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Deliverable 2.2: ‘Analysis of stability and tensions in incumbent socio-technical regimes’

Country report 8: Regime analysis of the Dutch agro-food system

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Preface

This report is produced in the context of work package 2 ('Dynamics of transition pathways') of the FP-7 funded PATHWAYS project ('Exploring transition pathways to sustainable, low carbon societies'). More precisely, this report provides the Dutch country study of the agro-food domain for deliverable 2.2. ('Analysis of stability and tensions in incumbent socio-technical regimes').

The analysis in this report is based on a research template that is shared between the different contributors to WP2 to enable comparative analysis of findings between countries (UK, Netherlands, Sweden, Portugal, Germany and Hungary) and empirical domains (electricity, heat, mobility, agro-food and land-use).

Executive summary

In this report an analysis is made of the stability and the tensions in incumbent socio-technical regimes within the Dutch agro-food domain. In order to do so a number of sub-systems and sub-regimes within the agro-food sector have been analysed, being four production sectors (dairy, meat, vegetables, fisheries) and the retail sector, being an important agent between consumption and production.

The main conclusion is that there are indeed tensions within the various sub-regimes, but these tensions rather lead to adaptation within these sub-regimes than to new regimes. Most of the sub-systems and regimes are relatively stable. There are strong lock-ins, due to high investments on the production side, as well consumers' preferences on the consumption side. Moreover, there are yet no 'break-through' technologies in agro-food in the direction of a truly significant lower impact on biodiversity or GHG emissions (in the magnitude of 80-90% lower emissions or land use). This is largely caused by the nature of agro-food production, which is still mainly based on crop productions (including grasslands), and partly based on fisheries. Major breakthroughs of niche innovation, such as in-vitro meat culture on the production side, and a substantial switch to locally sourced food or vegetarianism on the production side are not be expected in the near future. This is different from for example the electricity domain, where a complete change in regime is feasible (like from fossil to wind).

As is argued in Chapter 2 of this report, the changes required to meet a number of environmental and other societal goals are profound, but are less drastic than in the energy domain: a reduction of greenhouse gas emissions from agriculture by around 25% is required (2050 relative to 2005). To meet the biodiversity target the management of probably 5-20% of the current agriculture area need to be different. In other aspects, the required changes are larger: in order to reduce to external effects of agriculture, nutrient losses have to be reduced significantly, while the use of pesticide and antibiotics have be reduced considerable.

Reduction of pressure on the environment will largely have to come from stepwise (or accelerated improvements) within existing regimes (notably in case of improvement through technological measures as in 'Pathway A'). Some regimes can become larger at the expense of others (for example more plant-based food and less animal-based food). Other identified niche innovations involve a change of the nature of a regime (for example conventional versus organic production), or global supply chains versus local supply chains.

This report has found that in agro-food many incremental changes occur, partly as a result of technological process, partly as a result of pressure from society. Due to incremental technological improvement in current production regimes, the production of plant and animal products is generally becoming more efficient (in terms of land, water and energy use). Due to pressure from for example NGOs or the general public certain issues are put forward, leading to cracks in current regimes. In general this leads to adaptation of current regimes. Examples are the increased concerns around animal welfare (leading to higher animal welfare standards), as well as around overfishing (leading to a higher market share of MSC or ASC certified fish).

Also on the consumption side incremental changes are generally favoured over niche innovations. For example experiments with hybrid meat do only have a limited influence on the main actors' interests, but can lead to lower meat consumption. This example can be framed as an 'in-between' or hybrid solution. The minor changes that are occurring in the agro-food domain can be seen as reconfiguration, and as we discussed in Deliverable 2.1. most of the innovations belong to Pathway B.

As the different domains are relatively stable and locked in, because there are mainly big companies involved with high stakes, we can expect that the niche innovations described in D2.1. will mainly have some minor influences on the sector, but will not lead to a breakthrough. The Dutch fish sector (both on the consumption side as well as on the production side) has undergone major changes over the last 10 years. One development is the replacement of wild catch by fish from aquaculture. Another important development is the rise in MSC certified fish. Within the fisheries sector, this has led to a major shift in applied fishing methods, as from bottom trawling to pulse wing trawling. This is not only method with much lower negative impacts on marine biodiversity; it also saves lots of fossil fuels.

Table 1 Overall assessment of Dutch agro-food regimes

Overall assessments regimes		
	Lock-in, stabilising forces	Cracks, tensions, problems and opportunities
Meat regime	STRONG <ul style="list-style-type: none"> • Very stable market, huge players involved and meat consumption is an important part of culture 	MODERATE <ul style="list-style-type: none"> • There is societal pressure on the meat regime. However, as eating meat is also a cultural issue and the production system is locked in, it is difficult to change.
Fish regime	WEAK <ul style="list-style-type: none"> • As a result of the decreasing fish population changes are occurring and the sector is not so much locked in. 	MODERATE <ul style="list-style-type: none"> • Awareness on the decreasing fish population has led to measures to stop that decline. • Public opinion, the pressure from society via NGOs and social movements and the development of MSC have led to changes in the fish sector.
Dairy regime	STRONG <ul style="list-style-type: none"> • The sector is relatively stable, because the large investments made in land, machinery and livestock. However changes can occur, but will be mainly within the dairy regime. 	MODERATE <ul style="list-style-type: none"> • The dairy sector has a good image in the public debate and many actors would like to keep that. Dairy processors are asking for 'meadow milk'. • Technologies like milking robots can increase production and create flexibility (to a certain extent) for the farmer • The abandonment of the milk quota will probably have an impact on the dairy sector, but what the impact will be is not clear yet.
Vegetable farming regime	STRONG <ul style="list-style-type: none"> • Large investments in machinery, land and greenhouses make that only certain changes in cultivated crop type can occur. 	MODERATE <ul style="list-style-type: none"> • The prices are under pressure, what makes people looking for alternatives. • The introduction of GPS and precision farming can increase production
Retail regime	STRONG <ul style="list-style-type: none"> • The market is competing and a couple of large retailers are dominating the market. 	MODERATE <ul style="list-style-type: none"> • Discussions on animal welfare are influencing the supermarkets. Furthermore in consortia they set targets for example for sustainable fish. The retail is changing, but as they have a large market share and only a couple of retailers are dominating the market it is hard to change.

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1. Introduction

1.1. Context, goals and research questions:

Perhaps different from other domains, transitions within the agro-food sector can have multiple forms. This is also related to the nature of agro-food production, which is still largely based on crop productions (including grasslands), and partly based on fisheries. Other than for example in the electricity domain, a complete system shift (like from fossil to wind) is not to be expected within the agro-food sector. Some regimes can become larger at the expense of others (for example more plant-based food and less animal-based food), but some of the identified niche innovations involve a change of the nature of a regime (for example conventional versus organic production), or global supply chains versus local supply chains.

Moreover, as there are yet no 'break-through' technologies in agro-food in the direction of a truly significant lower impact on biodiversity or GHG emissions (in the magnitude of 80-90% lower emissions or land use), progress will certainly have to come from stepwise (or accelerated improvements) within existing regimes (notably in Pathway A).

The agro-food system can be considered to consist of dozens, if not hundreds, regimes. These can be discriminated as product-specific food chains (dairy, meat, fish, corn, coffee, chocolate), but for example the way retail is organized can be considered as a regime. Most food-chains consist of suppliers (of seeds, machines, feed, semen), primary producers (farmers), food processors/manufacturers, wholesale, retail (supermarkets), various consumers. Retail has a very dominant role in this chain. There is a lot of processed food on the market.

The goal of task 2.2 is to analyse the degrees of stability and tension in the Dutch agro-food domain. This analysis is an important step in the broader analysis of transition dynamics using the multi-level perspective (MLP). The MLP suggests that transitions come about through interactions between processes at different levels:

- 1) Niche-innovations gradually build up internal momentum (through positive interactions between learning processes, vision articulation, and social network building),
- 2) Exogenous changes (at the so-called 'landscape level') create pressures on the regime,
- 3) Destabilization of the regime (cracks and tensions) creates windows of opportunity for wider diffusion of niche-innovations.

The first step has been analysed in deliverable 2.1 of the PATHWAYS project, in which niche innovations are studied. The niche innovations we have studied are:

- Dairy alternatives
- Vegetarianism/flexitarianism
- Hybrid meat
- Cultured meat
- Algae production for fish feed
- Sustainable fishing (MSC)
- Shift towards local/regional food
- Organic food

Based on the study of these niche innovations, we assessed the momentum of niche innovations in the agro-food system is low to medium. Momentum basically refers to speed of changes and size. As the sector consists of many parties and consumers play an important role as well, most of the changes are incremental changes. Algae production for fish feed, hybrid meat and cultured meat are examples of Pathway A innovations and dairy alternatives, vegetarianism/flexitarianism, sustainable fishing (MSC), shift towards local/regional food and organic food are examples of Pathway B innovations. However, as consumers are an important element of the chain it is important to notice that behavioural change is an important element of all innovations.

Step 2 and 3 will be analysed in this report for the agro-food domain. The research questions are:

- 1) What are the main external landscape developments that affect the Dutch agro-food regime?
- 2) Do external pressures and internal problems lead to tensions and destabilisation of the Dutch agro-food regime? Or is the regime still fairly stable, with (most) actors focusing on incremental change?

1.2. Analytical framework

Work package 2 uses a socio-technical framework, which makes a distinction between:

- *Socio-technical system*, which refers to the configuration of elements necessary for the achievement of a societal function (such as mobility, heating, sustenance/food and light/power); these elements may include technical artefacts, production facilities, supply chains, infrastructure, markets, consumption patterns, repair facilities, public debates, formal policies. Socio-technical systems refer to relatively ‘tangible’ elements that can often be measured quantitatively (e.g. technical performance, price, market demand).
- *Socio-technical regime*, which refers to the cognitive, normative and regulative institutions (Scott, 1995) that shape the actions, interpretations, and identities of the actors that reproduce elements of the socio-technical system. These actors include: firms, consumers, policymakers, civil society actors, wider publics, scientists. The focus is more ‘intangible’ elements, referring to beliefs, motivations, strategies, alliances, goals, norms that underlie concrete actions.

For the analysis of stability and tensions, we will look both at the socio-technical systems and the socio-technical regime and actor perceptions and commitments.

The figure below is a graphical representation of the analytical framework. As the figure shows the agro-food domain consists of different regimes (or sub-sectors) consisting of a socio-technical regime and a socio-technical system. The agro-food domain is positioned in and influenced by the landscape.

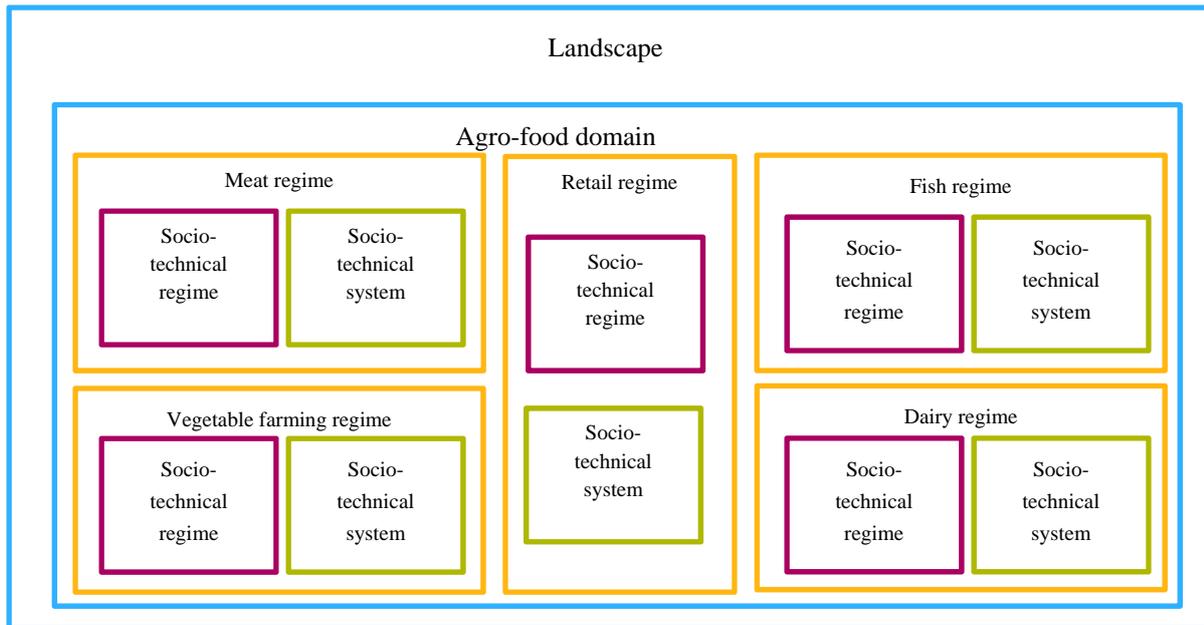


Figure 1 Graphical representation of analytical framework

1.3. Characterization of the agro-food domain and project focus

The agro-food domain can be characterized as a complex system, consisting of a socio-technological, economic and ecological system, with a lot of different functions and effects. The agro-food chain consists of many actors between production and consumption, each with their own motives, behaviour and challenges. The agro-food domain for the Netherlands can be considered to consist of three sub-domains, being the Dutch agricultural and fisheries sector, the Dutch food system (feeding the people living in the Netherlands) and the Dutch food industry (partly feeding the Dutch population, but being also a major exporter of food) (Figure 2). Although these are overlapping and interconnected entities, it is useful to discriminate between the three. Some of the regimes (which will be described later) are part of the agricultural system (as the meat sector or the horticultural sector), while others are part of the Dutch food system (as the supermarket regime). This has also implications for the way environmental performance is expressed: where it concerns the Dutch agricultural sector it is logic to focus at the environmental impact of this sector within the Netherlands, and where the Dutch food system is analysed it is more logic to look at total the ‘footprint’ of food consumption.

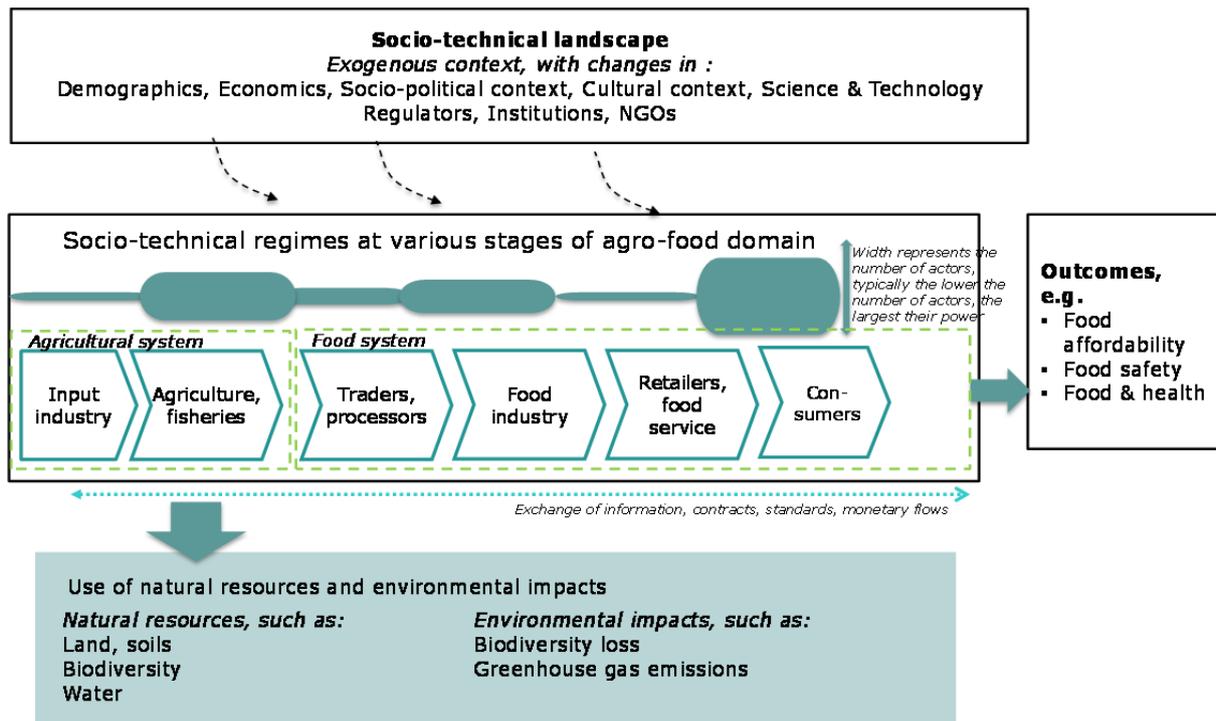


Figure 2 Schematic representation of the socio-technical regime

The Dutch agricultural sector is still an important driver of the Dutch economy, although the share of agricultural production in the GDP decreased from 3.2% in 1995 to 1.5% in 2011. Between 1980 and 2013 the number of farms decreased 53%, largely related to an increase in farm size (more hectares for crop farms; more animals for livestock farms). The agricultural area used decreased only 9% (CBS et al., 2014); still over 50% of the Dutch land area is used for agricultural activities (CBS, 2014a). In terms of land use, grassland and silage maize are the main crops. In terms of financial output, the main products are horticultural products (flowers, flower bulbs and other ornamental products, vegetables), milk and pig meat, followed by the seed sector, veal and poultry, and crops as potatoes, onions and sugar beets (EC, 2015). The products which dominate the landscape (grass, cereals) in terms of land use are less dominant in output: the relatively small sized sectors as horticulture and intensive livestock production are overrepresented in agricultural output (when measured in financial terms). Due to the high prices for both land and labour, Dutch farmers opt for crops with high revenues: if possible seed potatoes instead of regular potatoes, vegetables and grass seed production instead of cereals. The agricultural sector can be considered to consist of various regimes, although linkages exist between the regimes (for example via feed production). The sector is however more than farms; input industry (feed, fertilizers) as well as the primary processing industry (dairy, slaughter houses) can be seen as part of the larger agricultural sector. Here are intersections again, as the processing industry can be seen as part of the food system as well as of the food industry. A large part of the Dutch agricultural production is exported to other countries, mainly within the EU, but also beyond. Due to relative large size of the Dutch agricultural and food sector (compared to countries as the UK and Germany), the sector still has considerable political influence in both national and EU politics.

The Dutch food system can be defined as all activities needed to feed the Dutch population. These activities consist of primary food production by farmers and fishermen across the globe, traders, processing industry, retail and food service (as caterers and restaurants). Although for most environmental aspects (as land use and impact of biodiversity) the largest

impact is at the level of farms and fishermen. For greenhouse gases this might be different, due to the large use of fossil fuels for the processing, transport and cooling of food. Although the political influence of most of the food system actors is probably not really large (with an exception of farmers and food companies), the influence of food companies, retailers and restaurants on food consumption and food choices is truly significant. Therefore the supermarkets will be considered as a separate regime.

The third element of the Dutch agro-food sector is the large food industry, partly based on nationally produced products (as milk and meat), but also based on imported products (as coffee, cacao and soy beans). A large part of the production is exported, mainly to EU countries. This 'hub' function makes the Netherlands globally the second largest exporter of agro-food products. In this study the food industry will not be discussed further.

In WP2 we chose to focus on the regimes with the highest environmental impact, so we decided to focus on meat, dairy and fish, but we will discuss the main elements of the horticulture and arable farming regime as well, although to a lesser extent. The latter two regimes are important as well in the Dutch context. Furthermore we will also study the retail regime.

Furthermore, the Dutch consumption pattern is not only influencing the Dutch environment, but as a result of globalization, food is transported all over the world. For example animal feed is imported from South America, what makes that eating meat has impact on different areas, also outside the Netherlands or Europe.

To understand agro-food transitions, one needs to understand the main dynamics of the different regimes and their interactions, which can lead to changes in relative size (e.g. decreasing meat consumption may lead to increasing vegetable product consumption).

1.4. Data-sources

Quantitative information for 'tangible' system elements is based on data from LEI WageningenUR (Agricultural Economic Institute), CBS (Statistics Netherlands) and PBL Netherlands Environmental Assessment Agency.

Qualitative data and interpretations draw on secondary sources (books, articles, reports) and primary sources (White Papers, policy documents, newspapers, company annual reports, industry journals) complemented with a workshop with experts and one additional interview (see annex 1 for names of experts).

1.5. Report structure

The report is structured as follows. Chapter 2 describes overall system trends and longitudinal developments. Chapter 3 identifies the main external landscape developments that affect the agro-food regime. Chapter 4 to 8 describe the longitudinal developments in the Dutch meat, dairy, fish, vegetable products and retail regime. And Chapter 9 provides conclusions on stability and cracks in both regimes.

2. Overall system trends and longitudinal developments

2.1. Longitudinal developments in the agro-food domain

2.1.1 Environmental performance

Dutch agricultural sector

The share of the agriculture sector in the total Dutch GHG emissions is about 13%. The emissions of greenhouse gases by the Dutch agricultural sector have decreased over the period 1990-2013 (Figure 3), especially those of nitrous oxide (N₂O). The reduction in N₂O-emissions is largely a positive by-effect of the Dutch mineral and manure policy. This central goal of this policy is to reduce nitrogen and phosphorus losses to the environment. Although the policies focus more on nitrate and ammonia, N₂O emissions have decreased in a parallel. Methane emissions (largely stemming from ruminants as cattle) have decreased as well, largely as a result of the milk quota system, which was introduced in the mid-eighties. In combination with a steady growth in milk production per cow, the milk quota system resulted in a steady decline in the number of dairy cows, and thus in lower methane emissions. After 2007 the methane emissions increased again, partly due to higher milk quota (EU policy) and partly due to the growth of combined heat and power (CHP) systems in greenhouses in the horticultural sector. These CHP systems use methane gas as fuel, some leakages of methane occur as well. Carbon dioxide emissions from the horticultural sector are still about at the same level in 1990, but it is important to note that around 25% of the energy is being used to generate electricity for off-farm use. The horticultural production has increased as well. The 'energy efficiency index' of the greenhouse horticulture sector (primary fuel consumption per product unit) has increased by 56% compared to 1990. There is a covenant between the horticultural sector and the government for a 57% increase in energy efficiency. Given the nature of the agricultural production process, in which emissions occur which are hard to reduce, the EU Commission proposes that the reduction of GHG emissions in 2050 from the agriculture sector needs to be much less than those from other sectors: a reduction of 42-49% is proposed (relative to 1990), while in 2005 already -20% was achieved (EC, 2011).

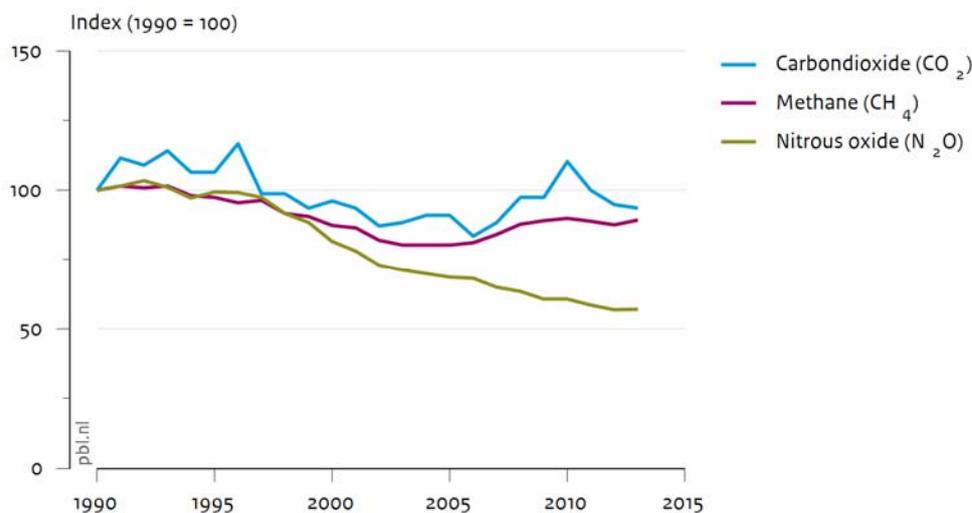


Figure 3 Emission of greenhouse gases from the agricultural sector 1990-2013. Adapted from (Leefomgeving, 2014)

The number of farmland birds in the Netherlands shows a steady decline over the period 1990-2013 (Figure 4, blue dots). This decline corresponds with a decline seen in other countries (green dots). Also for other species groups (butterflies, plants) the trend has been negative over the last decades¹. This is despite the area under agri-environmental schemes, which is more or less stable around 60.000 ha (around 3% of the total agricultural area). It is hard to say which measures are needed to reach to EU goal to halt biodiversity loss in 2020. Given the current pressure factors from the agro-food sector on biodiversity, this will require different land management (proper management of High Nature Value Farmlands, a green veining with ecological focus areas in intensive production regions), a reduction of nutrient losses (nitrogen and phosphorus), as well as a reduction of pesticides. Although these are certain major challenges for the agro-food sector, it does not require reductions in the magnitude of 85-90%, like in the energy sector.

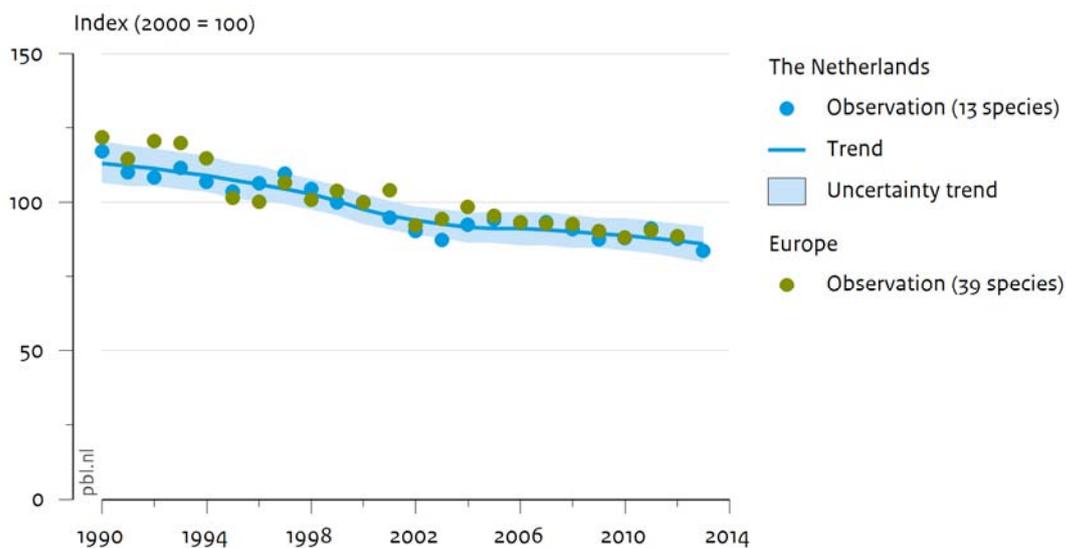
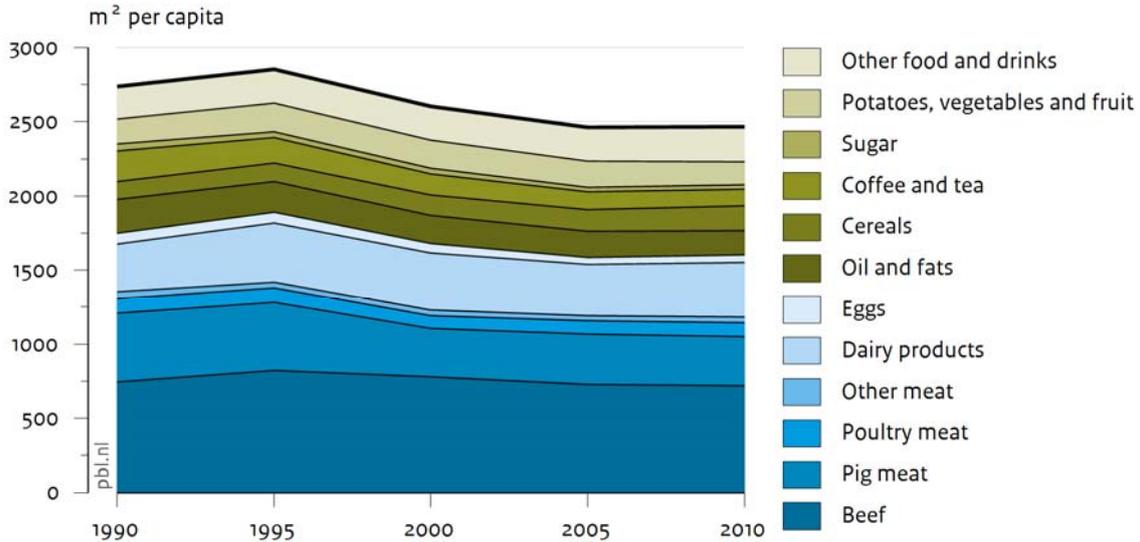


Figure 4 Farmland Bird Indicator (FBI). Adapted from (CBS et al., 2014)

Dutch food system

For the Dutch food system no consistent data regarding GHG emissions are available to construct a reliable trend. Such data are available for the land use needed to produce the food consumed by the Dutch population (Figure 5). This graph demonstrates that the land use footprint (which can be regarded as a proxy of the impacts on biodiversity) of the Dutch food consumption has decreased slightly over the last 15 years. This is largely due to technical progress (higher crop yield and higher livestock feed efficiency), as on the consumption side there were no major changes. Figure 5 also demonstrates that around 60% of the land use is related to the production of animal based products, while these products account for 28 % of the calorie-intake.

¹ <http://www.compendiumvoordeleefomgeving.nl/indicatoren/nl1543-Ontwikkeling-soorten-natuurgebied-en-agrarisch-gebied.html?i=2-10>



Source: PBL, 2013

Figure 5 The amount of agricultural area necessary for Dutch consumption pattern. Adapted from (PBL, 2013a)

2.1.2 Structural economic and societal developments in the agro-food domain

Dutch agricultural sector

The Dutch agricultural sector can be regarded to consist of a number of sub-systems (regimes), such as the various meat regimes (consisting of pork, poultry, veal/beef), the dairy sector (which produces meat as a 'by-product'), the fisheries sector, the horticultural sector (consisting of many regimes, which major distinction between food / non-food (ornamental) and between greenhouse cultivation and field cultivation) and finally arable farming. The impact of socio-technical landscape developments over the last 20 years are very regime-specific, as well as development within each socio-technical regime. Nevertheless, some major developments can be perceived:

- A continuation of increase in labour costs (wages), forcing the sector to reduce labour input, for example by mechanization and automation. Especially the horticultural sector depends on external labour, while arable and dairy farms are largely depending family labour. The wage increase was partly mitigated by the influx of relatively cheap labour from Central and Eastern European countries as Poland, especially after their accession to the EU.
- Partly due to urban development, land prices increased as well, which also puts pressure on farmers to cultivate high revenues crops.
- The combination of the high prices for the production factors land and labour, the scale of Dutch farms increased, and the number of farms almost halved in the period 1990-2014: 125000 farms in 1990 to 65000 farms in 2014.
- As the number of farmers decreased (a steady process over the last 50 years), and thus less citizens have relatives who live on farms, and people moved into the vacated farms, farmers had to take effects (such as odour and noise) on their neighbours into account. This became more manifest with the outbreak of Foot and Mouth Disease, bird flu and especially Q-fever. This last disease led to the death of at least 25 people.

- Mainly due to urbanization, expansion of infrastructure, and to a lesser extent conversion of farmland into nature (in order to realize the Ecological Main structure) the agricultural area decreased from by around 8%: from 2 million hectares in 1990 to 1.84 million hectare in 2014.
- The expansion of the EU, and new trade arrangements with other countries (East Europe, Northern Africa) led to new markets and thus increased export, as well as to new competitors.
- Overt the period 1990-2014 (with a focus on the period 1990-2002) all kinds of environmental measures were introduced, mainly aiming at reduction of losses of nutrients (nitrogen as ammonia and nitrate, phosphate), or the impact of pesticide use (ban on certain pesticides, better control of use). Furthermore measures were introduced to increase animal welfare, especially in the pig and poultry sectors.
- The Common Agricultural Policy evolved over time, which had especially impact on the arable, veal and dairy sector: in 1992 the MacSharry reforms meant a decoupling of support from production, much lower cereal prices and a compensation per hectare of arable land.
- The increased attention within society for food safety and food ‘scandals’ put a large pressure on both the food and agricultural sector to become more transparent and to invest in all kinds of tracking and tracing systems. Due to the general disconnect between food production actors and consumers, people have little confidence in food safety, although in reality food safety has increased over the last decades. One exemption where food safety has decreased is the spread in antibiotic resistance due to do widespread use of antibiotics in intensive livestock production.

Dutch food system

- The number of players in the retail sector is decreasing. Because of supermarket chains taking over other supermarket chains the number of different buying organisations is decreasing.
- Recently there is more attention for food waste. The amount of food waste in households is around 50kg per person (PBL, 2014a).
- The amount of meat consumed per person in the Netherlands seems to stabilize.
- The increased attention within society for food safety, animal welfare and environmental pressure is also influencing the food system. For example via NGOs retailers are encouraged to choose for animal friendly produced meat (1 star better life label).

2.2. The different regimes

In this report we discuss the following regimes:

- **Meat:** Meat production is having a large impact on land use and GHG emissions and is therefore important to take into account. In the meat regime we make a distinction between pork, poultry and beef/veal.
- **Fish:** The fish caught by the Dutch fishermen is mainly used for export, while fish being consumed in the Netherlands is mainly imported. The fish sector has a large impact on marine biodiversity.
- **Dairy:** Dairy production is having a large impact on land use and GHG emissions and is an important sector for the Netherlands. Therefore it is important to take this sector into account.

- Arable farming and horticulture: The vegetable production in the Netherlands is an innovative sector and mainly influencing land use and biodiversity. The focus is will be mainly on vegetable production.
- Retail: As some of the changes occurring are having an impact of the entire food chain, such as organic farming and the shift towards local food, the chains itself are also interesting to study. Due to the large share of retailers in food purchases, retailers have a large effect on both production systems as well as on consumption patterns. In order to study the cracks and tensions on the regime level, we will especially focus on the retail part of the chain. A new way of organising the chain will mainly influence the retailers and distributors, so therefore we included the *retail sub-system* as well.

3. Main external landscape developments influencing the agro-food domain

Besides changes that start from the regime itself, there are also exogenous landscape developments that can influence the agro-food system. In this section these influences are discussed, and a distinction is made between destabilizing and stabilizing factors.

3.1. Main destabilising pressures

The main destabilising pressures on the agro-food domain are the following:

- Food prices: decreasing food prices, ask for increasing production efficiency
- Changes in agricultural policy and environmental policy: a shift from promoting production towards policy decoupled from production.
- Increasing attention for health issues related to food: however, Dutch policy is mainly focussing on production and the government is only taking limited action to encourage a different type of consumer behaviour for example via the education by education centre food. The choice for sustainable food is a task of the consumer and the government is only involved in objective information regarding health and production methods (Dijksma, 2013).
- Expansion of the EU leading to a growth of the market, increase of production area and potential to improve efficiency.
- Increasing attention for sustainable products: ‘Sustainable’ products (e.g. certified organic, MSC, Fairtrade) are gaining popularity among the Dutch population: they spent 2.46 billion euros on certified sustainable food in 2013 (LEI Wageningen UR, 2014).
- Urbanization leading on the one hand to increasing distance between production and consumption, and on the other hand increasing dependence of farmers on people living in the cities.
- The demand of consumers is changing: different diets, but there is also an increasing awareness of society on the origin of products, animal diseases, animal welfare and distrust in the value chain: Especially the last decade a remarkable increase in consumer preferences regarding higher quality, responsibly produced foods (either local, or global) can be witnessed (Oosterveer & Spaargaren, 2012). Food choices are (at least) partly determined by cultural and personal preferences of consumers, although these preferences can change over time influenced by retailers, food companies, or health concerns. Issues with animal diseases, pesticide residues or food scandals can (temporarily) influence the sale of products. Food preferences change over time: ‘slow food’ was a movement reacting on the fast food trend and nowadays ‘super foods’ (e.g. quinoa, wheat grass) gain popularity. Media, cooking programmes and for example ‘diet gurus’ are influencing the preferences. Furthermore, food production is connected with many ethical aspects as the origin of food (regional food production) as well as the way it is produced (like animal welfare and GMOs). The ‘agro-industry’ is receiving much more resistance in the Netherlands compared to other countries. For example mega farms are under discussion and receive resistance from the public. Innovation programs are furthermore focusing on the energy transition.
- The IT revolution also had major impact on farmers, in various ways. Due to the improved communication, farmers could communicate better, for example regarding market prices, as well as regarding the protection of their interests. The IT revolution also led to improved management, and therefore a higher productivity, as well as a more targeted use of inputs. For example: most dairy farmers now apply a feeding system based on the recognition of individual cows. This facilitates precision feeding, leading to lower feed costs, as well as to a lower nutrient content in the manure. All greenhouses are

equipped with automated climate control, to optimize climate (higher production) and fuel use (lower emissions).

- A number of societal trends have especially an impact on the Dutch food system. One important trend is the larger number of single or two-person households; the other important trend is the sharply increased labour participation of women. Both trends have led to the demand for more convenience, both in shopping (one-stop shop) as well as in products (more outdoor consumption, more pre-prepared food).
- Due to globalization food and ingredients are imported and exported from different countries. Recently the problems in the relation between Europe and Russia have caused a Russian ban on import of for example fruit from the Netherlands. An example in which the Netherlands is dependent on the import from other countries is soy and palm oil. That makes that geopolitical issues can play a more important role in the near future. Furthermore developments around the TTIP (Transatlantic Trade and Investment Partnership) will probably lead to changes in the food market.

3.2. Main stabilising landscape aspects

Besides destabilizing landscape aspects, there are aspects that stabilize the current food domain as well. The main stabilising landscape aspects are the following:

- Finances and investments: The difficulty with the agro-food regimes is that farmers invest a lot in e.g. land, machines, and buildings. It is not easy to set aside their business and start something else, because of these investments. This makes the system relatively difficult to change.
- Producers are dependent on price developments. That leads to a race to the bottom.
- Soil-bound agriculture is not easy to change. It is not expected on the short run that there will be no or tremendously less land needed for agricultural production. Especially for soil bound agriculture land is needed close to the farm.
- To a certain extent, dependency on water and land for food production will be present, while the amount of pesticides or fertilizer can be decreased and applied more efficient.
- Consumer behaviour is difficult to change: consumers have certain expectations on food that are hard to change: The consumer has an important role, as prices still play an important role in determining the food consumption, but a small, increasing, percentage is focussing on 'special' products (Hoogland et al., 2008).

In the following chapters, the developments in the sub-systems will be discussed.

4. Developments in the meat sub-system

The meat regime in itself actually consists of a number of sub-regimes, of which pigs and poultry are the largest. Despite evident differences between the various sub-regimes, there is also much in common, such as the farm structure (typically large family farms with no or limited amount of land, depending on purchased feed) and production method (intensive livestock farming).

4.1. Developments in (tangible) system elements

Over the period 1995-2015, there are three dominant developments, being a strong increase in farm size (together with specialization), and more attention for animal welfare as well as for environmental impacts. Mainly due to environmental regulation (regarding minerals and manure) changes in the animal husbandry sector occurred.

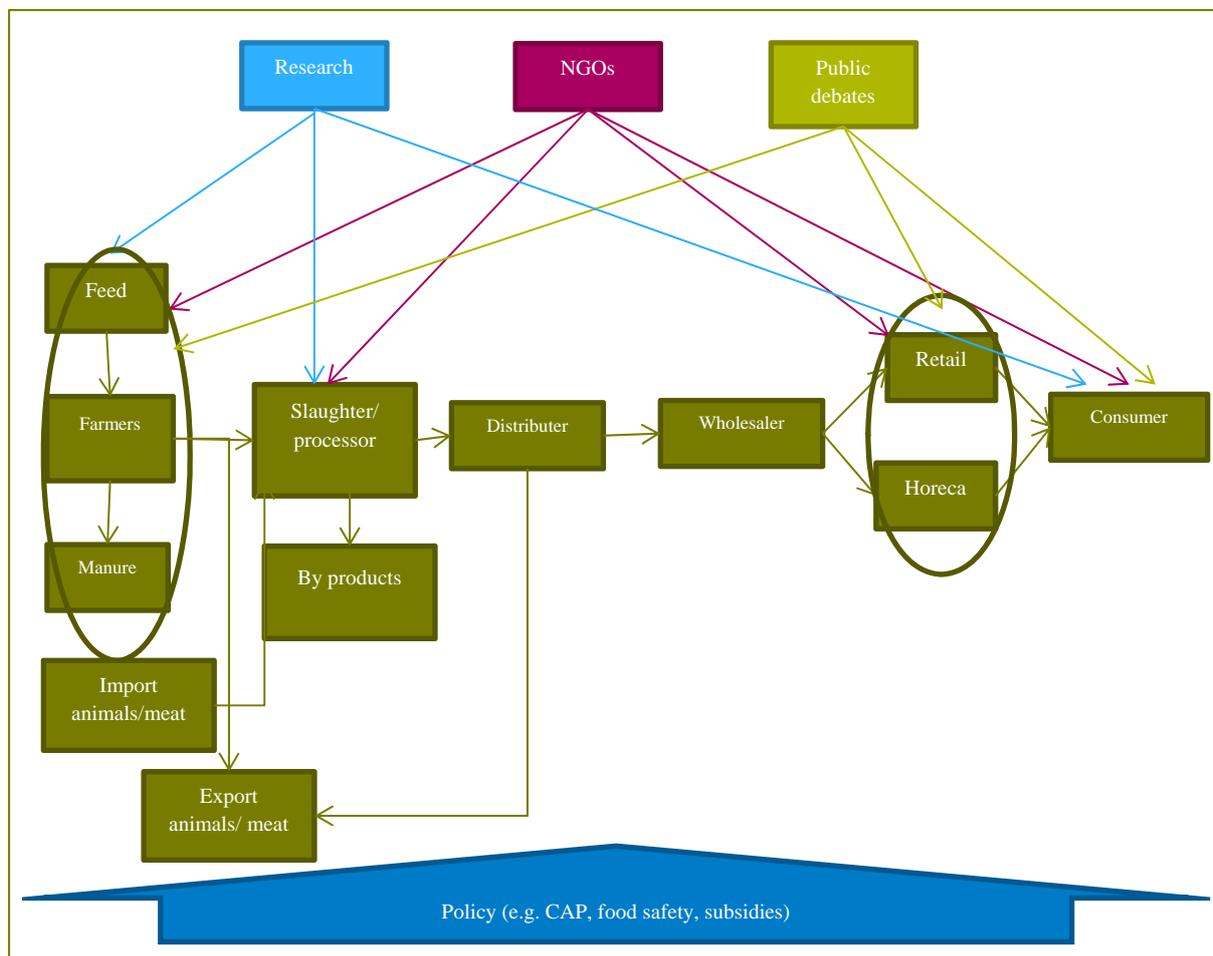


Figure 6 The socio-technical meat system

In order to analyse the meat system a distinction is made between the production and consumption part of the system. The different subsectors that are distinguished are: pork, poultry, and beef/veal.

Meat in general:

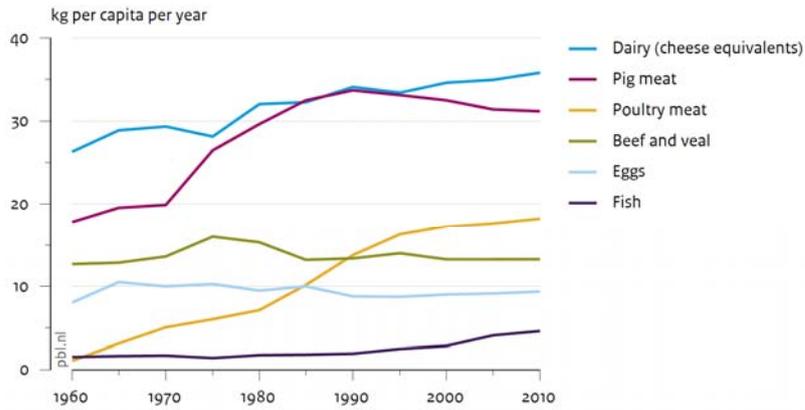
Production (data from (van Drunen et al., 2010):

- The gross production value of the animal, meat and egg sector was 6.2 billion euro in 2012. The highest production value was realised by the pork sector. The export volume was 2.6 million tons in 2012. The export of meat did increase, but the export of eggs did decline compared to 2011. The import of meat was 1.3 million tonnes, somewhat lower compared to 2011 (Productschap Pluimvee & Eieren & Productschap Vee & Vlees, 2013).
- Export value (2010): €5.5 billion (meat, excluding poultry)
- Around 12.000 people were working in the Dutch meat sector in 2010.
- There are around 60 large and middle large slaughterhouses in the Netherlands and around 2200 butchers (including the ones specialised in poultry).
- The production of meat (or protein products in general) is associated with high land use and greenhouse gas emissions. (see Figure 8 and Figure 9).
- Public investments, amount of subsidies: There are subsidies for sustainable husbandry systems (2007-2014).
- The price of meat does not contain all costs in the chain from feed to the supermarket shelf (van Drunen et al., 2010). The external costs are, among others, loss of biodiversity (related to land use and nutrient emissions), emissions of greenhouse gas emissions (e.g. methane emission), and animal suffering.
- Around 2005 the discussion on the use of antibiotics in animal husbandry started. In 2006 there was a European ban on the use of antibiotics as growth promotor, but it was allowed to use antibiotics in a preventive way. In 2010 the Dutch government announced target figures for reduction of antibiotics use in farming. Since then the amount of antibiotics used in farming has decreased considerable (J. V. Zwartkruis, 2013).

Consumption

The intake of animal products is in general increasing in the Netherlands (see figure below). The figure shows that especially the consumption of poultry meat and fish is increasing. The amount of meat used per person in 2012 was 83.7 kg² (in 2000 this was around 87kg). Mainly beef and pork consumption did decline. The main reason for this decline is the increasing consumer prices. The higher prices are the result of increasing costs for resources and supermarkets giving fewer discounts on meat products. Furthermore it seems that an average higher price is the result of an increasing demand for sustainable, and therefore often more expensive, products. The expenditures on meat in euros are more or less the same (Productschap Pluimvee & Eieren & Productschap Vee & Vlees, 2013).

² This is the weight including bones. The consumption (what people actually eat) is around 50% of this weight.



Source: CBS, 2009; LEI, 2008; adapted by PBL

Figure 7 Consumption of animal products (PBL, 2013a)

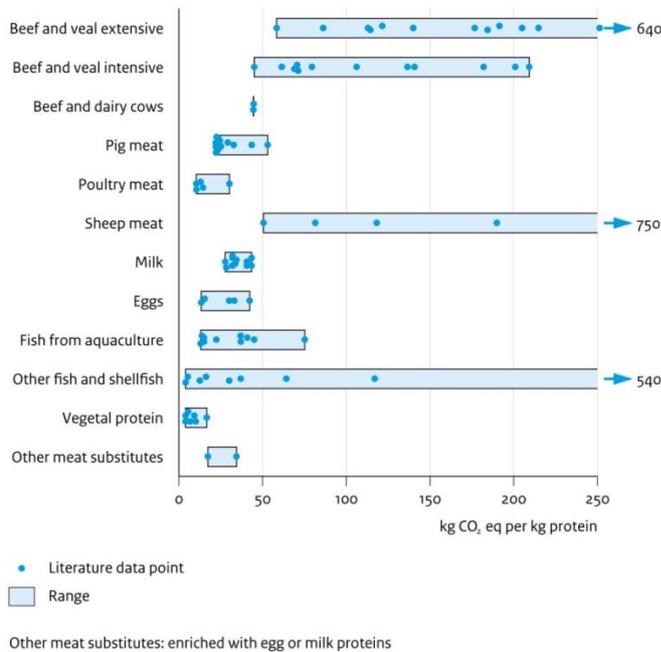


Figure 8 Greenhouse gas emissions per protein source. (Nijdam et al., 2012; Westhoek et al., 2011)

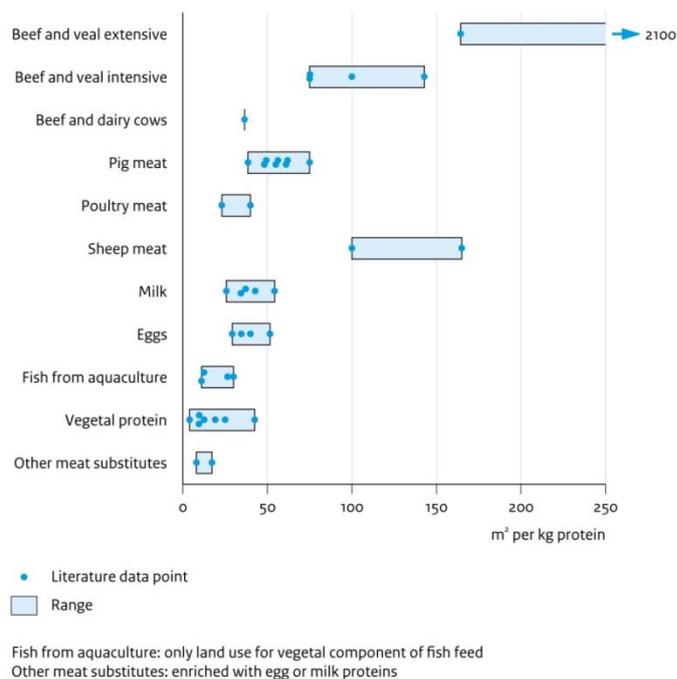


Figure 9 Land use per protein source. Source: (Nijdam et al., 2012; Westhoek et al., 2011).

In general we can state that policy is mainly focussing on production measures and regulations, and not on consumer choices. In the past, there were promotion campaigns to stimulate the consumption of dairy products and poultry meat. These campaigns were for 50% sponsored by the EU and for 50% by the sector itself (Verburg, 2009). In April 2013 the ZLTO received almost 2,8 million euro subsidy for the promotion of meat in the Netherlands from the EU as part of the subsidy regulation for promotion of agricultural products (Vermaas, 2013). In the Policy note Sustainable food (Nota Duurzaam Voedsel TK 31 532 nr. 18) and the policy agenda sustainable food systems (Beleidsagenda Duurzame Voedselsystemen TK 31 532 nr. 17) attention is drawn to the environmental impact of food production (Verburg, 2009).

Below we will describe the main developments per meat sector.

Pork

Production

- Numbers: Pork: 25 million pigs, around 13 million slaughtered in the Netherlands. 12 million pigs are exported, partly as piglets, partly as full-weight animals to be slaughtered. There are around 7000 pig farms (van Drunen et al., 2010). The number of pigs is controlled by production rights, which were installed in 1986 (in the form of manure rights).
- The environmental impact per kg of pig meat is 40% larger than chicken, but less than beef. The main environmental impact is because of the feed necessary. For 1 kilo pork meat 3 to 5 kilo feed is needed, resulting in energy, water and land use. Part of the feed is waste from the food industry, what reduces the environmental impact. Transport is influencing the environment as well (Voedingscentrum, 2015c).

The pork sector is a sector under pressure in the Netherlands. After the outbreak of Swine fever (1997), a law was accepted by the Parliament aiming at a restructuring of pig farming. One of the components of this law were measures to reduce the number of pigs by 25%. In a

court process the judges ruled that this percentage was disproportional. The government reduced it to 5%.

Since 2010 the prices for piglets and feed did increase, leading to higher production costs (Productschap Pluimvee & Eieren & Productschap Vee & Vlees, 2013).

Consumption

The amount of pork consumed is declining since the 1990s. In 2012 around 41 kg of pork meat was available per citizen, of which 19 kg was consumed and the rest is waste. Pork meat is the most popular meat in the Netherlands (Voedingscentrum, 2015c).

Poultry

Production

- The Dutch poultry sector counts on average around 47 million animals (in 2012). The number of poultry farms was 655. The total production of poultry (including turkey) was 992 000 tonnes of slaughtered weight in 2012, of which 944 000 tonnes chickens (Productschap Pluimvee & Eieren & Productschap Vee & Vlees, 2013). In 2012 945 000 tonnes of poultry meat is exported. The main countries importing meat from the Netherlands are Germany (28500 tonnes), UK (16600 tonnes), African countries (12600 tonnes) and 'other European countries' (e.g. Austria, Spain, Hungary) (12600 tonnes) (Productschap Pluimvee & Eieren & Productschap Vee & Vlees, 2013).
- From 2010 onwards measures are taken to reduce the amount of antibiotics used in poultry farming (Productschap Pluimvee & Eieren & Productschap Vee & Vlees, 2013).
- There are different labels for poultry meat, such as 'label rouge', better life label, free-range chickens and organic chickens. The systems in which these types of chickens are kept differ from the 'standard' system and focus mainly on animal welfare aspects. However, 95% of the Dutch chickens are kept in a standard system. In a conventional system more than 20 000 chickens are kept in one stable compartment (Voedingscentrum, 2015a).
- The poultry farms in the Netherlands, similar to other European countries, need to meet the regulations of the health and welfare law for animals. The amount of animals for example is restricted to a maximum of 39 kilos of chicken per square meter; resulting in 19 chickens per square meter. The average amount of chickens per square meter in the Netherlands is between 18 and 21 (Voedingscentrum, 2015a).
- Chicken feed consists of grains, seeds, soy, fish meal and milk components (Voedingscentrum, 2015a).
- The results of the poultry sector did decline. The revenues of chickens did increase, but as feed, energy and chicks did increase much more, the results did decline (Productschap Pluimvee & Eieren & Productschap Vee & Vlees, 2013).
- In the conventional poultry husbandry the main problems have to do with limited space and fast growth. In 6 weeks (42 days) chickens are slaughtered. Stress because of limited space, can lead to a higher risk of diseases and infections. Because of the fast growth and high weight chickens often have health and welfare problems. The chickens used for breeding are getting less feed in order to limit their growth. If they get their necessary amount of feed, they will become too heavy (Voedingscentrum, 2015a).
- The fact that the regulations outside Europe are often unclear is an issue for the import of chicken in the Netherlands.

- Compared to other meat products, chicken has the lowest impact on the environment. This is mainly related to the higher feed conversion of chickens. For one kilo of chicken meat 2 kilos of feed are needed (in case of a fast growing chicken). That is more efficient than for example pork or beef, where more feed is necessary for the same amount of growth. This is reflected in the amount of greenhouse gas emissions per kg of protein (Figure 8) as well as in the land use (Figure 9). Organic chickens do need more feed, as they live longer.

Consumption

Around 22.3 kg of poultry meat was consumed per person in the Netherlands in 2012. That is around 30 grams, without bones, a day per person. This consists of 18.4 kg chicken and 1 kg of turkey. Chicken breasts are most favourite (Voedingscentrum, 2015a). The amount of poultry meat consumed is increasing since the 1980s. That is mainly due to the fact that from that time onwards chicken breasts are sold in the supermarket.

Beef/veal

Production

- Beef: Netherlands is producing beef on a limited scale, most of the beef is from milking cows, and however, in general the Netherlands is importing beef. In 2010 the Netherlands counted 2.4 million cows, of which 530 000 are slaughtered (165 000 tonnes). In the same year 60 000 cows are exported. The total export of cows was 243 500 tonnes, mainly because a lot of meat is only traded in the Netherlands (van Drunen et al., 2010).
- Veal: Most of the veal produced in the Netherlands is for export. The production is around 200 000 tonnes meat. Around 90% of the production is exported to other EU countries. In 2010 there were around 930 000 calves in the Netherlands of which 124 000 are exported and 767 000 are slaughtered (van Drunen et al., 2010).
- Beef is having a large impact on the environment compared to other products. The amount of methane emission is high, as cows are ruminants. Furthermore there is a lot of CO₂ emission as a result of energy use and the manure is polluting the water. The environmental pressure of beef is around 2.5 times higher than for poultry. That is mainly due to the higher amount of feed needed, leading to a larger land and water usage. For 1 kilo of beef between 4 till 7 kilo feed is needed. However, the environmental impact of cows that a grazing is less, as they need less imported feed. The processed meat from dairy cows does have less impact on the environment as the impact can be divided among dairy products and meat products (Voedingscentrum, 2015b).
- Cows used for meat consumption live 1 to 2 years. Female animals live 6.5 year after giving birth to a number of calves.
- Since 2010 the supply of beef did decline as a result of decreasing production and limited possibilities for import. The decline of supply did lead to higher prices. For veal the prices did decline (compared to 2011) as a result of higher prices for milk powder and lower revenues for veal (Productschap Pluimvee & Eieren & Productschap Vee & Vlees, 2013).

Consumption

Beef or veal in the Netherlands is from both dairy and meat cows. Produced meat, such as minced meat, hamburgers and tartare, is mainly from dairy cows. Around 16.6 kg of beef was sold per person in 2012 in the Netherlands, of which around 50% is consumed. The amount of veal consumed is very small; around 1,5 kilo per person per year (Voedingscentrum, 2015b).

4.2. Developments in social groups and (intangible) regime elements

The main social groups in the meat regimes are the following:

- **Industry/firms:** The main companies involved in the meat regime are: feed companies, farmers, slaughters, processors of meat and distributors. Because of some food scandals (e.g. horse meat sold as beef) the companies are under pressure. Furthermore there is competition from other countries that can produce meat for a lower price. Because of transfers only a couple of companies are involved in the meat business. The big companies are responsible for 80% of all the animals slaughtered.
- **Consumers:** Meat is an important part of the diet for many people. However there are some initiatives to decrease meat consumption. As eating meat is a 'habit' it is difficult to change.
- **Policymakers:** There is no policy on meat consumption. Policy is mainly focussed on production and food safety and quality. The political discourse in the Netherlands on meat consumption and its consequences for the environment was raised when the movie "Meat the Truth" made by the political party: Partij voor de Dieren (Party for the Animals) was published. The discussion started, and political parties were asking questions on the effects of meat consumption on the environment. The government asked for research on the effects of meat production and alternatives for meat (Blonk et al., 2008). In 2008 the notion 'The future of the livestock sector' was raised by the minister of agriculture announcing measures to change routines in the livestock sector: Sustainable development of the sector was key. This can be seen as a starting point for changes in the sector. The term 'protein transition' was coined in 2008. The protein transition involved the shift towards a diet with less protein. Since the 21st century, collaboration has started between individual (niche) players and NGOs (Stichting Natuur en Milieu, Milieukeur) regarding animal welfare.
- **NGOs, social movements:** Social movements and NGOs are attracting attention for e.g. animal welfare and environmental impacts.

Main discourses

The animal diseases that were present from the 1990s onwards, such as BSE (1997), swine fever (1998), Q fever (2007-2009), chicken flu (2003) did have an impact on the discourse on meat production. Furthermore rules and regulations were influenced by these events. Especially after the swine fever a lot of farms were cleared out, leading to fluctuation of prices and changes in the sector. Q fever raised the awareness that diseases in animals can have an impact on humans as well. Together with the increased attention for the possible risks of antibiotics use in animal husbandry, such as the potential risks of bacteria in humans that are resistant against antibiotics as a result of antibiotics use in animal welfare increased the discussion on antibiotics use in animal husbandry (J. V. Zwartkruis, 2013).

The public discourse on meat has changed. In the 1970s there were only some small groups of people that started to discuss the way of producing meat and the amount of people not eating meat was very small. In the 21st century the discussion is enlarged, and the sector is put under pressure by a broad and varying public, even scientists, politicians, action groups and multinational institutes. They are discussing the effects of a protein rich diet in relation to for example land- and water use, biodiversity, manure and emissions, health issues, animal welfare and animal diseases (Hoogland et al., 2008).

The discussion on so-called mega farms; systems in which a huge amount of animals are kept on one spot (van Lieshout et al., 2011). This term did lead to a lot of discussion and has a strong negative connotation for many people.

5. Development in fish system and regime

5.1. Developments in (tangible) system elements

The fish sector involved not only production but also supply, processing and distribution of fish (see figure below). Although that seems similar to the agricultural sector, the main difference is the nature of production. In agriculture the culture dominates the production while in fish it is mainly hunting. Fish farming has more similarities with farming. In the 1980s the understanding came that the fish population was decreasing rapidly (NRLO, 1998).

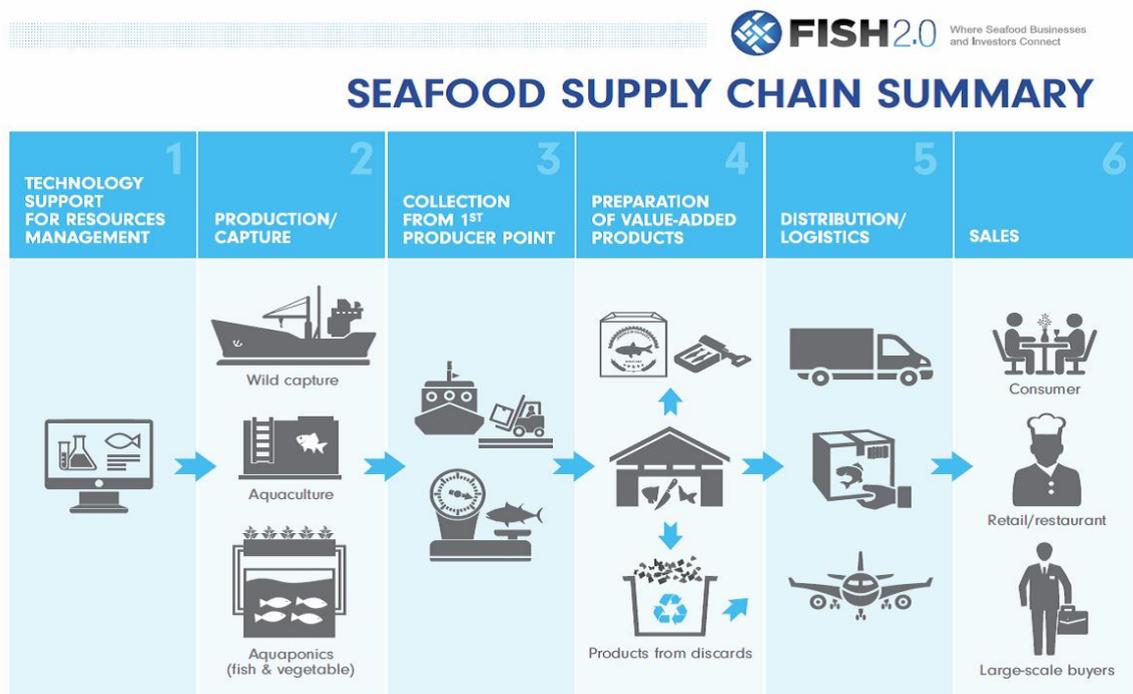


Figure 10 The seafood supply chain (Manta Consulting Inc., 2013)

It is important to notice that the fish caught by Dutch fishermen, is mainly exported to other countries. The fish consumed in the Netherlands is mainly imported. It is important to make a distinction between caught fish and aquaculture. Regarding caught fish the most important problems have to do with overfishing, disturbing ecosystems, by-catch and energy use.

In aquaculture the main issues have to do with the use of fishmeal, the use of medicines (especially antibiotics), manure and energy and water usage.

Production/fish catch

The Netherlands is one of the 10 largest exporters of fish worldwide. One third of the export is caught by Dutch fisherman, what makes that two-third of the exported fish is imported as well. Around 80% of all fish traded in the Netherlands is for export, mainly within Europe.

Fresh caught fish is mainly sold in one of the 11 fish auctions. The retailers have direct contracts with ship owners and fish farmers and buy the fish without the auction (Voedingscentrum, 2015e)

The total amount of fish caught and produced in the Netherlands was 621 million kg in 2005. That is around 10% of the production and catch of the EU-15. The Dutch fleet counts 366 ships (sum of different types of ships). The amount of surface with shellfish (oysters and mussels) was 7558 ha in 2013(CBS, 2015c). The turn-over of the shell fish sector was about 60 million euro, with about 60 shell fish farms. In 2010 the Netherlands counted 54 fish farms, with a total turn-over of about 16 million euro. Around 600 businesses involved in trade or processing. The value of the import of fish was around 1.9 billion euro (around 50% from outside the EU) and the value of the export was around 2.3 billion euro (around 75% within EU) (Productschap Vis, 2013).

The yield of the Dutch fishery sector is declining (see figure below).

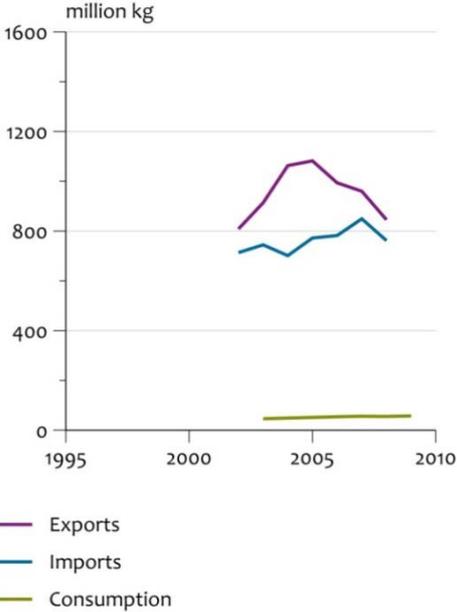


Figure 11 Import, export and consumption of fish in the Netherlands (PBL, 2011)

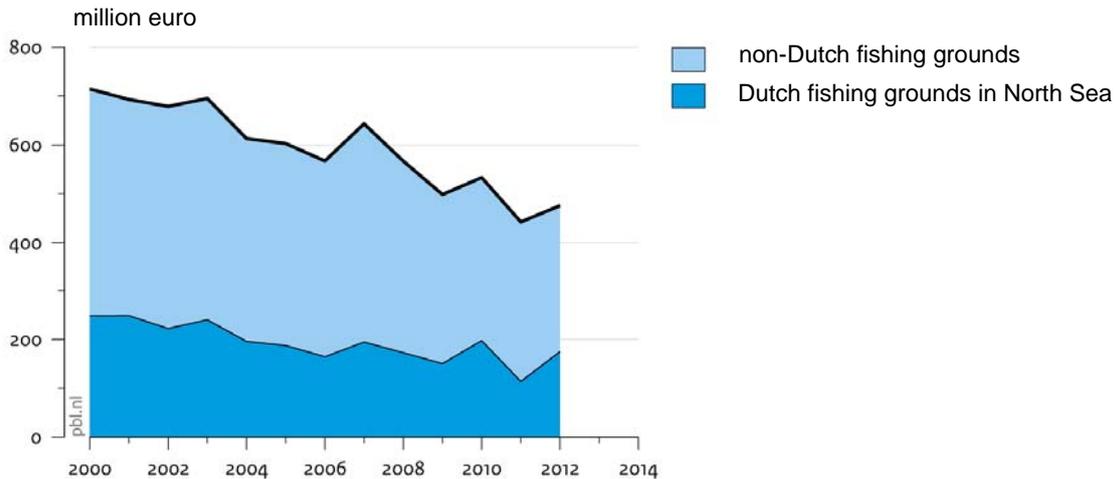


Figure 12 The yields of the Dutch fishery sector from 2000-2012 in million euros (CBS, 2015c)

Environmental performance

The last decades the energy efficiency of fisheries decreased globally as a result of declining fish stocks and greater distances travelled to catch fish. CO₂ emissions from EU15 fisheries declined by almost 11% between 1995 and 2006 as a result of reductions in fleet, engine power and fishing days. However, the amount of CO₂ emissions from fuel use for propulsion of fishing boats per kg fish increased as a result of a reduction of fish catch with 30% (in the same period). Changes fishing practices from coastal and deep sea fishing to trawling and fishing boats having to travel a greater distance also contributed to this increase (Westhoek et al., 2011).

In Pathways Report 2.1 we have described the five main categories of fishing methods: trawling, purse seining (encircling a school of fish with a large wall of net), gill or fixed net, line fishing and other passive fishing tools (Marine Conservation Society, 2014; Stichting De Noordzee, 2014).

The tools used for fishing have an influence on the sustainability of fishing:

- Heavy tools, dragging the bottom of the sea, demand a heavier ship (often creating more emissions) and damage the bottom;
- The net can be more or less selective: a less selective net also catches a lot of small fish, which has to be thrown in the sea again. Furthermore also other animal like sea turtles or sea mammals can be caught by the net;
- A heavy tool needs a powerful ship, using more fuel. When fish is caught only far from the coast more fuel is needed as well.

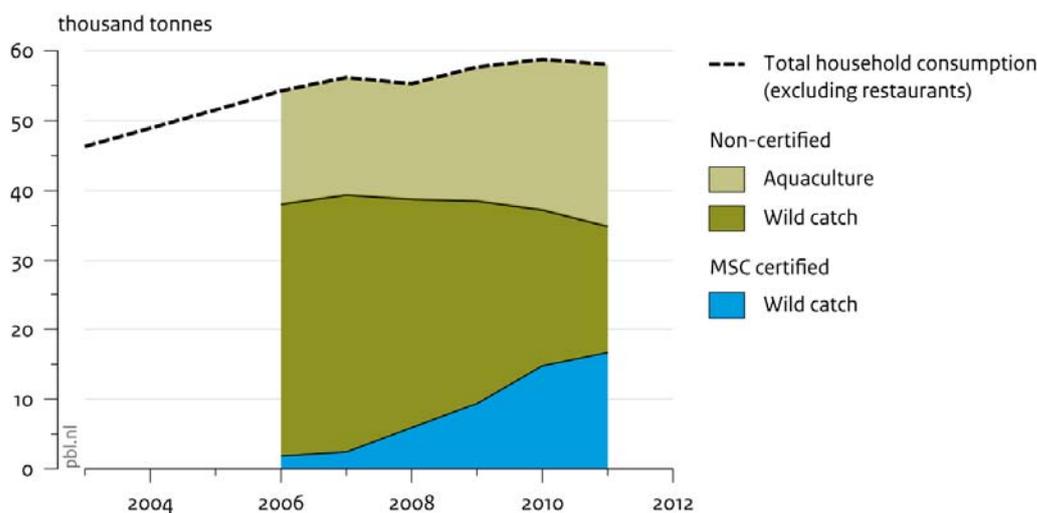
In 2004-2005 the Dutch fish sector is experiencing severe problems. Lower quota, rising fuel prices and disappointing economical revenues make it difficult for fisheries to earn money. Furthermore there is more societal attention for negative impact on the ecosystem, what makes the public more critical towards the fish sector. The sector itself asks for help at the Parliament, and the minister of Agriculture, Nature and Food quality develops a Task Force Sustainable North Sea Fishing to study the situation and developments. The taskforce advices the different parties in the chain to collaborate and innovate together in order to create an ecological, social and economic sustainable fishery (Witteveen+Bos, 2009).

In 2009 the Dutch Ministry of Agriculture, Nature and Food brought into life a subsidy regulation for certifying trajectories (MSC) for sea-, coast and inland fisheries and aquaculture. The 1 million euros (available till the end of 2010) was partly derived from the EFF. The ministry of Economic Affairs stated that the market is performing, so policy measures are no longer necessary (Algemene Rekenkamer, 2013). MSC would prefer to stay independent, and therefore does not ask for this type of regulations. An indirect measure, providing subsidies for investments in innovative projects will be more attractive and help fisheries to do investments (Van Oorschot, 2014).

Fish catch is associated with impact on both (marine) biodiversity (as not all fish caught is used) and greenhouse gas emissions (caused by ships). Fish is not only caught for consumption. Forage fish is caught to feed fish grown in aquaculture. As aquaculture is increasing, the amount of forage fish is increasing as well.

Consumption

The consumption of fish is also increasing. Dutch people eat on average 70 grams of fish per week that is more or less once in the two weeks. As there are many people not eating fish at all, the average is very low (Voedingscentrum, 2015d).



Source: MSC International, 2012

Figure 13 Dutch consumption of fish (Van Oorschot, 2014)

5.2. Developments in social groups and (intangible) regime elements

The main social groups involved in the fish sector are the following:

- Industry/firms: fisheries and fish feed businesses. Fisheries are usually small firms.
- Retailers: The retailer has a very important role in sustainable fish. (J. Zwartkruis et al., 2014). Many retailers have formulated specific goals regarding sustainable fishing, for example they only sell fish with an MSC label or do not sell endangered species. In 2008 the supermarkets set the goal to only sell sustainable fish by 2011 (CBL, 2013), mainly focusing on MSC and ASC (Aquaculture Stewardship Council) certified products. Around

85% of the wild fish catch in Dutch supermarkets is MSC certified or comparable in 2011³ (Van Oorschot, 2014). The amount of MSC certified products consumed increased since then a lot: from 6% of the consumption in 2007/2008 to almost 40% of the consumption in 2011/2012 (Van Oorschot, 2014). The services and catering are lagging behind and the amount of sustainable fish⁴ used in foodservices is even declining (Stichting De Noordzee, 2014). The organisation for supermarkets (CBL) has developed the “zevenstappen plan Vis Beter” (CBL, 2013) in which they formulated seven steps to get to a more sustainable and responsible fish assortment. They focus on MSC norms (or Responsible Fishing Scheme (RFS) for smaller companies), formulating a list of species that can be caught in a sustainable and responsible way (together with the government, chain partners and societal organisations), a ban on harming ways of fishing, limitation of by-catch, Global CAP, attention for animal welfare and stop illegal fishing.

- Consumers: The consumption of fish is increasing, and the consumption of MSC fish is increasing as well (see Figure 13). NGOs have developed the so-called VISWijzer. A tool to find out what the sustainable fish species are. This campaign made people more aware of the sustainability of fish.
- Policy: Policy is mainly focussing on production and fish catch. (J. Zwartkruis et al., 2014). Policy regarding fishing in the Netherlands is determined by EU policy and Dutch policy. For fishing in the North Sea, the Common Fishery Policy is in place. This policy is focusing on preventing overfishing and takes care for a sustainable fish population. Since January 2014 there is a new European policy on fishing. The main elements are: a ban on throwing back fish, more authority for the sector, decentralized decision making, priority for aquaculture, support of small scale fisheries, improving scientific knowledge on fish population and the EU takes also care of water outside their areas (Commission, 2014). In the coastal areas and inland water, the Dutch policy needs to be considered. Both the EU and the Dutch government encourage fisheries to develop sustainable methods to catch fish (Rijksoverheid, 2014). The government initiated a platform and encouraged the sector to collaborate in order to be able to innovate and deal with the difficulties they face. They took a facilitating role in bringing the parties together and provide financial support for the transition process. The Dutch approach has three pillars (Witteveen+Bos, 2009):
 1. The Fisheries Innovation Platform (FIP) (Visserij Innovatieplatform, VIP) (established in 2007): The platform encourages innovation in the daily practices of the fisheries and collaboration between fisheries, chain actors, knowledge institutes and societal organisations. This is a difficult task, as the sector is inward-looking, fragmented and fishermen are practically trained and used to work individually. In the four-year existence of the FIP changed the sector from inward-looking towards open and innovative fishery. Innovation networks are organized in five Blueports. The FIP is still involved in rating the innovation and collaboration projects for financial resources from the European Fishery Fund.
 2. Fisheries Knowledge Networks (established in 2008): 14 networks, supported by the Dutch government, in which entrepreneurs and scientists collaborated to solve common problems in the fisheries sector, e.g. alternative fishing techniques, fossil fuel reduction or added value creation. Assisted by a scientist they formulate research questions and try to answer them. As a result the scientific knowledge becomes available for fishermen.

³ This includes only fresh fish or frozen fish of the homebrand, so-called A brands are not taken into account (Van Oorschot, 2014).

⁴ Sustainable is not necessarily the same as the MSC label

3. The European Fisheries Fund (EFF) (2007): Focussing on supporting projects that use innovation and cooperation to serve a common interest. The funding is supplied through a tender system, resulting in only the most promising projects receiving funding.
- The public discourse is mainly on sustainable fisheries and fish from abroad. The attention for sustainable fish is increasing and initiatives like the “Viswijzer” did help to facilitate that discussion.
 - NGOs, social movements; WWF (was involved in MSC). The ‘Viswijzer’ was a tool to make people more aware of what the endangered species are.

The main discourses

- Overfishing is prevented by means of fish quota. These quotas are established by the EU and are there to make sure the level of adult fish is enough to generate offspring. The Total Allowable Catches (TACs) are developed based on scientific advises from biologists specialised in fish. The quotas are arranged per country and within the country per fleet of fishermen. Besides the quota there are regions in which fishing is prohibited. In case a deficit is almost reached a temporary ban on fishing is into place. Furthermore there are rules on how to handle fish and the sizes of fish (Voedingscentrum, 2015e).

- Although the market for MSC labelled fish is increasing, the MSC certification is discussed by some parties. The opinions differ to what extent the certification scheme is helping to safe biodiversity, as it is difficult to judge the effect of measures (Beukers & Harms, 2012). The principles of sustainability are written and sometimes interpreted in an ambiguous way, what makes it difficult to judge the sustainability as well (Christian et al., 2013). Fisheries can choose their own certification organisation and for certification organisations a successful certification could mean continuation of work for the certifier in terms of annual monitoring and re-assessment when needed (Jaquet et al., 2010; Ward, 2008). Certified fisheries have an advantage as they have broader market access. However for small scale fisheries it is difficult to get certified (Kessler et al., 2012). Comparison in research showed that there is a minor positive influence of MSC on the protection of certified fish populations, especially because by-catch is prevented. The effect is only small as certified fisheries in general were already doing a good job in protecting fish populations (Cambridge et al., 2011; PBL, 2013b).

- Sustainable fish received more attention, as initiatives like the VISwijzer (Fish indicator) was developed to learn the consumers about sustainable fish and fish populations (Stichting De Noordzee, 2014). The label “Milieukeur” examines the water- and energy use and feed conversation in fish farming. The idea is that these aspects do have the biggest influence on the environment.

6. Development in the dairy system and regime

6.1. Developments in (tangible) system elements

Dairy production

The Dutch dairy sector made a shift from a situation of 140 years ago in which dairy production was mainly a farm activity focusing on local needs, towards international expansion. Between 1950 and 1980 the production has doubled. Especially after 1960 there was a substantial growth as more farmers started to use mechanical milking systems and cooled tank systems were introduced. A higher processing efficiency led to a decreasing number of locations and many dairy factories closed down in the 1980s.

The milk quota scheme in Europe was introduced in the early 1980s, and can be marked as the start of a new phase in the development of the dairy sector. This led to productivity improvements of the sector: efforts are aimed at more economic use of existing means of production, and thus reducing production costs. As a result of more effective roughage production, improved feed quality and genetic selection via breeding programmes, the productivity per cow did increase and the dairy herd did decrease. As the expansion of milk production required high investments from farmers (given the need to buy milk quota), many farmers sought alternative sources of income, such as nature conservation, on farm recreation (small camping sites), energy regeneration (solar and wind) and various forms of care.

Due to changes in the EU dairy policy and expansion of the milk quotas, since 2008 the number of dairy cows is increasing again.

The Dutch dairy sector is one of the most consolidated industries worldwide. Most of the milk is processed within a cooperative structure. The cooperatives consist of dairy farmers, who own the cooperative and took control of central processing of their milk. FrieslandCampina is the largest cooperative in the Netherlands.

However, some changes are ahead: in 2015 the milk quota system is ended.

Production figures (ZuivelNL, 2015):

- 17.800 dairy farmers
- 1.55 million dairy cows, 0.28 million dairy goats
- 1.2 million hectares of grassland and maize (28% of the surface area in the Netherlands)
- 12.4 billion kg of milk production
- 22 milk processing companies and 51 dairy factories
- 300 wholesalers
- 7000 sales outlets
- 60 000 jobs (production, processing, wholesale and retail)
- 65% of the Dutch milk production is sold abroad (mainly EU)
- 35% of the Dutch milk production is consumed in the Netherlands
- The dairy sector contributed to 1.2% (about €6,3 billion) of the Dutch economy in 2012
- Most of the milk processed is used for cheese (55.8%); only 8.3% is used as drinking milk and other fresh milk products.

The milk production per cow did increase rapidly, from 7200 kg per cow per year in 2000 to 8000 kg per cow per year in 2010 (ZuivelNL, 2015). Due to various reasons (larger herd sizes, better controlled feeding and availability of farm labour) many farms have shifted from day-and-night grazing in the summer to only day grazing or no grazing. Currently more than

20% of the farms (and probably a higher percentage of dairy cows) does not apply grazing, while 25 years ago almost all farms were still based on grazing animals.

Dairy consumption

The Dutch consumption of dairy products (cheese equivalents) was around 45 kg per person per year in 2010 (PBL, 2013a, see figure 16). While production is increasing, the consumption of milk and dairy products by the Dutch is decreasing.

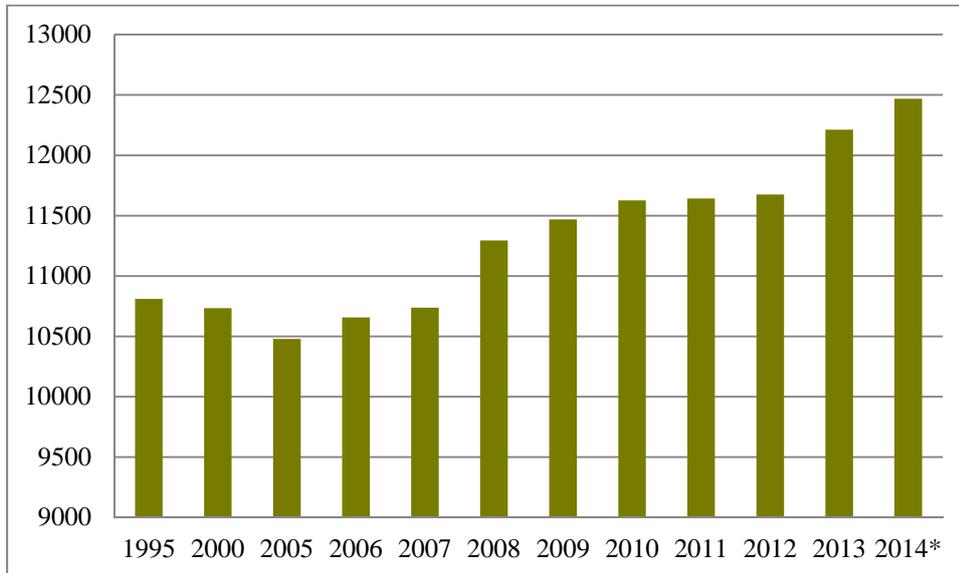


Figure 14 Amount of milk brought to Dutch factories 1995-2014 (*estimation) (CBS, 2015b)

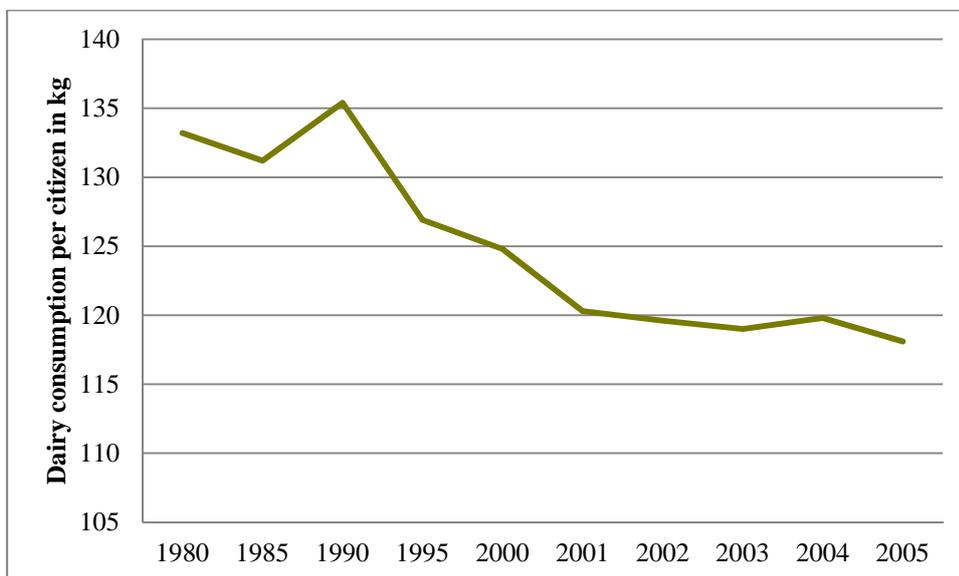


Figure 15 Dairy consumption per person (CBS, 2010)

Environmental performance

Around 60% of the ammonia emissions in the Netherlands originate from dairy farming. Ammonia emissions lead to a reduction of the biodiversity. Dairy farming is causing the

lion's share of greenhouse gas emissions caused by animal husbandry. Around 8% of the total greenhouse gas emissions in the Netherlands are related to dairy farming, mainly in the form of methane (from enteric fermentation and manure) and nitrous oxide (from manure and mineral fertilizers). Methane originates from the stomach of ruminants. The amount of GHG emissions from dairy farming decreased since the 1990s with around 20%. That is mainly due to the reduction in the number of cows. Furthermore water and energy are needed to produce feed.

The dairy sector however is in many using of land that is not suitable for any other type of agriculture, for example peaty soils or with very heavy clay.

Traditionally managed grasslands (without mineral fertilization and with low grazing intensity) could be very rich in plant species, as well as in meadow birds. Due to the intensification of land use (use of fertilizers, higher animal densities) and land 'improvements' (lowering of groundwater tables, land levelling) the level of biodiversity declined rapidly between 1950 and 1980. Currently, some dairy farmers are taking measures to attract meadow birds by for example mow grass in a later stage. Others are stimulating plant species richness by means of a more extensive grassland management. These farmers get are being compensated for these measures.

6.2. Developments in social groups and (intangible) regime elements

The main social groups in the dairy regime are:

- Dairy firms: the dairy industry is relatively stable. One of the largest dairy businesses is a cooperation of dairy farmers. Therefore there is a direct connection with the farmers.
- Consumers: Dairy is an important element of the diet of Dutch people. Furthermore, the cow in the meadow is seen as an important element of the Dutch landscape.
- Policymakers: The end of the milk quota can have an influence on the dairy sector. Not only the milk quota is limiting production, also manure and ammonia legislation is controlling the number of cows. In response to the recent increase in number of cows, the government has created a new law to regulate the number of cows per farm.
- Public discourse: The public discourse is mainly on animal welfare and the cow in the meadow. Cows are often seen as part of the Dutch landscape (historical value).
- NGOs, social movements: NGOs are mainly focussing on animal welfare issues. However, the dairy sector is not so much under discussion compared to the more intensive sectors like poultry or pork production.
- Sector representative organisations: The sector is characterised by a high degree of organisation as every segment of the production chain has its own organisation(s) to represent its interests. Table 2 shows the main sector organisations.

Table 2 The main actors in the dairy sector (ZuivelNL, 2014)

Primary sector	
LTO Nederland	Dutch Federation of agriculture and horticulture
NMV	Dutch dairy farmers Union
BBZ	Farmhouse and Artisan Cheese and Dairy producers
Industry and trade	
NZO	Dutch Dairy Organisation
Gemzu	Dutch dairy traders
CBL	Dutch food retail association
Other categories	
PZ	Dutch Dairy board (until 2014)
ZuivelNL	Dairy Chain organisation
RVO	Netherlands Enterprise Agency (governmental organisation)
COKZ	The Netherlands Controlling Authority for milk and milk products
QLIP	Private organisation for analysis and certification in the dairy chain and agro food sector
GD	Leading Dutch animal health and animal production organisation
WUR Livestock research	Research institute focusing on i.e. dairy farming related themes
NIZO Food Research	Research Institute for i.e. dairy product technology and milk quality

The main discourses

- The end of the milk quota: Since April 2015 the milk quota disappeared. It is not sure what the impact will be on the sector and the prices. Since the announcement that the milk quota will disappear the number of cows is increasing and the new stables that are build can keep more cows in them, what makes it possible for farmers to increase the number of cows from 2015 onwards.
- The cow in the meadow is an important discourse related to the dairy sector. The cow in the meadow is appreciated by Dutch citizens and does according to many belong to the Dutch landscape. Some of the dairy companies, such as Friesland Campina, encourage farmers to keep cows outside by providing an extra price for the milk of cows that are in the meadow for a certain amount of days per year. They sell their product as ‘weidemelk’. However, sometimes cows in the meadow are associated with higher nutrient losses, as the manure and urine are not spread evenly by the grazing cows. The ammonia emission of grazing cows is typically lower
- Cows are often fed with concentrates as well in order to increase the milk production. These consist mainly of maize (or other cereals and protein rich material (such as soy bean meal). Soy production is (rightly or wrongly) associated with deforestation in South America Most soy beans are produced by GMO crops, which is also controversial.

- Since the mid 1980s agricultural nature conservation is gaining popularity especially for dairy farmers. By mowing later in the season for example meadow birds are protected.
- The introduction of the milk robot created more flexibility in the scheme of the farmer and make it possible to increase the number of cows to be managed per person. Because of the milk robot the farmer doesn't have to milk the cows at a certain time, but the cows can enter the robot whenever they want. However, in case the farmer wants to keep the cows outside as well, the outside area must be surrounding the stable in order to provide access to the milk robot. That is often not the case in the Netherlands.

7. Developments in the vegetable (horticulture and arable farming) system and regime

7.1. Developments in (tangible) system elements

In the Netherlands, vegetables are being produced by means of horticulture and arable farming. A relative small share of the vegetables is being produced in glasshouse horticulture, mainly in the form of tomatoes, sweet peppers and cucumbers. Other crops are for example early and late cultivated green salad and endive. The distinction between open air horticulture and arable farming is in the scale of farming and degree of mechanisation. Crops which require much hand labour are usually seen as horticultural crops (such as salad and herbs), while crops that can largely be cultivated mechanically (such as spinach, winter carrots, cabbages, leek) are seen as arable crops.

Figure 16 below shows the developments of the different sectors over time.

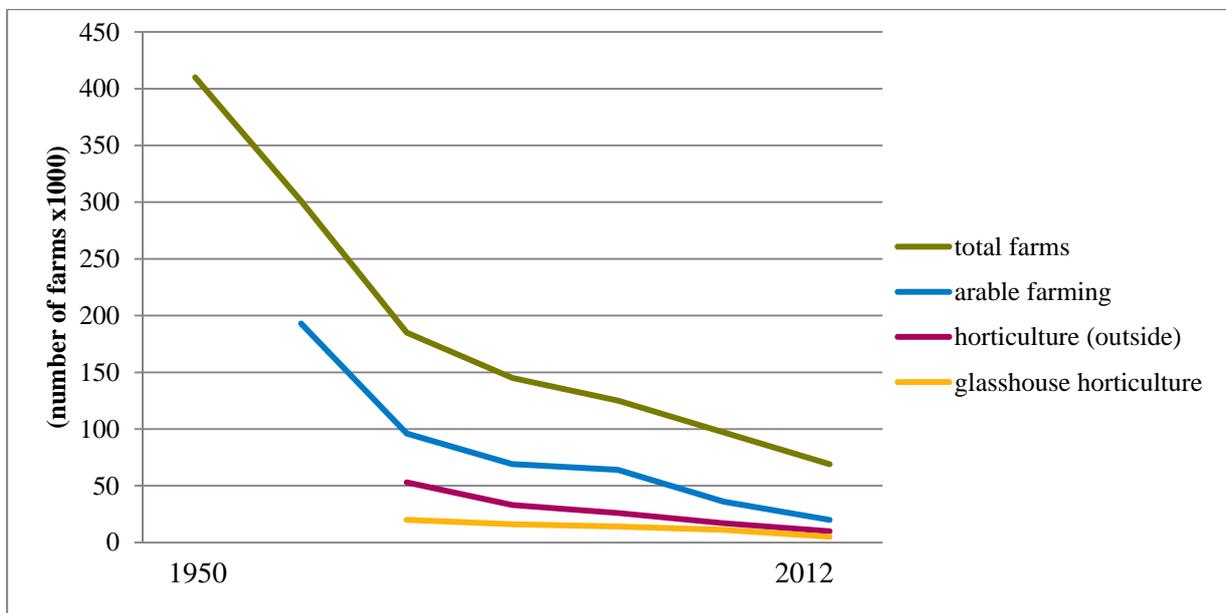


Figure 16 The arable farming and horticulture sector in the Netherlands (CBS, 2015b)

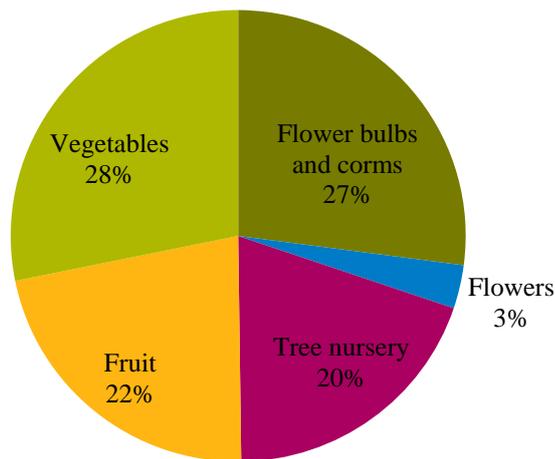


Figure 17 Horticulture in the Netherlands (CBS, 2015a)

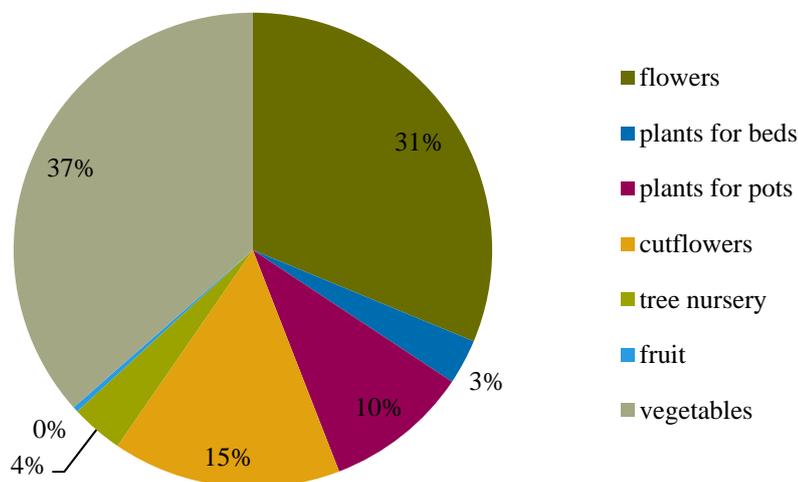


Figure 18 Glasshouse horticulture in the Netherlands, m² (CBS, 2015a)

The main developments in the arable farming and horticulture sector are described below:

- In 1992 MacSharry (the EU agricultural commissioner) announced a shift in agricultural policy and changed the system from price support to a system of support for producers. This was the beginning of the current CAP. Especially cereal farmers were affected by these measures, as cereal prices became much lower. One of the responses of farmers was to intensify their cropping system, as change for cereals to mechanized cultivation of vegetables.
- From the 1980s onwards Integrated Pest Management was introduced. IPM was defined by the FAO as: "the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms".
 - Furthermore precision farming is getting more important over the last years. The use of Global Positioning Systems on tractors or adapting the amount of water and nutrients needed to the needs of one specific plant are making the production more efficient. Furthermore because of technological improvements, robots or machines can

take over some of the activities what makes that less people are needed in the production.

- In greenhouses technological improvements did lead to experiments with energy neutral greenhouses, or even energy producing green houses. Energy subsidies are decreasing what makes the farmers with greenhouses were in need for becoming more efficient and reducing the energy they produce.
- In the Netherlands, no Genetically Modified crops are grown, but especially in the USA a lot of genetically modified soy and grains are grown. As the amount of GM crops is growing, the prices for non-GM crops are increasing because of scarcity.

Regarding the consumption the amount of vegetables Dutch citizens consume is not decreasing very much. That is mainly due to the availability of packages with pre-cut vegetables that make it easier for the consumer to prepare meals with vegetables.

The introduction of heavier but more compact machinery in the 1980s led to changes in the way farmland was used. Because of heavier machinery the soil is getting compacted at the places the machines are driving.

7.2. Developments in social groups and (intangible) regime elements

The main social groups in the vegetable production regime are:

- Farmers: The farmers invest a lot in land and machinery. That makes it hard to transfer the farm to someone else. The introduction of new technologies and machinery makes that less people are needed to help with the production.
- Citizens: The societal discourse on agriculture is more on animals than arable production. However the sector is opening up by initiatives like ‘visit the greenhouse’.
- Nature conservation organisations: Although agricultural nature conservation is mainly focussing on grasslands, there is also attention for the maintenance of the borders of agricultural areas. The buffers between areas can be managed in such a way that biodiversity will increase.
- Government: Similar to the other agricultural sectors, the Dutch and European legislation is leading for production. Regarding consumption the government is via its ‘Voedingscentrum’ promoting the advised intake of 200 gram vegetables and 2 pieces of fruit a day.
- Businesses (supermarkets, purchasing organisations): The number of purchasing organisations is decreasing, what makes that on auctions less actors are active. This leads to lower prices of products for the producers.
- Energy companies: Especially in the greenhouse sector energy companies do play a role. As the attention for saving energy is increasing and initiatives like the energy neutral greenhouse are developed the farmers are no longer only the ones using energy, but become producers as well. That creates different roles and relations between farmers and energy companies.
- Scientists: There are a lot of technologies developed by scientists, among which: energy neutral systems, GPS trafficking, development of pesticides and fertilizers, but also breeding new species in order to increase production. Many of these innovations do not lead to entire system changes, but do have an impact on the regime itself.

8. Developments in the retail system and regime

8.1. Developments in (tangible) system elements

In this chapter we did not focus on a regime being a specific sector, but as part of the chain. As deliverable 2.1 also discusses some niche innovations that focus on retail, or other aspects of the agro-food chain, we choose to also discuss the retail regime (Figure 19). Important to notice however is that the niche innovation on organic farming actually addresses the whole chain: from farm to fork.

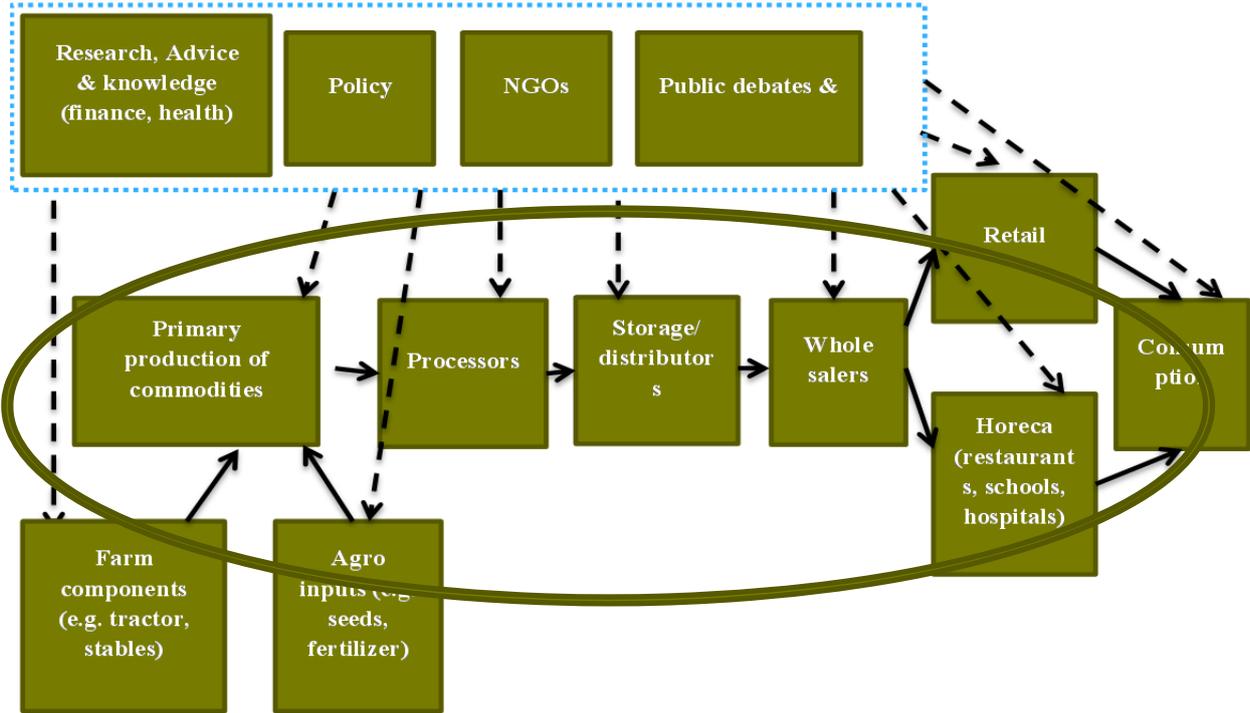


Figure 19 The agro-food chain with the main actors

As Figure 20 schematically represents, the power in the Dutch agro-food chain is mainly within a couple of purchasing companies (of the big supermarket chains). They are the central nodes for many diverse commodity chains, which link upstream to 65.000 Dutch farmers, 6500 food manufacturers, and 1500 suppliers, and link downstream to 4400 supermarket stores, 7 million households, and 16.7 million consumers. Please note that before the stage of farmers and horticulturists there is another sector, being the agro-input sector (e.g. machines, feed and fertilizers). This figure only presents the Dutch (mainstream) market. It should also be noted that the Netherlands is a big player in the export market of food, as they are in the top of large agro-food products exporting countries worldwide (Topteam Agro & Food, 2011). Furthermore the agro-food businesses are influenced by the main sellers of their products as well. Besides the big influence of the supermarkets, the interaction between the demand and supply side is a returning “chicken and egg” problem. Demand is determining the production and the production is also determining the demand. Farmers only produce certain products if there is a demand, while the demand is also determined by the assortment in the (super) markets. Recently, fresh products and ready-to-cook segment are booming in the retail sector. Regional products are gaining popularity in some areas and farmer shops and markets are gaining popularity as well (Oosterveer & Spaargaren, 2012).

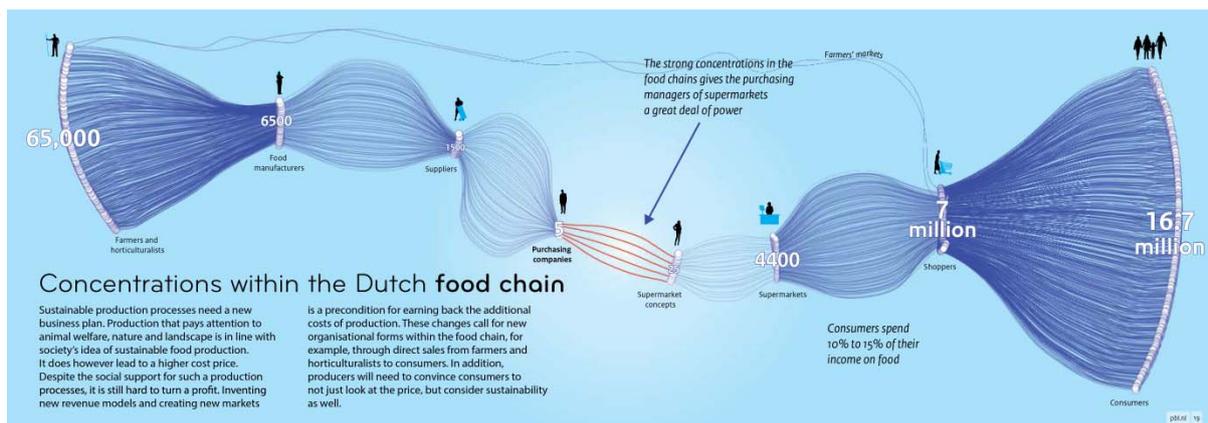


Figure 20 Concentration and relative power positions of commodity chains in the Dutch food system (PBL, 2014b)

As the figure above shows, a lot power in the Dutch agro-food sector is with the supermarkets. As only a couple of retailers form the bridge between producers and consumers, they are influential in determining what is produced and what is consumed. Some of the innovations we study are not really focussing on one (production) regime, but are on a change in the organisation of the chain itself. For example local food innovations are about a new and shorter chain. This can be viewed as a movement against the dominant regime of big retailers determining the lion share of the market. Another niche innovation described in 2.1 is the developments of organic farming. This innovation is not only about the retail part of the chain, but focusses on a different way of producing food. However, a separate chain is the result as organic food should be treated separately from the 'conventional' chain.

The Netherlands counts 4300 supermarkets what makes it possible for everyone to do their shopping in the near environment. The supermarkets have around 4 million customers every day. Around 46% of the people visit the supermarket 3 or more times per week, what makes doing the shopping for many people a routine. In 2013 51,5% of the food was bought in supermarkets, 30,7% in food services and 17,8% in specialty shops (CBL, 2015).

In 2013 the total turnover was 34,2 billion euro. The market share of supermarkets within the total amount of expenditures by consumers' expenditures on food and drinks was 51.5% in 2013. That means that 51.5% of every euro spend on food is spend in the supermarket.

The supermarket market is mainly dominated by three large formulas: Albert Heijn, Jumbo Group and Superunie.

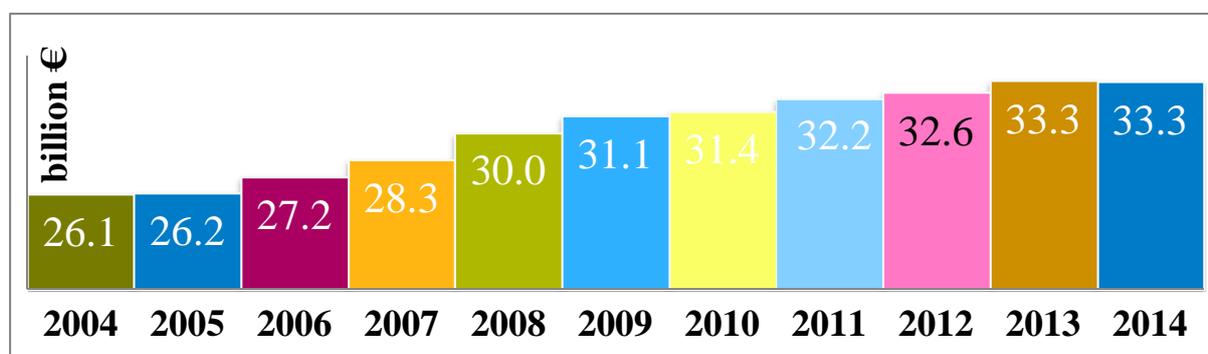


Figure 21 History supermarket turnover in the Netherlands (GfK, 2015)

8.2. Developments in social groups and (intangible) regime elements

- Supermarkets/Retailers: As the figures above show, there are a couple of retailers/supermarket formulas dominating the market. That means that these supermarkets have a lot of power. The lion share of food produced by the farmers need to be sold by these supermarkets, what makes that for example discussions on price are important. Supermarkets have certain quality demands and demands on for example the shape of fruit and vegetables.
- Consumers: As more than 50% of the consumers buys their food and drinks in the supermarket, the supermarket has an important role in what the consumer is buying. Consumer behaviour in supermarkets is difficult to change as doing the shopping is routine behaviour for many consumers.
- Policymakers: Policy is mainly focussing on food quality and safety.
- Public discourse: Public discourse is mainly on food safety and prices. Sustainability seems to become more important as well.
- NGOs, social movements: NGOs and social movements have an influence on for example meat in the supermarkets. Campaigns in which specific supermarkets are accused of selling animal unfriendly meat are on national television.

Main discourses

- In the 1980s and 1990s there was a consolidation of supermarkets. Form the 1990s onwards the number of one-man businesses was decreasing and the small supermarkets in rural areas started to disappear.
- As a result of the growing number of one-person households from the 1990s onwards the amount of customers and expenditures was increasing. Supermarkets were gaining popularity as people can buy all the products they need in one shop.
- In 2003 there was a 'price war'. Prices of products in supermarkets were decreasing and supermarkets were competing with each other. Often the producers were the ones that suffer the most from the decreasing prices.
- Since the 21st century supermarkets increased their opening hours. It is becoming more common that they are open 7 days a week. Because of digitalization it is even possible to order groceries online. The consumer can get them delivered at home or pick them up at a pick-up point (for example a point near the highway).
- In the 2000s some of the retailers were taken over by other retailers, what did decrease the number of actors on the purchasing market. Only a couple of actors are dominating the market what gives them a lot of power. That also did lead to changes in the power distribution. While the Albert Heijn was by far the biggest retailer in the past, Jumbo, that is taking over C1000 as well, is growing rapidly, what makes them a competitor of Albert Heijn. Besides supermarkets taken over, also some international supermarkets (with very low prices) were entering the market, like Lidl and Aldi. Their market share is still increasing.
- Since 2010 other concepts are introduced as well. With the increasing attention for sustainable and local food, concepts like MarQt and the food halls in Rotterdam are gaining popularity. Furthermore short chains, such as buying food directly at the farm or order a bag with organic vegetables are getting more popular. Although the market share of these initiatives is not so large yet, there is a change visible. Some people

state that this could be the result of a form of distrust in retailers or producers as a result of recent food scandals.

- The products in the supermarkets did change as well. The introduction of food that is easy and fast to prepare, processed food and a great variety of products year round, makes that the assortment of the retailer is changing.
- The campaigns of for example Wakker Dier in which supermarkets are accused of selling animal unfriendly produced meat did sharpen the relation with retailers. Some started to switch to animal friendly meat.

9. Conclusions about stability and cracks/tensions

This report described the different regimes in the agro-food domain. In order to be able to make a statement on the stability and tensions of the agro-food domain, we will summarize in this paragraph the main lock-in factors and cracks and tensions that we observed in the different regime. For relevant actors in each regime both the lock-in or stabilising force and cracks, tensions and problems are assessed (weak, moderate or strong). A strong lock in means that the system is difficult to change because of for example a strongly organised sector, in which different actors are closely connected. A weak lock-in suggests that the system is easier to change; innovations can more easily be applied and less resources or time may be required to change a system. A strong tension, crack or problem will possibly open up a regime to a lot of changes, on the short run. A weak tension, crack or problem is not influencing the system so much, and the chance that an innovation will change the regime is small. An overall assessment of the lock-in and cracks and tensions of the system is made based on the assessment of the regime elements. The idea is that a strong locked-in regime is more difficult to change compared to a weak locked-in regime.

We will conclude this chapter with some overall conclusions on the stability and tensions in the agro-food domain in general.

9.1. Meat regime

Although the meat sector consists of different sub-regimes, in general the lock in and stabilizing forces and cracks, tensions and problems are similar for these sub-regimes meat (unless mentioned). In general we can state that in the meat sector the investments (in for example stables) are large and have a long time horizon (20-30 years). This makes it hard to change practices. The influence from society on meat production, such as food safety issues, animal welfare and health issues, makes that changes are occurring. Especially crises like animal diseases and food scandals make that changes are occurring within the regime, like changes in production methods. Up till now, the tensions and problems have not, or have hardly (or only temporally) led to shift away from meat products.

Table 3 Conclusions about stability and tensions in the meat regime

	Lock-in, stabilising forces	Cracks, tensions, problems
External landscape pressures	<ul style="list-style-type: none"> Demand for meat remains and is even increasing outside Europe 	<ul style="list-style-type: none"> Problems with animal diseases: BSE, MKZ, Chicken flu Food “scandals” (food safety, origin of products) Financial crisis The import of feed (esp. soy bean) might get problematic in case of conflicts or other issues (approval of certain GM crops)
Farmers	<p>STRONG</p> <ul style="list-style-type: none"> Large investments in stables, debts for farmers, present location and size livestock production 	<p>WEAK</p> <ul style="list-style-type: none"> Certain developments push farmers to change their practises: such as increased attention for animal welfare, need to reduce the use of antibiotics
Industry	<p>STRONG</p> <ul style="list-style-type: none"> The meat industry/businesses as well as feed companies consist of large and influential players 	<p>MODERATE</p> <ul style="list-style-type: none"> Food scandals led to distrust in the sector. Pressure on production

Retailers	<p>STRONG</p> <ul style="list-style-type: none"> Meat is an important ‘traffic generator’ for supermarkets. Retailers have a large influence on consumers’ behaviour as well as on the production chain 	<p>MODERATE</p> <ul style="list-style-type: none"> NGOs are exerting pressure on retailers by campaigns on animal welfare. That makes the retailers and consumers aware of this issue.
Consumers	<p>STRONG</p> <ul style="list-style-type: none"> Eating meat is part culturally habituated, and difficult to change 	<p>WEAK</p> <ul style="list-style-type: none"> Alternatives are becoming more widely available, but are sometimes perceived as more expensive and not tasty Animal welfare and sustainability issues are getting more attention
Policy-makers / politicians	<p>MODERATE</p> <ul style="list-style-type: none"> No specific policy on meat consumption Policy on production is mainly focussing on environmental pressure 	<p>MODERATE</p> <ul style="list-style-type: none"> Political party: Party for the animals brings animal freedom issues on the agenda of the parliament EU nitrate directive within water framework directive
Public debate and opinion	<p>WEAK</p> <ul style="list-style-type: none"> The public debate is not so much locked in. There is a shift visible into more attention for animal welfare issues. However, the behaviour of consumers is not changing so much. 	<p>MODERATE</p> <ul style="list-style-type: none"> Public debate on meat consumption is gaining importance and animal welfare is becoming higher on the agenda. Discussions on: animal welfare and mega stables
Pressure from social movements, NGOs, scientists	<p>WEAK</p> <ul style="list-style-type: none"> The pressure from social movements is increasing and not so much locked in. NGOs and social movements are getting more attention. 	<p>STRONG</p> <ul style="list-style-type: none"> Social movements are trying to create awareness on animal welfare, effects of antibiotics, the effects of meat consumption on the environment and health. Campaigns focussing on ‘very cheap meat’ (kiloknallers), megafarms and flexitarianism
Overall assessment	<p>STRONG</p> <ul style="list-style-type: none"> Very stable market, huge players involved and meat consumption is an important part of culture 	<p>MODERATE</p> <ul style="list-style-type: none"> There is societal pressure on the meat regime. However, as eating meat is also a cultural issue and the production system is locked in, it is difficult to change.

9.2. Fish regime

The Dutch fish sector is different from the other sectors as the lion’s share of the fish caught by Dutch fisherman is exported and much of the fish consumed in the Netherlands is imported. However, the Dutch fishermen are changing the ways of fishing. The fish sector contains many small fisheries, what makes that changes occur more gradually. In general we can conclude the fish sector is not so locked in compared to other sectors. Since a couple of years changes occur in the sector as a result of increasing awareness of environmental pressure and reduction of the fish population.

Table 4 Conclusions about stability and tensions in the fish regime

	Lock-in, stabilising forces	Cracks, tensions, problems
External landscape pressures	<ul style="list-style-type: none"> The fish population is dependent on the quality of the environment 	<ul style="list-style-type: none"> Marine Biodiversity is decreasing; many fish stocks are overfished. Some species are endangered. Over fishing and illegal fishing is putting pressure on the market.
Industry	<p>MODERATE TO STRONG</p> <ul style="list-style-type: none"> Large investments in vessels and processing industry and large investments in aquaculture 	<p>MODERATE</p> <ul style="list-style-type: none"> Food businesses are sensitive for negative images, so therefore they can be influenced by NGOs
Retailers	<p>MODERATE</p> <ul style="list-style-type: none"> Supermarkets can steer consumers to only buy certain types of fish 	<p>MODERATE</p> <ul style="list-style-type: none"> Supermarkets have agreed to mainly sell 'responsible' fish Because of globalization more species of fish are widely available
Consumers	<p>WEAK</p> <ul style="list-style-type: none"> The fish consumption is relatively low in the Netherlands. Possible health effects of eating fish are getting more attention. 	<p>MODERATE</p> <ul style="list-style-type: none"> Consumers are confronted with different types of fish to choose from in supermarkets. Campaigns are developed on what is sustainable fish (VISwijzer). Demand for fish and the consumption of fish is increasing.
Policy-makers	<p>WEAK</p> <ul style="list-style-type: none"> Government is mainly focussing on establishing an institutional basis for the management of fish stock and supporting parties. Policy is encouraging investments in production of e.g. algae; however there is in relation to this not much attention for fishery, environment or nature. The main focus is on energy and health aspects. 	<p>STRONG</p> <ul style="list-style-type: none"> Regulation is getting more stringent (part of the regulations developed by MSC did become part of governmental regulation)
Public debate and opinion	<p>WEAK</p> <ul style="list-style-type: none"> Fish is framed as healthy 	<p>STRONG</p> <ul style="list-style-type: none"> Sustainable fishing is getting more attention as a result of the campaigns of for example WWF.
Pressure from social movements, NGOs, scientists	<p>STRONG</p> <ul style="list-style-type: none"> Different NGOs and social movements are working on fish. Especially WWF has a large influence on public opinion. 	<p>STRONG</p> <ul style="list-style-type: none"> NGOs set up the MSC and ASC label, they put pressure on supermarkets to only sell MSC / ASC certified fish. WWF and Stichting Noordzee are trying to increase awareness of consumers. The food industry is sensitive for negative images, so therefore they can be influenced by NGOs
Overall assessment	<p>WEAK</p> <ul style="list-style-type: none"> As a result of the decreasing fish population changes are occurring and the sector is not so much locked in. 	<p>MODERATE</p> <ul style="list-style-type: none"> Awareness on the decreasing fish population has led to measures to stop that decline. Public opinion, the pressure from society via NGOs and social movements and the development of MSC have led to changes in the fish sector.

9.3. Dairy regime

The dairy sector is very important for the Netherlands. Both consumption and production of dairy products are high. In the dairy sector large investments are done in machinery, buildings, land and livestock. That is hard to change as these investments have a long time horizon. However the dairy sector has a relatively good image that they would like to keep. Dairy companies are contributing to that image by selling ‘meadow milk’. Changes are mainly occurring within the regime: for example different types of feed or a different type of stable. However, as it is difficult for farmers to increase their livestock, they are looking for other ways to generate a higher income. This has led to increasing attention in for example agricultural nature conservation. In general the lock-in is moderate and the cracks and tensions as well.

Table 5 Conclusions about stability and tensions in the dairy regime

	Lock-in, stabilising forces	Cracks, tensions, problems
External landscape pressures	<ul style="list-style-type: none"> Land will be necessary to produce dairy products 	<ul style="list-style-type: none"> Price pressure on the dairy sector Increasing demand for dairy products
Farmers	<p>STRONG</p> <ul style="list-style-type: none"> Large investments in land, equipment and stables, debts for farmers, present location and size livestock production 	<p>MODERATE</p> <ul style="list-style-type: none"> Subsidies for example for agricultural nature conservation can be an incentive to change activities. Milk robots can create more flexibility for the farmer and make it possible to increase the number of cows in a stable.
Industry	<p>MODERATE</p> <ul style="list-style-type: none"> The dairy industry in the Netherlands is very stable. A large share of the production is processed by Friesland Campina, a cooperative of dairy farmers 	<p>STRONG</p> <ul style="list-style-type: none"> The industry encourages the farmers to keep cows outside (during summer) (weidemelk) Industry looks for new ways of selling dairy: for example ice cream, coffee products
Retailers	<p>STRONG</p> <ul style="list-style-type: none"> Demand for different types of dairy products will keep existing 	<p>MODERATE</p> <ul style="list-style-type: none"> Different innovative products with dairy in it are becoming available on the market (like desserts, coffees) Alternative for dairy products are becoming more widely available in supermarkets as well (e.g. soy, almond, coconut milk)
Consumers	<p>MODERATE</p> <ul style="list-style-type: none"> Dairy products are still an important part of Dutch diets; shift of consumption from straight milk to processed products (like desserts and coffees) 	<p>MODERATE</p> <ul style="list-style-type: none"> The demand for milk is increasing worldwide Alternatives for dairy are becoming more widely available
Policy-makers	<p>MODERATE</p> <ul style="list-style-type: none"> Subsidies for farmers are available for developing sustainable dairy housing systems. Until April 2015 the milk quota stated the maximum milk production in the Netherlands 	<p>MODERATE</p> <ul style="list-style-type: none"> Subsidies may decrease in the future. Dairy farming is an example of relatively extensive farming. Milk quota has disappeared in spring 2015. That could lead to an increase in milk production in the future.
Public debate and	MODERATE	WEAK

opinion	<ul style="list-style-type: none"> Cows in the meadow are an important image for the citizens and keep the landscape 'open' 	<ul style="list-style-type: none"> Animal husbandry is susceptible for a bad image because of living animals. The dairy sector has a good image (compared to more intensive ways of keeping animals)
Pressure from social movements, NGOs, scientists	<p>MODERATE</p> <ul style="list-style-type: none"> The cows in the meadow and animal welfare are an important point for social movements 	<p>MODERATE</p> <ul style="list-style-type: none"> On the one hand cows in the meadow are important for the Dutch landscape, on the other hand cows in the meadow are associated with emissions. The production of soy, an important part of the feed for cows, is under discussion. Different sustainability issues play a role here.
Overall assessment	<p>STRONG</p> <ul style="list-style-type: none"> The sector is relatively stable, because the large investments made in land, machinery and livestock. However changes can occur, but will be mainly within the dairy regime. 	<p>MODERATE</p> <ul style="list-style-type: none"> The dairy sector has a good image in the public debate and many actors would like to keep that. Dairy processors are asking for 'meadow milk'. Technologies like milking robots can increase production and create flexibility (to a certain extent) for the farmer The abandonment of the milk quota will probably have an impact on the dairy sector, but what the impact will be is not clear yet.

9.4. Vegetable farming regime

The vegetable sector consists of two production systems: open air production (around 90% of the area) and greenhouse cultivation. The sector involves a wide variety of technological innovations, such as precision farming, GPS trafficking and energy generating systems. However, investments are large, and competition with countries with lower land and labour prices makes it difficult for Dutch farmers.

The vegetable farming regime is strongly locked in and has moderate cracks and tensions.

Table 6 Conclusions about stability and tensions in the vegetable farming regime

	Lock-in, stabilising forces	Cracks, tensions, problems
External landscape pressures	<ul style="list-style-type: none"> Land will remain necessary to grow crops 	<ul style="list-style-type: none"> Increase of EU member states with cheaper labour and land Climate change and fluctuations in rainfall and temperature can influence the production of crops
Farmers	<p>STRONG</p> <ul style="list-style-type: none"> Large investments in land, greenhouses, machinery. 	<p>MODERATE</p> <ul style="list-style-type: none"> Farmers can usually switch to other crops, but that does have an impact as well There is a lot of competition from countries that can produce cheaper products Many greenhouses went out of business and started innovating alternatives

Industry/ supermarkets/ retailers	STRONG <ul style="list-style-type: none"> • A lot of power in hands of a limited number of actors leading to lower prices for products • Need a consistent quality, quantity and variety of products year round 	MODERATE <ul style="list-style-type: none"> • Increasing demand for seasonal, low carbon, local and quality products • Increasing demand for functional and bio-fortified food
Consumers	MODERATE <ul style="list-style-type: none"> • Prefer processed food, are ready to eat vegetables • Would like to have a variety of vegetables all year round 	WEAK <ul style="list-style-type: none"> • Increasing demand for organic products
Policy-makers	MODERATE <ul style="list-style-type: none"> • Promotion of knowledge intensive sectors • special arrangements for non-Netherlands farm labourers 	STRONG <ul style="list-style-type: none"> • Stop of subsidies on energy made glasshouse growers looking for innovative solutions, resulting in projects like the energy producing greenhouse.
Public debate and opinion	WEAK <ul style="list-style-type: none"> • The quality of Dutch products was point of discussion in the past (e.g. Wasserbomben tomatoes) 	WEAK <ul style="list-style-type: none"> • More public awareness created by opening up glasshouses
Overall assessment	STRONG <ul style="list-style-type: none"> • Large investments in machinery, land and greenhouses make that only certain changes in cultivated crop type can occur. 	MODERATE <ul style="list-style-type: none"> • The prices are under pressure, what makes people looking for alternatives. • The introduction of GPS and precision farming can increase production

9.5. Retail regime

The retail sector is changing a lot. The number of different supermarkets is decreasing, and market shares are increasing. However the attention for shortening value chains is increasing. This may be due to distrust in industry or retailers and because of food scandals. Besides, there is an increasing attention for authentic products, eating products in the right season and cooking.

Table 7 Conclusions about stability and tensions in the retail regime

	Lock-in, stabilising forces	Cracks, tensions, problems
External landscape pressures	<ul style="list-style-type: none"> • A couple of large supermarkets/retailers are dominating the food sales. • The competition among retailers is fierce: a price cut in one supermarket leads to a lower prices in other supermarkets as well 	<ul style="list-style-type: none"> • Opposition within a small group within society against the larger power of supermarkets (and food companies) had led to the emergence of types of supermarkets, with higher transparency and usually higher prices for farmers. A few shops are selling unpackaged food only.
Industry/ supermarkets/ retailers	STRONG <ul style="list-style-type: none"> • The food companies are discussing prices with retailers. As retailers sell the lion share of their products, the food companies are more or less dependent on the retailers. • Location of shops is not easy to change • Convenience and trust of consumers 	MODERATE <ul style="list-style-type: none"> • Competition on price keeps only the ones who can compete on price in the market (usually the big retail formulas)

Consumers	STRONG <ul style="list-style-type: none"> • Consumers buy most of their groceries in supermarkets. One-stop-shopping is easy for them. • The availability of products year round is important. 	MODERATE <ul style="list-style-type: none"> • Food scandals make consumers aware of risks in food. • The new types of supermarkets or way to buy food (e.g. vegetable boxes) are getting more attention
Public debate and opinion	WEAK <ul style="list-style-type: none"> • There is a debate on the role of supermarkets since the ‘war on prices’ in which supermarkets were competing a lot. 	WEAK <ul style="list-style-type: none"> • Scandals can change buying behaviour, although this may only be temporary.
Pressure from social movements, NGOs, scientists		STRONG <ul style="list-style-type: none"> • Social movements are accusing supermarkets of selling meat from production system with low animal welfare standards. They put pressure on the supermarkets to formulate demands on that issue. In some cases the policy of the supermarket did change
Overall assessment	STRONG <ul style="list-style-type: none"> • The market is competing and a couple of large retailers are dominating the market. 	MODERATE <ul style="list-style-type: none"> • Discussions on animal welfare are influencing the supermarkets. Furthermore in consortia they set targets for example for sustainable fish. The retail is changing, but as they have a large market share and only a couple of retailers are dominating the market it is hard to change.

9.6. Overall conclusion agro-food domain

Our analysis shows that most of the sub-systems and regimes are relatively stable. Due to high investments on the production side, as well consumers’ preferences on the consumption side, there are strong lock-ins. Therefore major breakthroughs of niche innovation, such as in-vitro meat culture on the production side, and a substantial switch to locally sourced food or vegetarianism on the consumption side are not be expected in the near future.

What we do see however, is that in agro-food many incremental changes occur, partly as a result of technological innovations, partly as a result of pressure from society. Due to incremental technological improvement in current production regimes, the production of plant and animal products is generally becoming more resource-efficient (in terms of land, water and energy use). Due to pressure from for example NGOs or the general public certain issues are put forward, leading to cracks in current regimes. In general this leads to adaptation of current regimes.

Examples are the increased concerns around animal welfare (leading to higher animal welfare standards), as well as around overfishing (leading to a higher market share of MSC or ASC certified fish). Another important development is the rise in MSC certified fish. Within the fisheries sector, this has led to a major shift in applied fishing methods, as from bottom trawling to pulse wing trawling.

Also on the consumption side incremental changes are generally favoured over niche innovations. For example experiments with hybrid meat do only have a limited influence on the main actors’ interests, but do lead to lower meat consumption. This example can be framed as an ‘in-between’ or hybrid solution. The minor changes that are occurring in the

agro-food domain can be seen as reconfiguration, and as we discussed in D2.1. most of the innovations belong to Pathway B.

The dominance of 'incremental' adaptations of incumbent regimes over niche innovation is linked with the nature of agro-food domain: other than for example in the electricity domain a complete shift (from fossil to renewable) it is not be expected in the agro-food sector: humankind will continue to depend on crop production based on the cultivation of crops on arable land and grasslands. Within current regimes important changes can however occur. Examples are the shift from battery cages to free range chicken, or in the past the introduction of pesticides and antibiotics. As it is argued in Chapter 2 of this report, the changes required to meet a number of environmental and other societal goals are profound, but are less drastic than in the energy domain: a reduction of greenhouse gas emissions from agriculture by around 25% is required (2050 relative to 2005). To meet the biodiversity target the management of probably 5-20% of the current agriculture area need to be different. In other aspects, the required changes are larger: in order to reduce to external effects of agriculture, nutrient losses have to be reduced significantly, while the use of pesticide and antibiotics have be reduced considerable.

Different domains are relatively stable and locked in, as there are mainly big companies involved with high stakes, therefore we can expect that the niche innovations described in D2.1. will mainly have some minor influences on the sector, but will not lead to a breakthrough. In the fish sector we do not see that one or a couple of companies dominate the market, while for example in meat or dairy that is the case. However, also minor changes can have an impact on the environment.

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Annex 1

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