thanks to improvements in refrigeration technologies, trade in meat was able to replace trade in living cattle. The Netherlands played only a modest role in this international market.

⁴Van Zanden, *De economische ontwikkeling van de Nederlandse landbouw*, 331–332. Van Zanden refers to the increasing proletarianisation of the countryside and the increasing economic distance between farmer and labourer.

The crisis also had its positive sides. Foodstuffs became cheaper. Domestic demand increased. The cost of living declined. These developments contributed to the decline of poverty in the Netherlands. That said, this is not a sufficient explanation, because the decline had already set in at the end of the 1860s and not in the 1880s.

Another effect of the crisis was to accelerate the modernisation of agriculture. We will illustrate three aspects of this modernisation: the use of artificial fertiliser because it played a crucial role in this period – but also in the twentieth century – in the development of agriculture; the enclosure of the ‘commons’ because as a centuries-old corporative institution it was of essential importance for the management of the communal grounds and therefore of a large part of the Dutch landscape; and the emergence of the cooperative movement, because this was essential for the well-being of the small farmer and the smallholder.

8.2.2 *Artificial Fertiliser and the End of the Closed Chain*

At the beginning of the nineteenth century, foreign chemists and agronomists had discovered that nitrogen (N), potassium (K) and phosphor (P) were essential elements for plant growth. In 1840, Justus von Liebig, the ‘father’ of the artificial fertiliser industry, had summarized this knowledge, together with the results of his own investigations, in his book *Agricultur-Chemie*.⁵ His insights rapidly diffused in agricultural circles throughout Europe and stimulated dedicated efforts to develop fertilisers that would enable plants to absorb these elements with ease.

Up to then, Dutch farmers used manure from stables, if possible, augmented with urban waste, urban night soil (human and animal faeces) and waste materials like slaughterhouse waste, rotten fish and ground bones. In the 1840s this was supplemented by a lively trade in Guano, dried manure from sea-birds that was especially rich in nitrogen.⁶ After that things moved quickly in regard to the application of new fertilisers. There were various options.⁷ ‘Super Phosphate’ contained phosphates and nitrogen compounds and was based on treating bone with sulphuric acid. It was imported chiefly from Belgium, England and Germany. Chili Saltpetre was a South American raw material composed among other things of the nitrogen compound sodium nitrate. Thomas slag powder, imported from Germany and Belgium, was a phosphate-rich artificial fertiliser made from finely ground blast furnace slag derived from iron ore and raw iron with a high phosphate content. Potassium Salt was mined in Germany. The fertiliser ammonium nitrate was a component of ammonium sulphate, derived from the wastewater of municipal gasworks.

For a long time, the Netherlands was highly dependent on foreign suppliers for its artificial fertiliser. The domestic fertiliser industry consisted in part of suppliers who mixed fertilisers produced elsewhere. It also included factories that produced

⁵E. Homburg, *Groeien door kunstmest. DSM Agro 1929–2004* (Hilversum 2004), 25–27.

⁶Van Zanden, *De economische ontwikkeling van de Nederlandse landbouw*, 252–254.

⁷Homburg, *Groeien door kunstmest*, 25–44, passim.

fertilisers using foreign raw materials, for example the super phosphate factories. Finally there were also small enterprises that fabricated fertilisers from domestic raw materials. Gasworks, for example, processed ammonia water into ammonium sulphate. Beet sugar factories used their earth foam and potassium to produce potassium salts. At the outset of the twentieth century, there were six super phosphate factories in the Netherlands that were able to produce at large scales against internationally competitive prices. In addition, there were another ten to twenty small miscellaneous fertiliser factories.⁸

Initially, the use of artificial fertiliser spread slowly in the Netherlands. After 1880 things accelerated. Around 1900 lead users applied between 100 and 170 kg per ha, but the Dutch average was much lower. The Belgians were the most energetic fertilisers, followed by Germany and the Netherlands. In the 1920s the Dutch would seize the lead and become by far the biggest users of artificial fertilisers (see Table 13.2).

At the outset, four factors played a role in the adoption of artificial fertilisers: the price of the fertilisers, the farmers' ability to bear the costs, the knowledge he had at his disposal and the type of agricultural zone.⁹ Artificial fertilisers were expensive and it was long uncertain what the profit was. The pioneers were above all the large wealthy farmers able to bear greater risks and embedded in networks that gave them ready access to information. Some of them even performed elaborate experiments on test fields. The lead users also tended to be located in the fen-colonies in Groningen and Drenthe. These regions had a tradition of employing alternative fertilisers, particularly urban wastes. Regions like eastern Zeeuws Vlaanderen and the island of Goeree-Overflakkee were big users of urban waste. Farmers there cultivated sugar beets, a crop that required intensive fertilisation.

The sand grounds would eventually follow, even though there, because of the nature and the intensive cultivation of the soil, the issue of soil fertility was extremely urgent. In these regions, the declining cost of artificial fertilisers was an important incentive to adoption. The founding of cooperative purchasing associations was a contributing factor. Smallholders and dirt farmers first waited for the market to recover so that they could free up the necessary funds. They were further supported by so-called 'walking teachers' that educated them about the use of fertilisers. These teachers were part of a knowledge infrastructure that the government had been putting together since the onset of the agricultural crisis. Agricultural education was modernised. Every province was provided with teachers of agronomy that organised winter courses and provided farmers with information. Moreover, the government set up three additional experimental stations, in addition to the existing one at Wageningen. Among other things these institutes monitored the quality of fertilisers and experimented with them.

Artificial fertilisers did more than just increase the yield per hectare. Their use also meant the end of a production cycle, that is to say, a largely closed cycle of production and consumption. Agricultural products were formerly produced with

⁸Homburg, *Groeien door kunstmest*, 35.

⁹Van Zanden, *De economische ontwikkeling van de Nederlandse landbouw*, 255–262.

organic fertilisers derived from animals and humans, who after consumption contributed their organic wastes, or faeces, to agricultural production. Sunlight was the most important source of exogenous energy feeding the cycle. The adoption of artificial fertiliser stimulated the development of a linear chain, in which mineral and fossil raw materials – generally imported from abroad – were the beginning and in which the organic metabolic products produced at the end were only organic waste.

8.2.3 *The Landscape and the End of the ‘Common’ Lands*¹⁰

Another theme that was discussed throughout much of the nineteenth century in agricultural circles was the management of the ‘commons’ or the communal lands. At the outset of the nineteenth century, associations of owners managed at least a third of the national territory. They were known variously as commons, *marken*, *holtelingen* and *buurschappen*. They consisted mostly of heaths and moors, but also of lakes, swamps, meadows and woods. Most communal lands were on the sand grounds, but some also in the regions of river-clay and the high moors.

There were differences of opinion about the role of the common lands. Was the land more optimally exploited under collective or individual property rights? Proponents pointed to the functions fulfilled by the common lands. They served as a source of turf and firewood and to graze sheep, cows and pigs. Sometimes parcels of common land were cultivated. The common lands also provided heath sods for the production of manure compost. Agriculture could not exist without the common lands. Smallholders and dirt farmers with a small plot of land were extremely dependent on the commons.

Those pursuing the modernisation of agriculture spoke of a regressive remnant of the past that was maintained by ‘short-sightedness, prejudice, blind egoism and the most egregious ignorance...’¹¹ According to them this was a far from optimal use of the lands:

‘...Everywhere you can ... see the skinny cows of Pharaon walking about, separated from the fat ones by a single drainage ditch: the first as representatives of the common pasture, the other as those of particular ownership.’¹²

¹⁰ See for this subsection: T. de Moor, *The dilemma of the commoners: Understanding the use of common-pool resources in long-term perspective* (Cambridge 2015); A. van der Woud, *Het lege land: De ruimtelijke orde van Nederland 1798–1848* (Amsterdam 1998), 205–208, 213–237; van Zanden, *De economische ontwikkeling van de Nederlandse landbouw*, 152–165; Van Zanden and van Riel, *Nederland 1780–1914*, 158–162.

¹¹ Cited in van der Woud, *Het lege land*, 207. Original source: ‘De landbouw op de Nederlandsche Zandgronden’, *Mededeelingen en Handelingen van de Geldersche Maatschappij van Landbouw* III(1848), 10. Van der Woud endorses this standpoint. He speaks of a ‘remarkable relic from the early Middle Ages’ (206).

¹² Cited in van der Woud, *Het lege land*, 206. Original source: ‘De landbouw op de Nederlandsche Zandgronden’, *Mededeelingen en Handelingen van de Geldersche Maatschappij van Landbouw* III(1848), 4–5.

The opponents spoke of the ‘wastelands,’ lands that were barely profitable or had degenerated into bad lands due to poor management. That system had to be demolished and the *marken* organisations to be dismantled. The common lands had to be sold, so that farmers could get to work efficiently reclaiming them to the benefit of society.

In the twentieth century this theme would reappear on the political agenda in the guise of the ‘tragedy of the commons.’ The common lands were a metaphor for the problem of over-exploitation. Under a regime of common ownership farmers would above all pursue their own interests. Every farmer would cut as much heath sod as possible for his own fertiliser production or allow as many cows as possible to graze for his own milk production. If all farmers pursued this course, than over-cutting and over-grazing would be the consequence and the utility of the land would accordingly be seriously compromised. Similar phenomena occur at present with the over-fishing of the oceans and the pollution of the atmosphere by exhaust gases.

A recent study shows that the this metaphor is based on incorrect presuppositions. The collective management of the common lands was rather meticulous and provided a certain flexibility, for example if population pressure increased in the region, harvests failed and market demand fluctuated.¹³ Three principles underpinned the management: utility, fairness and appropriateness. Utility referred to the degree to which the use of the common lands was sufficient for the owners. Fairness was related to the degree to which the owners participated in the economic use and the management of the lands. The third principle, appropriateness, referred to an ecological optimum: the ratio between the yields and the future exploitation of the lands. The application of the three principles led in many cases to long periods of sustainable management.¹⁴

Despite this the common lands would disappear in the nineteenth century. A regulation dating from 1810 that envisioned the dissolution of the mark associations, had little effect. An edict by William I in 1837 that attempted to breathe new life into this regulation was effective especially in those marks where large land-owners and large farmers were in charge. Where small-scale farmers had more influence, the dismantling occurred later.¹⁵ In the end, a law passed in 1886 would seal the fate of the common lands. In the background other factors played a role in arriving at this decision. Reclamation of the wastelands was the immediate goal, but that demanded the solution of the fertiliser problem, the elaboration of infrastructures, the improvement of water management and adequate legal registration.¹⁶ By the end of the century private parties could enroll the services of the *Nederlandse Heidemaatschappij* (a professional reclamation firm) to advise them while in 1899 the government set up *Staatsbosbeheer* (State Forest Management) to reclaim state-owned lands.

¹³ De Moor, *The dilemma of the commoners*, 110–120.

¹⁴ De Moor, *The dilemma of the commoners*, 143–148.

¹⁵ Van Zanden, *De economische ontwikkeling van de Nederlandse landbouw*, 162–163; Van Zanden en Van Riel, *Nederland 1780–1914*, 161.

¹⁶ Van der Woud, *Het lege land*, 229.

Table 8.1 Land-use in the Netherlands, 1833–1913 (×1000 ha)

	1833	1913	Increase/decrease
Farmland	1895	2185	+ 290
‘Wastelands’	907	515	– 392
Forest	169	258	+ 89
Roads and Railways	11	53	+ 42
Built up	25	48	+ 23
Total	3007	3059	+ 52

Remark: Due to (minimal) differences in the definition of various kinds of land-use the figures are not completely comparable with each other

Source: J.L. van Zanden and S.W. Verstegen, *Groene geschiedenis van Nederland* (Utrecht 1993), 65, table 4.1

Between 1833 and 1913 a bit less than 400,000 ha of ‘wastelands,’ some 12% of the Dutch territory, disappeared. That provided (including the reclamation of the Haarlemmermeer and other reclamations) 290,000 ha of extra farmland and 89,000 ha of extra forest. Planting forests was a long-term investment. The forest could be felled after 20 or 30 years and would leave an improved humus-rich soil behind. In many parts of the Netherlands the landscape acquired a rather different aspect. That caused little consternation at the time. Not so in the twentieth century when decisions on the remaining ‘wastelands,’ still some 515,000 ha, had to be taken (Table 8.1).

8.2.4 Small Farms and the Cooperative Movement

For a while it seemed as if the smallholder and dirt-farmer would become victims of the disappearance of the common lands. But in the end the opposite appeared to be the case. At the outset of the twentieth century the small farm and in particular the family farm was the dominant form of agricultural entrepreneurship. These small farms were moreover apparently in most cases capable of providing a reasonable existence – above the poverty line – for the family.¹⁷ Oddly enough, the elimination of the mark organisation contributed to this. Smallholders and dirt-farmers were namely recompensed for the loss of their use of the common lands with small parcels of ‘wasteland’ or had become able to lease extra land. However that was still inadequate to build up a decent existence, in particular on the sand grounds in the east and south of the Netherlands,. We focus here on those regions.

An important cause of the relative prosperity of the smallholders was the commercialisation and specialisation of their farms. Thanks to improvements in infra-

¹⁷ Exact figures are hard to come by. Van Zanden and others speak of de-proletarianisation of the countryside and an improvement in the situation of the smallholder and dirt-farmer. For the rural village Woensel (near Eindhoven) van den Brink was able to establish that the farmers (and a small upper stratum) were able to avoid the dynamics of structural poverty in this municipality in the period 1850–1920. G. van den Brink, *De grote overgang: Een lokaal onderzoek naar de modernisering van het bestaan. Woensel 1670–1920* (Amsterdam 1996), 110.

structure, farming on the sand grounds had become completely integrated into national and international trade. The emphasis was no longer on self-sufficiency.¹⁸ Flax, hemp, barley and other products that formerly supplied the wants of the farm itself were no longer cultivated; flax and wool were no longer spun and woven for direct use on the farm. Activities that produced less income, for example timber production, were terminated. Emphasis was placed on cattle husbandry. Pastures were extended and improved. Parcels that supplied cattle fodder required less tillage because of cheap foreign fodder and the use of artificial fertiliser. Butter production was delegated to the dairy factory. Work focused on taking care of the milk cows, the pigs and the chickens. The most important raw materials were bought on the market, which is also where almost the entire produce was destined.¹⁹

An extremely important factor was also the rise of the cooperative movement at the end of the nineteenth century.²⁰ This institutional innovation commenced with the collective purchase of cattle fodder, artificial fertiliser, seeds and other raw materials. That not only meant considerable savings for smallholders, but also more control over quality. The communal use of machinery also provided economies of scale. Purchasing a steam-powered threshing machine was hardly attractive for a smallholder, but became profitable as a collective possession. The cooperatives expanded their scope of operations to also include the processing and sale of products. Cooperative auctions came into existence to sell and establish prices for products and transport cooperatives were set up to get the produce to export markets. Farmers established cooperative sugar factories to process sugar beets and cooperative dairies to process milk. In this way farmers attempted to avoid obstacles in the markets: the dealer as part of a cartel that demanded excessively high prices for raw materials, the monopolistic factory owner who underpaid for agricultural produce, the local store owner who exploited the farmer with compulsory purchases, etc.

Cooperatives developed later on the sand grounds than in the rest of the Netherlands. After 1890, however, in those regions too their popularity soared. The founding of the farmers' loan banks can be seen as the keystone of the movement. Access to credit was a major obstacle for farmers on the sand grounds, an impediment that hindered the modernisation of their enterprises. The cooperative banks accumulated the savings of the rural population in order to satisfy demands for credit. They turned out to be able to extend credit on favourable conditions, while keeping banking costs low, limiting the risks and offering a reasonable interest on savings.²¹ The driving force behind the founding of the banks was the Catholic elite.

¹⁸ Van Zanden, *De economische ontwikkeling van de Nederlandse landbouw*, 283–284.

¹⁹ Small enterprises also survived because real wages in Netherlands rose and labour became an ever more scarce commodity. Large farmers encountered difficulties because the increasing wages of hired hands and maids threatened to make their enterprises insolvable. Small enterprises, in contrast, had the possibility of doing without hired labour. Van Zanden, *De economische ontwikkeling van de Nederlandse landbouw*, 335.

²⁰ See for the cooperative movement in agriculture: Van Zanden, *De economische ontwikkeling van de Nederlandse landbouw*, 273–281; Van Zanden and van Riel, *Nederland 1780–1914*, 365–376.

²¹ However, H. Denweth, O. Gelderblom en J. Jonker doubt whether the mode of financing contributed much to the development of the small enterprises (including the smallholder), see: J. Jonker,

They were concerned not only with economic motives, ‘...to fight usury, support the farmer in his need...,’ but also with Christian values, ‘... to promote thrift, brotherly love, industriousness and temperance...’²²

At the beginning of the twentieth century Dutch agriculture was characterized by dense networks.²³ More than 50% of the farmers owning more than 1 ha of land was associated with a cooperative. In 1884 the provincial agricultural societies, long the association of choice for large landowners, large farmers and rural elites, had founded the Netherlands Agricultural Committee as a national umbrella organisation. The founding of the Netherlands Farmers’ Union in 1896 led to Catholic farmers’ unions in every province and to a rapid increase in the level of agricultural organisation. By 1913 the Netherlands Agricultural Committee, that by then had subsumed the Netherlands Farmers’ Union, counted 130,000 members, some 65% of all farmers.

At the same time the government was also beginning to intervene in the sector. Up to the agricultural crisis it had remained passive. The 1886 report of the State Commission regarding the condition of agriculture changed all that. The government began investments in the agricultural sector with the creation of a knowledge infrastructure. This would mark the beginning of the well-known OVO-triptych in the twentieth century, the infrastructure for Education, Extension and Research for the agricultural sector.

Farmers’ organisations became interwoven with the governmental apparatus, which laid the basis for a powerful agricultural lobby in the twentieth century.

The modernisation of agriculture was by no means a catastrophe for the small-holder and dirt farmer. He certainly had to work hard and employ his entire family to keep the farm going, but at the outset of the twentieth century the modernised sector was able to support the farming family at a level above the poverty line. Favourable economic circumstances also lent a helping hand. The agricultural crisis, meanwhile, had been bested.

What effects can we attribute to the modernisation of the food processing industry, the second link in the food supply chain?

8.3 The Modernisation of the Food Processing Industry

While agriculture flourished in the 1850s, the food processing industry fell on hard times. The cost of living had risen due to the liberalisation of international trade, which caused stagnation of demand in domestic markets.²⁴ Netherlands ate less

‘Welbegrepen Eigenbelang. Ontstaan en Werkwijze van Boerenleenbanken in Noord-Brabant, 1900–1920’, *Jaarboek voor de Geschiedenis van Bedrijf en Techniek* 5(1988), 188–206; H. Deneweth, O. Gelderblom, J. Jonker, ‘Micro-finance and the Decline of Poverty: Evidence from the Nineteenth-Century Netherlands’, *Journal of Economic Development* 39(2014), no 1, 79–110. O. Gelderblom, *Waar hebben we de financiële sector eigenlijk voor nodig?* (Inaugural Lecture Universiteit Utrecht, 2015), TPEdigitaal 9 (2015), no 1, 45–46.

²² Cited in: Van Zanden and van Riel, *Nederland 1780–1914*, 375.

²³ Van Zanden and van Riel, *Nederland 1780–1914*, 369–371.

²⁴ Van Zanden and van Riel, *Nederland 1780–1914*, 282.

Table 8.2 Number of power sources in the food processing industry, 1850–1890

	1850	1860	1880	1890
Steam engines	100	270	850	1310
Windmills	2150	2390	2280	1210
Horse mills	1640	1450	780	470
Water mills	290	290	90	60
Total	4180	4400	4000	3050

Remark: Figures rounded off to tens

Source: H. Lintsen, 'Een land met stoom', in: H. Lintsen et al. (eds.), *Geschiedenis van de techniek in Nederland. De wording van een moderne samenleving* (Zutphen 1995), part VI, table 7.9, 269–279

meat, resulting in less work for the slaughterhouses. More rye bread was consumed instead of the more expensive wheat bread, a shift that had consequences for bakers, millers and bread and flour factories. Beer brewers had to cope with declining beer consumption. The foods sector was also not very innovative. We can point to the small number of steam engines (270) over against the many windmills (2390) and horse treadmills (1450) in 1860 (Table 8.2). In this respect, the founding of the first bread and flour factory by Sarphati in this period was a ray of light. That was also the case for the first beetroot sugar factory in 1858, the start of an entirely new branch of industry.

The 1860s were a watershed for the food processing industry. The recovery of the domestic market was an important factor. In addition, a number of sectors oriented to the foreign market, like the potato starch and beetroot sugar industries, began to flourish. After this, the modernisation of the food processing sector proceeded apace. The steam engine gained terrain, first at the cost of the horse treadmills and from the 1880s on at the cost of the windmills. In addition, new branches of industry developed, like the margarine and the dairy industries.

An important characteristic of the modernisation of the food processing industry was the application of steam technology and associated modern apparatus like kneading machines, milk centrifuges and refrigerators. In some cases legal strictures had impeded the introduction of new production technologies, as we saw in the case of Sarphati's bread and flour factory. But other factors also played a role. The operating costs of the new process technologies were lower than those of the classic ones. Sarphati, for example, was able to sell his wheat bread in 1865 at an impressive 30% lower price than the bakers.

It did, however, mean that the entrepreneur was forced to realize a larger output. The new mode of production demanded the existence or creation of a sufficiently large market. We can again take Sarphati's factory as an illustration. The Amsterdam market was in principle sufficiently large, but it was dominated by the cartel of windmill operators and bakers that had successfully opposed earlier novelties. For centuries these two groups had been able to ply their trades under a benevolent providence, originally as part of the guild system, later in the form of cartels in protected urban markets. But the old corporatist institute lost the competitive struggle with the steam engine and disappeared from the Amsterdam scene.

The need for a large market applied not only to an industrialist who invested in large steam engines, but more particularly also to the entrepreneur with a small steam engine. This is why small-scale steam-powered enterprises were all but lacking in the countryside until well into the nineteenth century. Here windmills continued to produce for the local market. Their scale of production suited these circumstances. Due to limited transportation infrastructure, there was little threat of competition from outside. With the construction of a tramway network from the 1880s on, the countryside became accessible and the many remaining windmills quickly disappeared.

An entrepreneur could also create a larger market by creating a new product with the new process technology or by transforming a luxury commodity into a mass commodity. Again, Sarphati's factory can serve as an example. The demand for his white bread increased explosively. That was not only because of the low price. Wheat and white bread counted as a luxury, a sign of prosperity. Up to then it had graced the tables of the poor only on high holidays. On weekdays coarse breads and porridges were the common fare. But now finer bread came within the reach of the masses and they embraced the opportunity. White bread became a 'hype' in Amsterdam in the 1860s.²⁵

At the end of the nineteenth century the biggest steam boilers could be found in the sugar refineries, the beet sugar factories, the bread and flour factories and the potato flour factories (Table 8.3)²⁶ Smaller steam installations were found in the beer, margarine and dairy industries. Steam technology was not reserved to new branches of industry or to classical industries producing at a larger scale. The classical small enterprises modernised as well. Many grain mills, hulling mills, roasting houses and distilleries invested in steam apparatus, but of course of limited size. The consequence was that at the end of the nineteenth century far and away the majority of steam engines were to be found in the food processing industry, but with a modest average horsepower (10.6 hp) that lay below the national average of 13 hp (Chap. 10, Table 10.6).

The introduction of steam provides a first impression of modernisation, but innovations in the food processing industry reached further than the steam engine and the machines connected to it.²⁷ New processes, for example the pasteurisation of milk to increase its shelf life, and new methods, for example the thorough and hygienic

²⁵ In other places too, but not everywhere in the Netherlands. In some regions like the provinces of Drenthe and Overijssel, white bread counted as something for 'fine folk' or for the ill and popular opinion favoured firm dark rye bread.

²⁶ M.S.C. Bakker, 'Voeding', in: H.W. Lintsen et al. (eds.), *Geschiedenis van de techniek in Nederland: De wording van een moderne samenleving 1800–1890* (Zutphen 1992), volume I, 48–51. See for innovations in the production of flour, butter, margarine, beer and sugar, various chapters in: H.W. Lintsen et al. (eds.), *Geschiedenis van de techniek in Nederland: De wording van een moderne samenleving 1800–1890* (Zutphen 1992), volume I.

²⁷ M.S.C. Bakker, 'Techniek en voeding in verandering', in: H.W. Lintsen et al. (eds.), *Geschiedenis van de techniek in Nederland: De wording van een moderne samenleving 1800–1890* (Zutphen 1992), volume I, 253–264.

Table 8.3 Most important users of steam in the food processing industry, 1890

	Average size of the steam boilers, rounded off to 100 (m ²)	Number of enterprises	Total size of the steam boilers, rounded off to 100 (m ²)
Flour factories, bread factories, flour and bread factories	±590	±100	59,000
Beet sugar factories, sugar refineries	±522	±36	18,800
Potato flour factories	100	28	2800
Margarine factories	±52	±50	2600
Beer breweries	±42	±105	4400
Butter factories, cheese factories, dairies	±28	±50	1400
Grain mills	<16	>200	3200
Roasting houses, distilleries	±14	±150	2100
Hulling mills	±8	±150	1200

Source: table based on table 1.4 in: M.S.C. Bakker, 'Voeding in Nederland', in: H. Lintsen et al. (eds.), *Geschiedenis van de techniek in Nederland. De wording van een moderne samenleving* (Zutphen 1992), part I, 49

cleansing of apparatus, were introduced. New instruments, among others the introduction of the thermometer, improved the reliability of production processes.

But the question is whether the nutrition of the lowest classes of the population improved as a result of the emergence of new process industries, large-scale modes of production and countless innovations.

8.4 Food Quantity and Food Quality

It is estimated that around 1900 Netherlands consumed about one and a half times as much potato and grain as in the middle of the nineteenth century.²⁸ The modernisation of agriculture certainly was a contributing factor, particularly as regards the cultivation of potatoes. The Netherlands was self-sufficient in this staple and its

²⁸ The inventory of material flows in our investigation (see appendix 2.1) shows that the domestic supply of potatoes in 1913 was 1.4 times that in 1850, and of grain 1.7 times. Bakker, 'Voeding,' Table 1.1, shows that for the period 1897–1901, 1.8 times as many potatoes were consumed as in the period 1852–1856 (including cattle fodder), 3.0 times as much wheat and 1.1 times as much rye (including cattle fodder). M.T. Knibbe paints a somewhat different picture in his 'De hoofdelijke beschikbaarheid van voedsel en de levensstandaard in Nederland, 1807–1913,' *Tijdschrift voor Sociale en Economische Geschiedenis*, 4 (2007), nr. 4, graph 3. There, the *availability of calories* from the consumption of potatoes grosso modo remains the same between 1850 and 1890 and but that from bread cereals (wheat and rye) doubles.

yield per hectare had been greatly increased.²⁹ It is notable that the contribution of the modernisation of the food processing industry to the improvement of popular nutrition remained limited to the bread and flour factories.³⁰ In a number of cities these contributed to the decline in bread prices, though lower grain prices in the United States were probably the most important factor. Potatoes and cereals remained the staple foods of the largest part of the population. Sugar was a luxury; butter remained expensive and was first and foremost exported to England. Even margarine, introduced as a cheap substitute for butter, was mainly destined for export. Sugar, butter, margarine and meat did appear more often on the tables of the 'lesser classes', but they remained limited to a few grams per day.³¹

The modernisation of the agricultural and foods sector contributed in a largely indirect fashion to the improvement of the 'popular diet.' It improved the international competitive position of the Dutch economy. At the beginning of the twentieth century, the production and export of foodstuffs were still the most important sectors of the Dutch economy. The food processing industry had the biggest share in the added value of industry.³² In this way, agriculture and foods made an important contribution to the growth of the gross domestic product and of the consumptive expenditures per Netherlander. Among other things, the decrease in food prices meant that the relative share of foods in household budgets slowly but surely declined. It decreased from about 60% around 1850 to 50% around 1910.³³

After 1860 and up to the First World War, famines no longer occurred. Hunger stalked the poor from time to time, but ever less frequently and at increasingly smaller scales. Social movements were still active in supplying food to the poor. Amsterdam, for example, opened a People's and Children's Kitchen in 1887, where families could enjoy nutritious noonday meals for the price of 7 cents. The improved food situation was the most important cause of improvements in public health. Average height increased from 165 cm in 1850 to 173 cm in 1910 and the life expectancy of the Dutch from 37 to 55 years. That was an impressive accomplishment.

However the improvement in the food situation was above all a quantitative accomplishment. Food quality was another matter. Around 1900, politicians, physi-

²⁹ Van Zanden, *De economische ontwikkeling van de Nederlandse landbouw*, table 5.7. The yield per hectare in the period 1913–1918 is approximately two times higher than in the period 1854–1862.

³⁰ Bakker, 'Voeding in Nederland', 50.

³¹ Bakker speaks of a few grams per day. Estimates on the basis of our research into material flows (appendix 2.1) gives the following result: sugar consumption per Netherlander per day 16 grams in 1850 and 25 grams in 1913 (by comparison: 47 grams in 2010), butter and cheese 31 grams in 1850 and 30 grams in 1913 (by comparison: 47 grams in 2010), margarine 0 grams in 1850 and 18 grams in 1913 (by comparison: 28 grams in 2010), meat 93 grams in 1850 and 113 grams in 1913 (by comparison: 221 grams in 2010).

³² Van Zanden and van Riel, *Nederland 1780–1914*, table 8.9. See also tables 6.7 and 8.1.

³³ E. Horlings and J.P. Smits, 'Private consumer expenditure in the Netherlands', *Economic and social history in the Netherlands* 7 (1996), 15–40, graph 3. A.H. van Otterloo refers to a decline of 70% in 1850 to 50% in 1890. A.H. van Otterloo, 'Voeding'. in: J. Schot, H.W. Lintsen, A. Rip and A.A. de la Bruhèze (eds.), *Techniek in Nederland in de Twintigste Eeuw* III (Zutphen 2000), 241.

cians, nutritional experts and citizens engaged in heated debates on this issue.³⁴ The diets of the poor and workers was too one-sided, exhibited shortages of essential foodstuffs and contained too few calories. Knowledge about healthy nutrition, spoilage, proteins, fats, and carbohydrates was not widely disseminated. Exhibitions about nutrition were organised. Cooking teachers gave demonstrations for bourgeois ladies, servants, female workers and their daughters. These sorts of initiatives would result after the First World War in the adoption of nutrition as part of home economics curricula, food research at universities and research institutes, food counselling by expert bureaus and in 1953 the publication of the standardised food protocol, 'the disk of five.'

A separate question was that of the spoilage and adulteration of food. The sale of for example spoiled meat was not unusual, nor was illicit fiddling with food. Milk could be diluted with dirty water, flour mixed with alum, bread baked with poisonous copper sulphate, and candies doped with red lead to give them a cheerful red colour. This kind of fiddling was perennial, but it increased with the changes in the food supply chains. The scale of food production increased, it was distributed across numerous links and it became more anonymous. Producers attempted to generate trust in their products by introducing brand names that were supposed to represent quality. City governments intervened with inspectors and the establishment of food inspectorates, the first in Rotterdam in 1893. In 1919 the national government ratified the Law on Commodities.³⁵

At the start of the twentieth century one important aspect of the issue of 'public nutrition' had been solved. Quantitatively there was enough food, for the poor as well. The problem had now shifted to food quality. Nonetheless, the First World War would confront the Netherlands with another problem, namely that of food security. Was the food supply sufficiently robust to withstand serious shocks such as a war?

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³⁴ For this see: van Otterloo, 'Voeding', 240–242; Bakker, 'Techniek en voeding in verandering', 269–274.

³⁵ H.W. Lintsen (eds.), *Tachtig jaar TNO 1932–2012*, 108.

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