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Country report 8: The Dutch agro-food domain

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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'). This report analyses the agro-food domain for the Netherlands, as the case study, for deliverable 2.3. ('Integrated analysis of D2.1 and D2.2 to assess the feasibility of different transition pathways').

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, Hungary) and empirical domains (electricity, heat, mobility, agro-food and land-use).

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Executive summary

The purpose of this document is to make an interpretive assessment of the feasibility of sustainability transitions pathways within the Dutch agro-food domain. This document builds on the analysis of niche innovations and of regime stability in the Dutch agro-food domain, as presented in Deliverables D2.1 and D2.2 respectively.

First the breakthrough feasibility of the various niche-innovations is assessed. The niche innovations in the Dutch agro-food domain we have studied are: MSC fish label, local food, organic food, flexitarianism, hybrid meat, cultured meat, algae for fish feed and dairy alternatives. Of every niche the internal momentum is assessed, based on techno-economic, socio-cognitive and governance elements. The niches under study are Pathway B innovations, except for cultured meat, hybrid meat and algae. The niches have a medium to very low momentum. The table below shows the breakthrough analysis of the niche innovations studied.

Table 1 Breakthrough analysis of niche-innovations in the agro-food domain in the Netherlands

Niche-innovation	Internal momentum	Strong, medium or weak alignment with broader regime characteristics and developments	Likelihood of imminent breakthrough (and/or future potential)	Pathway A or B
MSC fish label	medium	Strong	Is already becoming part of the existing regime	B
Dairy alternatives	Medium	Weak	Growing, but not about to break through	B
Algae for fish feed	Medium	Medium	Not likely to breakthrough	A
Flexitarianism	medium	Strong	Likely to breakthrough	B
Hybrid meat	Low	Medium	Not likely to breakthrough	A
Cultured meat	Very low	Weak	Not likely to breakthrough (very early phase of development)	A
Local food	Medium	Strong	Is growing and can break through (but is uncertain)	B
Organic food	Medium	medium	Very slowly growing, but not really about to breakthrough). Will become a stabilised niche next to the mainstream	B

The agro-food system consists of various, largely interlinked regimes, both at the production side and partly at the processing and retail side. At the production side, there

are regime as the dairy regime, the beef regime, the egg regime and crop regimes, such as various types of horticulture. At the consumers' end, there are regimes as the supermarkets regime, and the food service regimes.

Other than in the energy-related regime, a complete regime-shift is not very likely within the agro-food system. The current food production, based on extensive land use, and inputs such as water, marine resources, and minerals will not be replaced by a complete different system (as for example in the electricity sector where fossil fuels are expected to be replaced by renewable energy). Only more or less gradual adaptations are possible, as for example increasing crop yields (in a sustainable way), reducing or even halting the use of pesticides or a transformation to more multifunctional land use. Only a complete shift from partly meat and dairy based diets to a plant-based diet could be regarded as a 'true' transition. This transition would have large implications for land use within the EU.

The description of the related regimes and landscape elements shows what elements of the regimes are influenced by the niche innovation, and what the possibilities are that a niche will break through. The regimes in the agro-food domain are dairy, meat, fish and retail regimes. The regimes have a strong lock in, except for the fish regime. The cracks and tensions are moderate (see table below).

Table 2 Assessment of regime trends in the agro-food domain in the Netherlands (with indicative 'scores')

Regime	Lock-in, stabilizing forces	Cracks, tensions, problems in regime	Orientation towards environmental problems	Main socio-technical regime problems
Meat regime	Strong	Moderate	Moderate (some incremental change)	Has to do with habits that are hard to change. Large, long term investments
Fish regime	Moderate	Moderate	Moderate (some incremental change)	Discussion on the label system. Global character of the issue
Dairy regime	Strong	Moderate	Moderate (some incremental change)	Milk prices are under pressure
Retail regime	Strong	Moderate	Limited (BAU)	Some big players involved that are hard to change
Vegetable farming regime	Strong	Moderate	Moderate (some incremental change)	Reducing energy use, maintaining water quality and reducing the use of pesticides and over-use of minerals

Based on this analysis we can conclude that in the agro-food domain there are hardly niche innovations that are about to breakthrough at the moment. The niche innovations in Pathway A (Algae, Hybrid Meat and Cultured Meat) seem to be in the experimentation phase, and do not have a high momentum yet. While the niche innovations in Pathway B (MSC, Dairy alternatives, flexitarianism, local food and organic food) seem to create a growing momentum. These innovations address the issues rose in society and therefore can be able to break through or generate an increasing interest. One could argue that MSC is the niche innovation with the highest momentum, and did become a part of the stabilised regime. The sector has strong lock-in forces, for example the dependency on land, the high investments in buildings and machines, the cultural aspects in consumer behaviour, the huge role of the agro-food sector in the Dutch economy and the strong lobby. There are many interests at stake, what makes discussions on substantial changes often very hard.

There is no transition unfolding yet in the agro-food domain. In the agro-food domain we can argue that 'radical incrementalism' is occurring, meaning that change is occurring, but only in small steps, such as improvement of production efficiency. This is mainly because the agro-food sector is organised in a complex chain from production to consumption with many actors in between. For example increase in production efficiency, reduction of manure application, reduction of pesticides use. It seems that niche innovations do only have a minor effect on land use, greenhouse gas emissions and biodiversity, but in the agro-food sector a small step is already an improvement.

1. Introduction

The goal of this report is to assess the possibility that niche innovations in the Dutch agro-food sector will break through. In order to be able to address that question, first the momentum of various niche innovations will be assessed and the possibilities for niche innovations to take advantage of the windows of opportunity provided by the regime problems. Furthermore we will assess to what degree, existing regimes are beginning to reorient themselves to address the focal environmental problems.

The main challenges in the Dutch agro-food domain are reduction of greenhouse gasses and land use, stopping the decrease of biodiversity, producing enough food for reasonable prices for consumers and generate a reasonable income for farmers.

In the PATHWAYS project three pathways are distinguished (see table below).

Table 3 Pathways

	Pathway 0: Business as Usual	Pathway A: Technical component substitution	Pathway B: Broader regime transformation
Departure from existing system performance	Minor (no transition)	Substantial	Substantial
Lead actors	Incumbent actors (often established industry and policy actors)	Incumbent actors (often established industry and policy actors)	New entrants, including new firms, social movements, civil society actors.
Depth of change	Incremental change	Radical technical change (substitution), but leaving other system elements mostly intact	Radical transformative change in entire system
Scope of change	Dynamic stability across multiple dimensions	1-2 dimensions	Multi-dimensional change
Focus of transformation		Focus on replacing technologies and management types by better ones with the same function.	Technological changes are combined with wider behavioural and cultural changes.

The agro-food domain is quite different from other domains studied in Pathways in two important ways:

1. In the agro-food regime, there are many challenges in order to address simultaneously: human health (related to food consumption patterns), reducing greenhouse gas emissions, as well as biodiversity loss (both within and outside the EU). Loss of biodiversity is related to land management, nutrient losses (nitrate, ammonia, phosphorus) and pesticides.
2. A complete regime shift in the form of a niche development replacing the current, land-based food production is not likely. The most drastic change theoretically

foreseeable is the replacement of the meat and dairy sector, which could happen in two ways: either because of consumption preferences changes; or because of technological replacement of meat by cultured meat.

Other than in the energy-related regime, a complete regime-shift is not very likely within the agro-food system. The current food production, based on extensive land use, and inputs such as water, marine resources, and minerals will not be replaced by a complete different system (as for example in the electricity sector where fossil fuels are expected to be replaced by renewable energy). Only more or less 'incremental' adaptations are possible, as for example increasing crop yields (in a sustainable way), reducing or even halting the use of pesticides or a transformation to more multifunctional land use. Only a complete shift from partly meat and dairy based diets to a plant-based diet could be regarded as a 'true' transition in terms of a niche gradually replacing a whole regime. This transition would be large implications for land use within the EU.

This means that the transition from the current, unsustainable food system to a more sustainable food system will probably consist of the combination of adaptation of the current regimes with a number of niche innovations. There is no 'silver bullet'.

The niche innovations, MSC, local food, organic food, flexitarianism and dairy alternatives are mainly oriented towards pathway B. These innovations are mainly on transforming behaviour and are dependent on wider societal change. These innovations are mainly step-by-step moving in a certain direction and are less obvious creating a 'turn'/change towards lowering GHG emissions and land use. Cultured meat, hybrid meat and algae (used as fish feed) are more technically oriented innovations and belong more to Pathway A. Once these innovations become more efficient, they could lead to a systems change leading to a change in impact on land use and GHG emissions. But we want to stress that the wider behavioural and cultural changes are necessary to make these innovations more prominent.

The niches described in this report are not overarching the whole agro-food domain. This is mainly because the agro-food sector is a sector with many different elements and many different products. Innovations in the agro-food domain vary from the innovations on the production side, processing, distribution, to the consumption side and between the different subsectors, such as horticulture, animal husbandry, glasshouse horticulture, fishing, aquaculture and arable farming. Therefore, the niches described in this study will only involve changes in some parts of the domain. However, it can be expected that changes will occur in the regimes.

The reduction of greenhouse gasses and land use that can be reached in the agro-food domain is limited: a zero-emission food system is very difficult to achieve. . Transitions in the agro-food sector are considered to be stepwise processes and many add-on innovations are developed (Berkers & Geels, 2011) and investments are spread by piecemeal engineering of farming technologies (Driessen, 2012).

The question we address in this report is: Is there a possibility that niche innovations in the Dutch agro-food domain will lead to a breakthrough and reorientation of the existing regimes? Or is it more likely that existing regimes will adapt?

In order to study this, four different phases in transitions can be distinguished (Geels, 2006):

1. **Predevelopment:** This phase is characterised by R&D support, subsidized small market niches. Novelties emerge in niches. There is not yet a dominant design and different options may compete with each other. There is not yet a match with the existing regime what makes it not easy for niche innovations to breakthrough.
2. **Early market niches:** In this phase the novelty is used in small market niches that may (still) benefit from subsidies and policy support. A community of dedicated people starts to emerge and activities are deployed to improve the niche innovation.
3. **Breakthrough, wider diffusion, and self-sustaining momentum:** In this phase the innovation is breaking through and gets more widely diffused. Both the internal drivers of the niche and the external circumstances at the regime and landscape level creating 'windows of opportunity' make it possible for niches to break through.
4. **Stabilization of new system:** When the innovation enters the mainstream market, and begins to replace the old regime, a new system stabilizes. This may be accompanied by wider changes in the regime and landscape developments.

The structure of the report is as follows. In chapter 2 for every niche innovation, or in case more niche innovations are related to one regime a group of niche innovations, there will follow an assessment of the breakthrough feasibility of the niches. In order to be able to assess the possibility that a niches will lead to a breakthrough we will first discuss the internal momentum of each niche innovation. The next step is to asses to what extent the niche innovation aligns with the wider regime and landscape developments. For every niche we will conclude with a section on the possibility that the niche innovation will break through more widely. Section 3 will assess the dominant regime trends and assess to what extent e regime reorientation is or will occur. In chapter 4 we will conclude with an assessment of the niche innovations that will break through and a suggestion of which transition pathway (A or B) will be unfolding. In the wider discussion we will discuss the scale of the transition challenge, the importance of actors and concrete plans in the sector.

2. Assessment of breakthrough feasibility of the various niche-innovations

In this chapter, we will discuss the feasibility that the studied niche innovations will break through. This chapter is based on D2.1. Dutch niche innovations in the Agro-food domain (Zwartkruis, Westhoek, & Kok, 2014). In order to be able to assess that, we will first describe the internal momentum of the niche innovation; second we will describe how the niche innovation aligns or conflicts with the wider regime and landscape developments; and third, we will discuss the extent to which a niche innovation is about to break through more widely or not and if not what is holding it back.

2.1. Marine Stewardship Council label for fish

The Marine Stewardship Council (MSC) label for sustainable fish is a pathway B niche innovation, as it is heading towards a broader regime transformation in which new entrants are involved, including social movements, and the focus is not only on technological, but on wider behavioural and cultural changes.

2.1.1. Internal momentum

Techno-economic factors

The market share of MSC labelled fish is growing, since the label was introduced in 2002. Around 85% of the wild fish catch in Dutch supermarkets is MSC certified or comparable in 2011¹ (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). In 2014 the consumption of sustainable fish (with MSC label) has decreased with 4% as a result of the decrease in the expenditures on meat and fish in general and the fact that there is less MSC fish caught as a result of sustainable control measures. Despite the recent decline, the market share of sustainable fish is with 21% still large (LEI, 2015). The services and catering are lagging behind and the amount of sustainable fish² used in foodservices is even declining (Stichting De Noordzee, 2014).

Socio-cognitive factors

There is much attention by large players for the MSC label. Many retailers in the Netherlands have set specific goals regarding their fish assortment, for example that they only sell sustainably sourced fish. However, the label is contested as well. Opinions differ on the extent to which the certification scheme is helping to save biodiversity (Beukers & Harms, 2012) and as certification is expensive, there is competition between large and small fisheries. However, research showed a minor positive influence of MSC on the protection of certified fish populations (Cambridge et al., 2011; PBL, 2013c). The public attention for sustainable fish seems to increase. By means such as the VISWijzer and the Sustainable fish week NGOs try to increase public awareness.

¹ This includes only fresh fish or frozen fish of the homebrand, so-called A brands are not taken into account (Van Oorschot, 2014).

² Sustainable is not necessarily the same as the MSC label

Governance and policy factors

The government did take parts of MSC regulation as a basis for their regulation. That is a new development. However, the governments' regulation is mainly focused on production and not so much on consumption of fish. That has to do with the idea that the government does not want to make policy on diets. The government is however acting as a launching customer, by buying products according to sustainability standards.

The momentum of the MSC label can be assessed as medium. The amount of MSC labelled fish has increased rapidly the last decade and the regulations are even taken up in current policy on wild fish. However, for smaller fisheries it is hard to get an MSC label, because it is expensive.

2.1.2. Alignment with the wider regime and landscape developments

The MSC label is influenced by and influencing the fish regime. The fish regime has a weak lock in, because the sector has no strong lobby and many actors are aware of the fact that something needs to be done. The cracks and tensions are moderate as the decreasing fish population asks for an urgent solution to overfishing. Furthermore the public awareness on sustainable fishing is growing. This results in new windows of opportunity with more positive, widespread public debates on fish. However investments in the sector need to be made by the fisheries themselves, what is hard to organize for many of them, as they are relatively small. The MSC label is trying to address the issues regarding marine biodiversity.

2.1.3. Potential for a breakthrough

The difficulty with the Dutch fish sector is that much of the fish catch in the Netherlands is exported, while the fish consumed in the Netherlands is imported. That makes that the production (or catch) is decoupled from the consumption. However, the concern regarding the decreasing fish population is present in many countries, what makes that there is a momentum for new ways of sustainable fishing.

The MSC fish label is a niche innovation that has already been growing and has a prominent role in the fish sector. This innovation is in between the third phase (breakthrough) and the fourth phase of transition (stabilization of a new system). The MSC label is becoming the basis for many fish products in the Dutch supermarkets. The label for aquaculture, ASC, is increasing in popularity as well, but is less developed yet.

2.2. Algae as alternative for fish feed

A niche that differs from the MSC label, but is related to the fish regime is the algae production for fish feed. This niche has to do with the production of fish in aquaculture. This means that the algae niche innovation is influenced by the fish regime in a different way.

2.2.1. Internal momentum

Techno-economic factors

Fish in farms (aquaculture) needs a substantial amount of feed to grow, but there is a downward trend in the percentage of fishmeal and fish oil used in compound feed. This is mainly achieved by more accurately measured amounts of feed and by using more fish

waste or by-catch as well as more vegetable material. Between 1995 and 2007 the amount of forage fish needed per kilogram of farmed fish has been reduced from 60% to 35% in 2008, and may even be further reduced. The global average of forage fish needed per kilogram farmed fish is well below 1 kg. That is partly because of a high percentage of herbivorous and omnivorous species (Westhoek et al., 2011).

Using algae to feed fish as an alternative to feed fish has an influence on biodiversity and GHG emissions. The use of algae decreases the GHG emissions compared to fish catch. Producing and drying algae costs results in less CO₂ emissions than the energy use of ships. Producing algae is more labour intensive and therefore results in a positive effect on employment (MNP, 2006).

Socio-cognitive factors

In case it will become economically feasible the fish feed companies can play a major role in introducing it in the production chain.

Governance and policy factors

The government is together with businesses investing in research on algae production. However research is focusing on different applications of algae (e.g. energy production).

The momentum for algae production for fish feed is medium. It is technically possible to produce algae for fish feed, but the production process is still very costly. Algae for fish feed are a pathway A innovation.

2.2.2. Alignment of niche-innovation with wider regime and landscape developments

Algae as alternative for fish feed, are hardly discussed in society. It is mainly within the sector that this option is discussed. But what is widely discussed is the decrease of marine biodiversity as a result of overfishing. Algae as an alternative for fish feed can be a solution to this problem and therefore could address environmental problems.

2.2.3. Possibility to break through

The algae as alternative for fish feed is an innovation in the second phase of transition; early market niches. It is technologically possible to use algae for fish feed, but it is not yet applied on a large scale because of the high costs. There is no clear possibility that the niche innovation will break through on the short run.

2.3. Dairy alternatives/soy drinks

Dairy production has a significant influence on land use and greenhouse gas emissions. The Dutch consumption of dairy products (cheese equivalents) was around 45 kg per person per year in 2010 (PBL, 2013a). Alternatives for dairy, especially milk, are widely available. Alternatives for milk are for example based on soy, almonds, rice, oat or coconut.

2.3.1. Internal momentum of niche innovation

Techno-economic factors

Although the total market of soy products in Netherlands is small, it has been growing. In 2007, around 17 million litres of soy drinks were sold in the Netherlands. Alpro Soya,

the leader in the market, realized a growth of 22 percent every year until 2007. The consumption of soy drinks in Germany, France and Belgium is higher than in the Netherlands. In Belgium the consumption is 4 litres soymilk per year per person and in the Netherlands it was 1 litre per person per year (in 2007). Soy drinks are often chosen because of the potential health effect (Distrifood, 2007). The market for dairy alternatives is small, but increasing. That is mainly because the demand is increasing.

Socio-cognitive factors

The most important reasons for consumers to shift from dairy to alternatives are milk allergy, lactose intolerance, perceived health benefits, and in a limited number of cases environmental concerns. Products are regarded as milk substitutions and are becoming more widely available (in supermarkets). Dairy alternatives, like soy drink, coconut drink and almond drink are slightly more expensive than dairy products, however according to some these products are healthier. The change from dairy products to alternatives is a change of habit that is often hard to realize.

Governance and policy factors

There is no specific policy support for promoting dairy products.

The dairy alternatives form a pathway B innovation, because it is mainly about changing diets and only a bit on new technologies. The internal momentum of the niche innovation dairy alternatives/soy drinks is medium.

2.3.2. Alignment of niche-innovation with wider regime and landscape developments

Dairy alternatives are mainly influenced by and influencing the dairy regime. The dairy regime has a strong lock in and moderate cracks and tensions. The dairy regime is stable, because the large investments made in land, machinery and livestock. However, changes in farm management do occur. The sector has a good image in the public debate and many actors would like to maintain that. Therefore the largest Dutch dairy processor has introduced 'meadow milk' in their assortment. Technologies like milking robots can increase the production and create some flexibility for the farmer. The factor that is most likely to cause changes in the regime is the abandonment of the milk quota in April 2015. This led to an increase of the speed with which the dairy sector is growing (van Grinsven, 2015). The amount of manure seems to increase and the milk prices are fluctuating, leading to more uncertainty for dairy farmers. However, the niche innovation is mainly on the consumption side. As the regime is still fairly stable, there are not much windows of opportunities for the niche innovation.

2.3.3. The possibility of a breakthrough

The medium momentum of the niche dairy alternatives and the relatively stable dairy regime make that it is not very likely that dairy alternatives will break through more widely. This niche innovation is mainly held back because the internal momentum is low. As habits and culture are hard to change, and Dutch citizens are consuming a lot of dairy products, it is not expected that they will completely substitute their dairy products by for example soy. The dairy sector itself is locked in, but that has mainly to do with the production side, while the dairy alternatives could cause changes at the consumption side.

The niche 'dairy alternatives' is a niche innovation in the second phase of transitions: an early niche market. The consumption of dairy alternatives is small, but growing. However it can not be expected that dairy alternative will take over the market and compete with dairy products. It is more likely it will remain a niche.

2.4. Flexitarianism

Flexitarianism became a more popular term as a result of the campaign of “Natuur & Milieu” (“Nature and Environment”) called “Flexitarians”. The campaign was focussing on people that consciously or unconsciously consume less meat, so called “flexitarians”. The campaign mainly focusses on providing healthy and tasty alternatives for meat to consumers (Natuur en Milieu, 2014).

2.4.1. Internal momentum of niche innovations

Techno-economic factors

As the figure below shows, the total amount of meat consumed in the Netherlands was slightly increasing since the 1980s and did recently stabilise more or less.

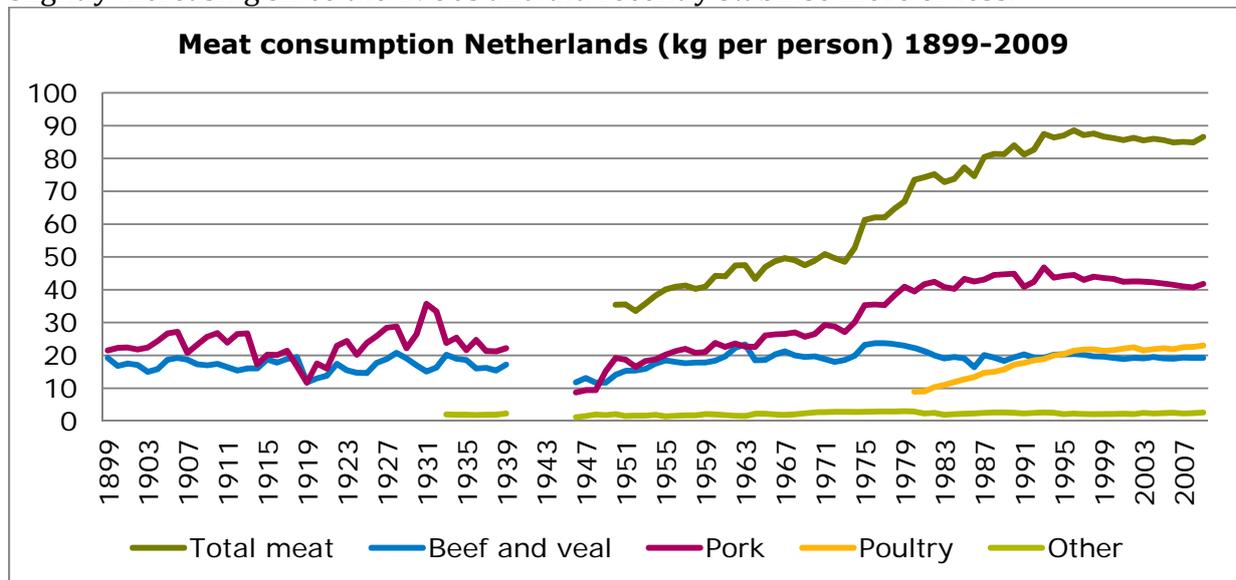


Figure 1 Meat consumption in the Netherlands (data from 1940-1945 are missing) CBS (2010a)

The number of flexitarians is growing in the Netherlands, meaning that more people are eating at least once a week no meat. The exact numbers on the amount of flexitarians differ) because of differences in the definition’, but research from Motivaction states that around 55% of the Dutch citizens does not eat meat with their main dish for at least 3 days a week’ (Keuchenius & Van der Lelij, 2015).

Socio-cognitive factors

Different reasons can be defined for this growth. First of all there can be economic reasons for decreasing meat consumption. There were campaigns by for example Nature and Environment (Natuur en Milieu) promoting flexitarianism and ‘Meatless Mondays’. However, this type of changes is hard to realize, as it is on behaviour and culture.

Governance and policy factors

The institutional environment is hard to change, as there are high stakes of parties involved. Furthermore from a political point of view it is hard to influence the meat consumption and production. On the one hand the government doesn't want to be involved in menu choices of citizens and on the other hand the meat regime has a large role in the Netherlands.

The momentum is medium. Flexitarianism is a social innovation that is mainly influenced by behaviour and/or culture, what makes it a pathway B innovation.

2.4.2. Alignment with broader regime characteristics and developments

The meat regime has a strong lock in. It is a very stable market and many huge players are involved. Meat consumption has many cultural aspects and is therefore hard to change. However, it seems that the meat consumption in the Netherlands is decreasing. There are moderate cracks and tensions in the meat regime as well. The pressure is mainly caused by society and NGOs. Issues related to animal welfare, animal diseases and recently health impacts of meat in a diet can possibly effect meat consumption in the future. The widespread public debates can create windows of opportunity for eating less meat. Very recent (November 2015) the World Health Organisation published a research in which (processed) meat consumption was discussed. An event like that creates possibilities for a niche like flexitarianism to break through.

2.4.3. Likely to breakthrough: second phase of innovation

Flexitarianism mainly has to do with consumer behaviour while cultured meat and hybrid meat do include many technological issues as well. A change in diet can probably be expected sooner than production of cultured meat on a large scale. A change in diet is however hard to realize, but there is a change in eating habits in the Netherlands. Were in the past a traditional meal consisted of 'potatoes, meat and vegetables' more recently the introduction of rice and pasta made it easier to leave out the meat.

Flexitarianism is able to connect to the discussions on meat consumptions. Based on this analysis we can state that flexitarianism is in the third phase of transition; the break through and wider diffusion. The internal drivers of the niche do meet the external circumstances in the regimes as well. The reason that flexitarianism could potentially break through is mainly because it does not involve a drastic change of a diet, but it is a scenario in which people do eat meat, but less. That is something which is relatively easy for consumers to apply.

2.5. Hybrid meat

Another way to reduce the amount of meat consumed is substituting meat by hybrid meat: meat combined with vegetable fibres, such as textured rice fibres, soy, wheat or lupine. People do not have to change their diet, but will consume less meat, with (according to the producers) less impact on the environment and health.

2.5.1. Internal momentum

Techno-economic factors

The commercial developments of hybrid meat started in 2006 and the technology is still developing. Although there are some hybrid products on the market, the market share is still limited. The main companies involved in the first developments on hybrid meat were: Meatless, VION and Albert Heijn (selling hybrid meat developed by the Hilton Food Group), Hulshof and Dalco. The production costs are still high, while R&D investments are decreasing.

Socio-cognitive factors

Marketing barriers do still exist. The name 'hybrid' is difficult to understand and often associated with manipulation. That has a negative connotation. There are only a couple of actors on the market. Hybrid meat is produced by new entrants and existing companies. Especially the health and environmental impacts can make hybrid meat interesting enough to become more widely available.

Governance and policy factors

Policy is providing minor support, mainly via supporting research and development with SBIR subsidies (Small Business Innovation Research).

Hybrid meat is a Pathway A niche innovation, as it is mainly a change of technology to produce meat with vegetable fibres. There are Pathway B elements involved as well, as the consumer in the end does have to choose for the product, however at the moment there is a lot of attention for the product development of hybrid meat. The momentum of hybrid meat is low.

2.5.2. Alignment with the broader regime characteristics and developments

Hybrid meat is an alternative for meat and is thereby trying to provide a solution to the large impact of meat on the environment. However, as these innovations are not yet fully developed, they are not yet aligned with the wider regime and landscape developments. There is only a medium alignment.

2.5.3. Potential to break through

Hybrid meat is in the second phase of transition as it is still an early market niche. The number of hybrid meat products is growing, but it is still a small niche.

2.6. Cultured meat

Cultured meat, or in vitro meat, is produced based on cultured muscle cells derived from stem cells of farm animal species. The idea is to make edible products from skeletal muscle cells, cultured from stem cells, outside the animal, in a bioreactor.

2.6.1. Internal momentum

Techno-economic factors

Cultured meat is seen as a solution to tackling problems with land use, greenhouse gasses and energy use. Cultured meat can be viewed as radical innovation for which the whole system needs to change. If cultured meat is becoming widely available, that means that animals are no longer necessary for meat production. That results in a different system (Overbeek & Dagevos, 2013). But so far, it is not available on the market.

Socio-cognitive factors

The opinion of consumers on cultured meat differs and cultured meat is both framed as 'solution to industrialised animal production' and 'modifying food'. There is a need for increased research on both technical issues and consumers opinions related to cultured meat.

Governance and policy factors

The government is involved by subsidizing research and can in the future play a role in knowledge development.

Cultured meat has a very low momentum. For cultured meat the main challenge is in the technological possibilities, what makes it a Pathway A innovation. It is still very expensive to produce cultured meat and there are many technical difficulties in production, especially on a large scale.

2.6.2. Alignment of niche-innovation with wider regime and landscape developments

Cultured meat is one of the alternatives for meat and is thereby trying to provide a solution to the large impact of meat on the environment. However, as this innovation is not yet fully developed, they are not yet aligned with the wider regime and landscape developments. The potential of cultured meat is that it can be a solution to land use issues, greenhouse gas emissions, energy and water use associated with animal production. However, so far still animal tissue is needed to produce cultured meat.

2.6.3. Potential to break through

Cultured meat is in the first phase of a transition; in the predevelopment phase. The innovation is in its experimental phase and it is not possible yet to produce cultured meat on a large scale, or even more important for a reasonable price.

2.7. Local and regional food

There are many definitions of regional and local products. In this study we are focussing on products sold in the same region as they are produced. A lot of initiatives exist in the Netherlands, varying from products sold at a farm to products from a specific region sold in the supermarket.

2.7.1. Internal momentum of niche innovations

Techno-economic factors

Since the 1990s there is more attention for so called 'authentic' products in the Netherlands: more people would like to know where and how products are produced (De Bakker et al., 2013). On the one hand there is a trend towards more efficiency, and on the other hand there is a trend towards social sustainability and authenticity. The trend towards authenticity can be linked to locally produced food, of which people know where it is produced. One related trend is the trend towards locally sold products, in which the consumer buys products in the region they are produced, for example at a farm or at a local (specialty) shop. The number of initiatives and market share is increasing, so is the potential number of consumers.

Socio-cognitive factors

The attention for authenticity of food is increasing. However, local/regional food is not available for everyone as financial and social costs are involved. Consumers are used to a wide availability of products and that is often an issue with regional products.

Governance and policy factors

Local/regional food is built on opposing the dominant system and therefore it will not be easily mainstreamed as there will be different types of logistics and availability issues. The government can only play a role by acting as a launching customer.

The momentum of local and regional food is medium. This is a Pathway B innovation, as it is mainly about new organisation structures.

2.7.2. Alignment with broader regime characteristics and developments

The retail regime has a strong lock in. The market is competing mainly on price and a couple of large retailers are dominating the market. The number of different retailers is declining as a result of fusions. However it seems that society is having an impact on the retail regime as well, leading to moderate cracks and tensions. For example the discussion on animal welfare raised by NGOs did influence choices made by the supermarkets on the meat they sell. Furthermore in consortia targets are set on sustainable fish or sustainable meat. Windows of opportunity are created for sustainable initiatives to become more widely spread. Local food has a good image. There are however local products produced on a large scale (e.g. apples) and typical local products.

2.7.3. Potential to break through

The possibility that niche innovations in the retail sector will break through is moderate. It can be expected that for example organic food and local food will remain niches and will not become mainstream, but their market shares seem to grow. The consumer expenditures on sustainable food in the Netherlands have grown in 2014 with 18% compared to 2013. The market share of sustainable food in comparison with the total food market share has grown from 6% (in 2013) to 7% (in 2014) (LEI, 2015). Interestingly, this is growth in market share is mainly due to choices made by retailers to for example only sell products with a certain label (UTZ certified, MSC fish, 1 star better life label for meat). So it is choice editing instead of a conscious choice by the consumer. In many cases the retailers decide to only sell products with a certain label after pressure by NGOs and society.

The niche local food is in between the second phase (the early market niche). Dedicated people are directing activities to improve the further developments. As the networks of people selling local food are growing and the number of initiatives (local food boxes, local products in supermarkets) as well, the innovation is already heading towards the breakthrough phase.

2.8. Organic food

Organic food is “food produced using environmentally and animal friendly farming methods on organic farms. These methods are legally defined and any food sold as 'organic' must be strictly regulated” (Soil Association, 2014). According to the IFOAM

(International Federation of Organic Agricultural Movements)(2009) organic agriculture is based on the following principles:

- The principle of health
- The principle of ecology
- The principle of fairness
- The principle of care

In EC regulations (EC, 1991, 1999) organic agriculture has been further specified, and it has become more or less standardized for all EU countries. Only products certified as organic and with a label, are allowed to be called organic (Smit, 2011).

2.8.1. Internal momentum of niche innovation

Techno-economic factors

Organic food production has developed from marginal alternative methods of producing food into a dominant model for producing and consuming 'natural and sustainable' food within 30 years. However, despite this development into a popular range of products and solid organization, organic food is still only a minor percentage of food sales in Western Europe (Oosterveer & Spaargaren, 2012).

The Dutch consumers spend 984.2 million euros on organic food in 2013 (in supermarkets, specialty shops and markets). That is a market share of 2,4% of the total market (LEI Wageningen UR, 2014). The amount of land used for organic farming in the Netherlands is low compared to other European Countries. The amount of organic agriculture as a percentage of the total amount of agricultural land was in 2007 around 2%.

Socio-cognitive factors

Organic food was gaining appeal as result of a number of tensions in the mainstream /conventional food regime such as harm from pesticides in the 1960s (Carson, 1962); factory farming of animals (Harrison, 1964), industrial processing of foodstuffs (TACC, 1974) and degradation of rural landscape. Furthermore concerns related to pesticide residues in vegetables, food contamination, BSE crisis, foot and mouth disease, food miles, loss of farm biodiversity and concerns about genetic modification (GM) did influence the organic food production. Besides actors in the regime taking action on these concerns, these tensions also provided opportunities for organic food. Because organic food was presented as free of these contaminations and side effects, its appeal was boosted (Smith, 2006).

Governance and policy factors

The number of organic farms is however increasing, but the reasons for farmers to become organic are changing. Instead of only idealistic reasons, the higher value of organic products can also be a reason for farmers to become organic. The government did set goals and provided payments for farmers converting towards organic farming. However, goals were not reached.

The momentum of organic food is medium. This is a Pathway B innovation as well. It is remarkable that in a saturated food market organic food consumption was growing last 10-15 years, although the market share is still marginal (2,4%) and relatively stable, even though organic products are already sold for years.

2.8.2. Alignment with broader regime characteristics and developments

The organic food sector is aligning with discussions in the retail regime on sustainability of food. Organic food is becoming more widely available and some retailers choose to only sell an organic version of a certain product. The retail regime has however a strong lock in. The market is competing mainly on price and a couple of large retailers are dominating the market. Windows of opportunity are created for sustainable initiatives to become more widely spread.

2.8.3. Potential to break through

Organic food is in the second phase (early market niche). However, it doesn't seem that organic food will increase and lead to a new system. Organic food started as a movement against existing food chains and will probably remain a movement separate from the mainstream and at the same time a business opportunity for conventional farms.. The question is whether it has to intention to become the mainstream.

3. Assessment of regime reorientation

The agro-food system consists of various, largely interlinked regimes, both at the production side and partly at the processing and retail side. At the production side, there are regime as the dairy regime, the beef regime, the egg regime and crop regimes, such as various types of horticulture. At the consumers' end, there are regimes as the supermarkets regime, and the food service regimes.

Below we will describe the main developments in the five main regimes in the agro-food sector: the meat regime, dairy regime, fish regime, vegetable growing regime and the retail regime. This chapter is based on D2.2. Analysis of stability and tensions in incumbent socio-technical regimes: Regime analysis of the Dutch agro-food domain (Zwartkruis, Westhoek, & Kok, 2015).

3.1. The meat regime

3.1.1. Summary of regime developments: lock-in, stabilizing forces, cracks and tensions in the regime

Between 1995 and 2015, there are three dominant developments: a strong increase in farm size (together with specialization); more attention for animal welfare; and increasing attention for environmental impacts. Mainly due to environmental regulation (regarding minerals and manure) changes in the animal husbandry sector occurred. The meat regime in itself actually consists of a number of sub-regimes, of which the most dominant sub-regimes are: pork, poultry, and beef/veal. The pork and poultry sub-regimes 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). In deliverable 2.2 (Zwartkruis et al., 2015) the different subsectors are described in detail. In this report we will only focus on the characteristics of the overall meat regime.

The pork sector is 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 was 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%.

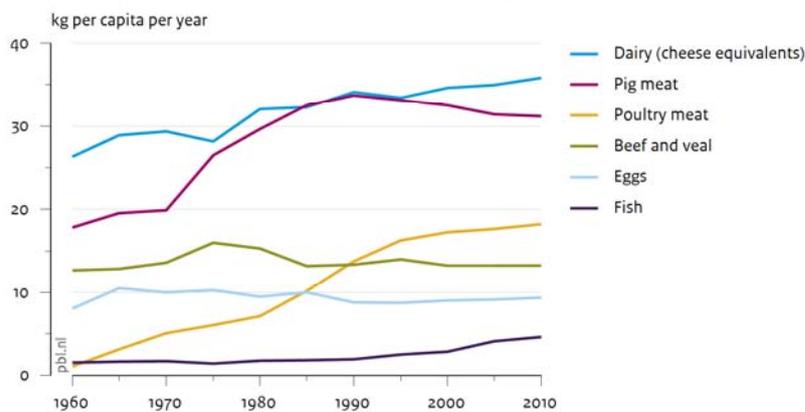
The results of the poultry sector did decline. The revenues of chickens did increase, but as feed, energy and chicks did increase much more, the results did decline (Productschap Pluimvee & Eieren & Productschap Vee & Vlees, 2013).

The Netherlands is producing beef on a limited scale and most of the beef is from milking cows. 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, van Beukering, & Aiking, 2010). 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).

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 kg³ (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).

Consumption in the Netherlands of animal products per capita



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

Figure 2 Consumption of animal products (PBL, 2013b)

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 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).

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.

³ This is the weight including bones. The consumption (what people actually eat) is around 50% of this weight.

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, Kool, & Luske, 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 21th 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.

The meat regime has a strong lock in and moderate cracks and tensions. The sector is strongly organised. However, societal debates on animal welfare and meat consumption in general could cause cracks and tensions in the future.

3.1.2. Scale of transition challenge and orientation towards environmental problems

The production of meat (or protein products in general) is associated with high land use and greenhouse gas emissions, what makes that the sector has a high environmental impact (see Figure 3 and Figure 4). 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. Organic chickens do need more feed, as they live longer. 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, 2015a).

Deliverable 2.3 Integrated analysis of the agro-food domain in the Netherlands

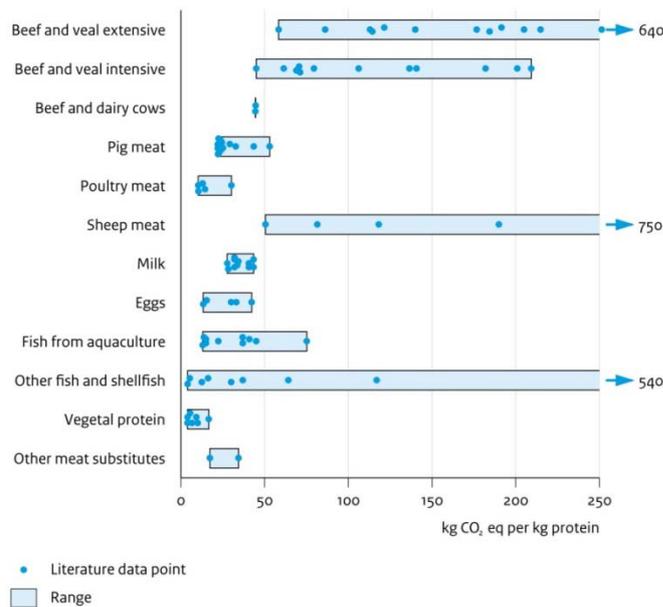


Figure 3 Greenhouse gas emissions per protein source. (Nijdam, Rood, & Westhoek, 2012; Westhoek et al., 2011)

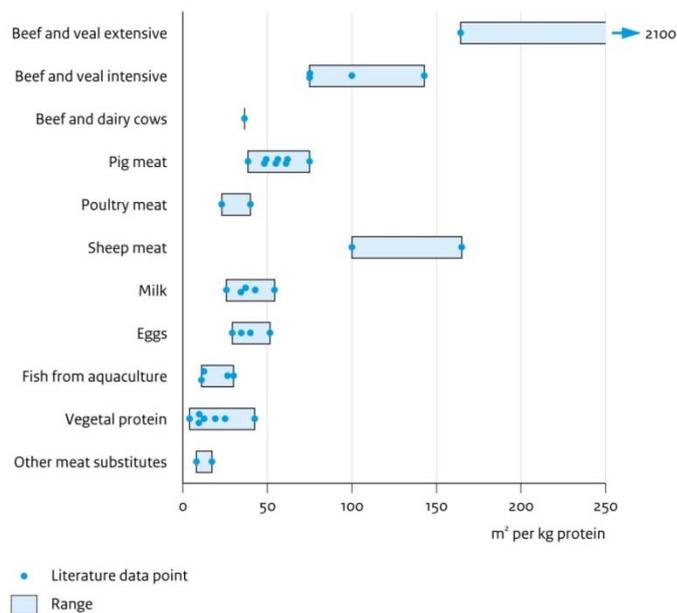


Figure 4 Land use per protein source. Source: (Nijdam et al., 2012; Westhoek et al., 2011).

3.1.3. Main socio-technical challenges

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, te Riele, & Rotmans, 2008).

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

3.2. The fish regime

3.2.1. Summary of regime developments: lock-in, stabilizing forces, cracks and tensions in the regime

The fish sector involved not only production but also supply, processing and distribution of fish. In the 1980s the understanding came that the fish population was decreasing rapidly (NRLO, 1998). 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 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 are 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 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, 2015c).

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

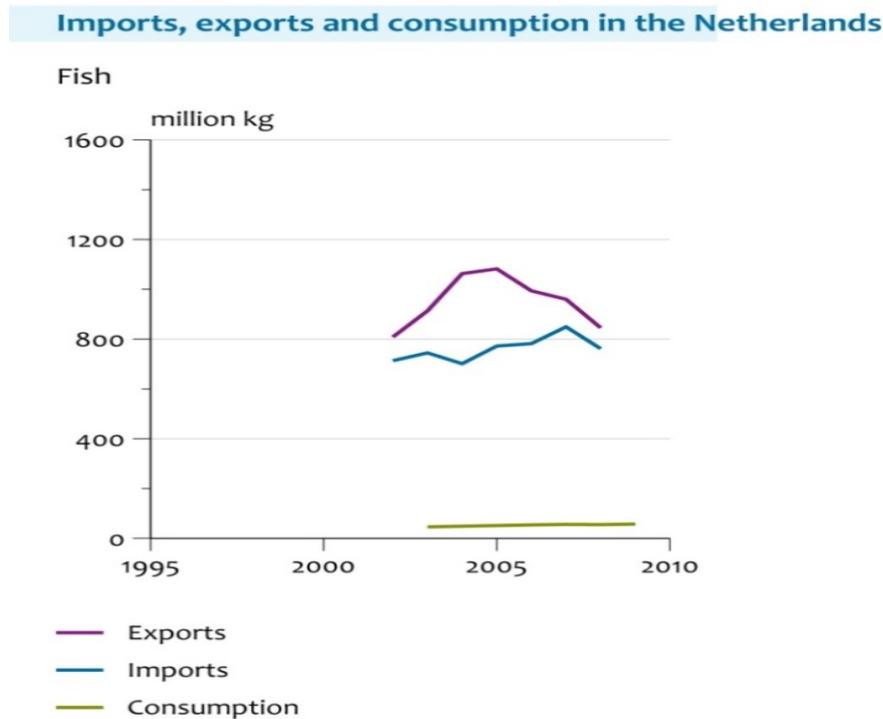
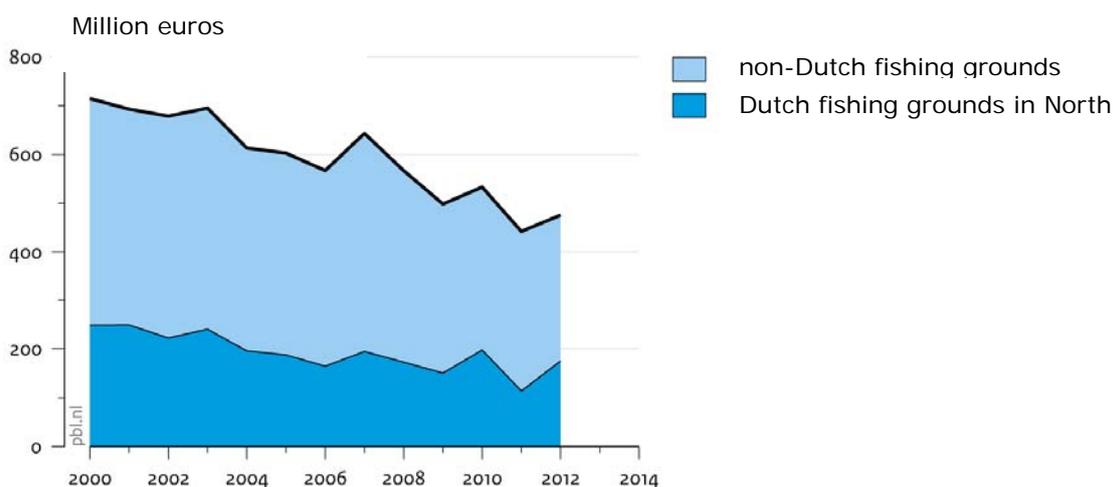


Figure 5 Import, export and consumption of fish in the Netherlands (PBL, 2011)



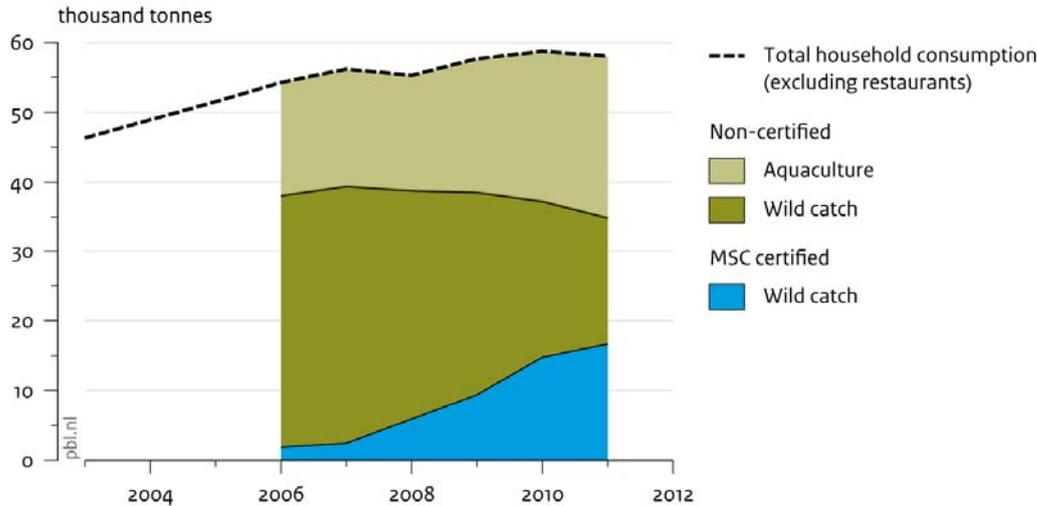
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Figure 6 The yields of the Dutch fishery sector from 2000-2012 in million euros (CBS, 2015c)

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, 2015b).

Dutch consumption of fish



Source: MSC International, 2012

Figure 7 Dutch consumption of fish (Van Oorschot, 2014)

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 setting targets for the amount of sustainable fish sold in the supermarkets (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. 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 7). 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 (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 (Witteveen+Bos, 2009).

- NGOs, social movements: WWF (was involved in MSC). The 'Viswijzer' was a tool to make people more aware of what the endangered species are. This tool started as a brochure, but is available as well as an app.

The fish regime has a moderate lock in and moderate cracks and tensions. The fish sector has a less strong lobby compared to the meat regime. The awareness of the decrease of the marine biodiversity is leading towards more societal debates.

3.2.2. Scale of transition challenge and orientation towards environmental problems

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 advises 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).

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.

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.

The last decades the energy efficiency of fisheries decreased globally as a result of declining fish stocks and greater distances travelled to catch fish. As a result of reductions in fleet, engine power and fishing days, CO₂ emissions from EU15 fisheries declined by almost 11% between 1995 and 2006. 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).

3.2.3. Main socio-technical challenges

The fish regime is facing socio-technical challenges related to fish quota, certification schemes and sustainability issues.

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, 2015c).

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 assess 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, Brons, Braam, Van Kuijk, & Pelders, 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, 2013d).

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.

3.3. The dairy regime

3.3.1. Summary of regime developments: lock-in, stabilizing forces, cracks and tensions in the regime

As the figure below shows, the milk production in the Netherlands has been increasing over the last years. In 2014, the Netherlands counted 17 800 dairy farmers, producing

12.4 billion kg milk. Around 65% of the Dutch milk production is sold abroad (mainly EU) (ZuivelNL, 2015).

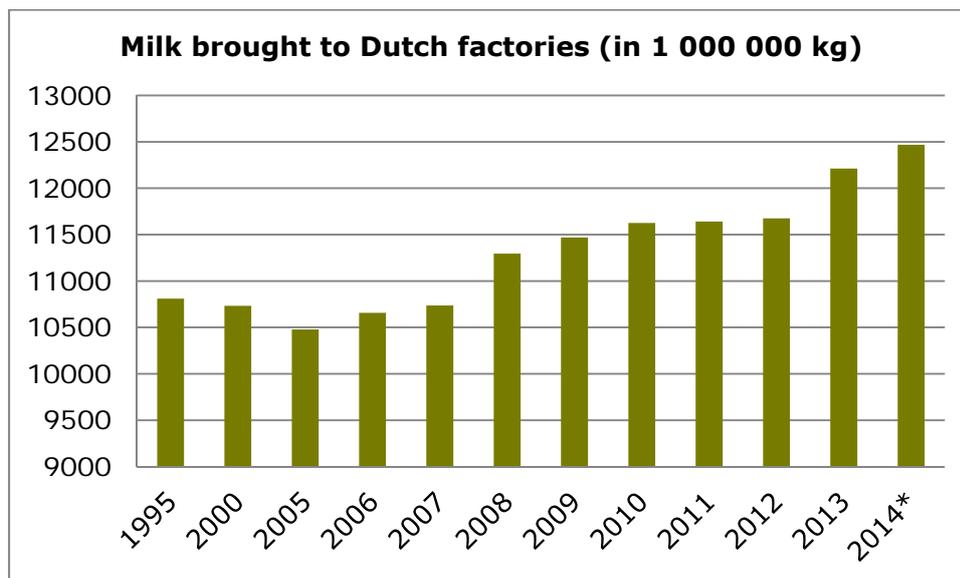


Figure 8 Amount of milk brought to Dutch factories 1995-2014 (*estimation) (CBS, 2015b)

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.

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. In 2015 the milk quota system has ended and the production is again increasing.

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.

The Dutch consumption of dairy products (cheese equivalents) was around 45 kg per person per year in 2010 (see figure 9) (PBL, 2013a). While production is increasing, the consumption of milk and dairy products by the Dutch is decreasing.



Figure 9 Dairy consumption per person (CBS, 2010b)

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.

The dairy sector has a strong lock in and moderate cracks and tensions. The sector has a good image, but the main cracks and tensions have to do with the abandonment of the milk quota, leading to decreasing milk prices in the Netherlands.

3.3.2. Scale of transition challenge and orientation towards environmental problems

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.

3.3.3. Main socio-technical challenges

The end of the milk quota was an important change in the last year. 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. New stables can host more cows, what makes it possible for farmers to increase the number of cows.

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.

Another discussion point is the feed used for the cows. 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.

3.4. The retail regime

3.4.1. Summary of regime developments: lock-in, stabilizing forces, cracks and tensions in the regime

The retail regime is included in order to be able to say something on the organisation in chains. The retail regime is in between the producer and the consumer, and as Figure 10 schematically represents, the power in the Dutch agro-food chain is mainly within a couple of purchasing companies (of the big supermarket chains). As only a couple of retailers form the bridge between producers and consumers, they have a huge impact on the production and consumption and are therefore important to study in order to be able to say something on the potential for change in the agro-food domain.

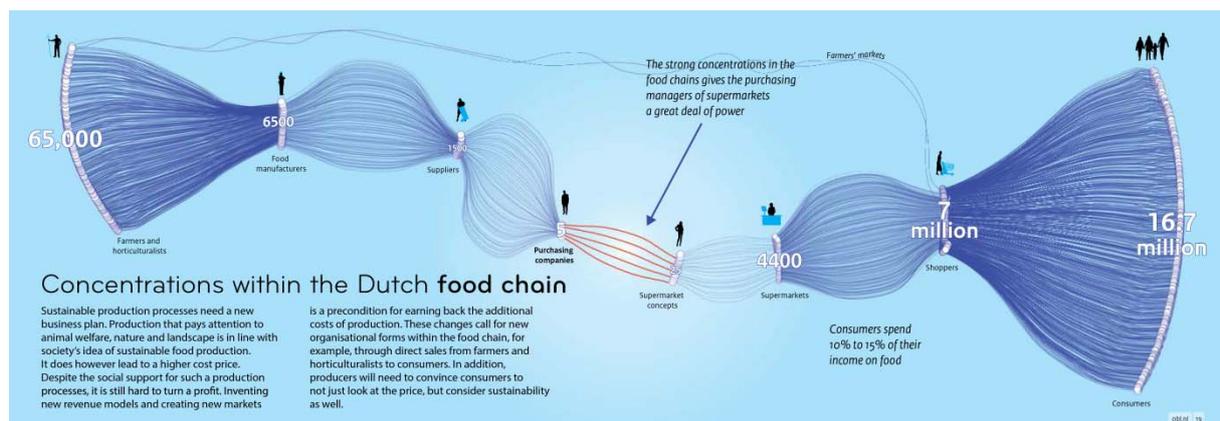


Figure 10 Concentration and relative power positions of commodity chains in the Dutch food system (PBL, 2014)

The retailers and purchasing companies 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. An important remark is 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).

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 (GfK, 2015). The supermarket market is mainly dominated by three large formulas: Albert Heijn, Jumbo Group and Superunie.

The most important actors in the retail regime are the following:

- 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.

The retail regime has a strong lock in and moderate cracks and tensions. The cracks and tensions are mainly caused by NGOs and social movements that start discussions on topics like animal welfare.

3.4.2. Scale of transition challenge and orientation towards environmental problems

The retail regime is not directly oriented towards environmental problems, but regarding some topics collective action is taken. For example regarding MSC fish. 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. 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, GlobalCAP, attention for animal welfare and stop illegal fishing.

The retail regime can, by making this type of statements, make a change in the transition towards a more sustainable agro/food sector. As the retail is the main link between producer and consumer, the choices made in that part of the chain are very influential.

3.4.3. Main socio-technical challenges

The retail regime is changing, but faces some challenges as well. Most of the challenges have to do with organisation of the chain and the retail regime. So is there a consolidation of supermarkets visible between the 1980s and 1990s. From the 1990s onwards the number of one-man businesses was decreasing and the small supermarkets in rural areas started to disappear. At the same time, 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.

There was a decrease of number of actors on the purchasing market as a result of the retailers taking over others in the 2000s. 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.

The 'price war' in 2003 had an impact on the retail regime. 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.

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. Furthermore more supermarkets are open 7 days a week, what make that people can go to the supermarket more often and probably as result make different choices for products.

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 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.

As the number of different actors in the retail regime is small, there is an important role for the retailers in the transition towards a more sustainable agro/food system, as they are the fringe between production and consumption. For example policy could address supermarkets or collective agreements on animal welfare issues or sustainability issues could change the markets.

3.5. The vegetable farming regime

3.5.1. Summary of regime developments: lock-in, stabilizing forces, cracks and tensions in the regime

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 11 below shows the developments of the different sectors over time.

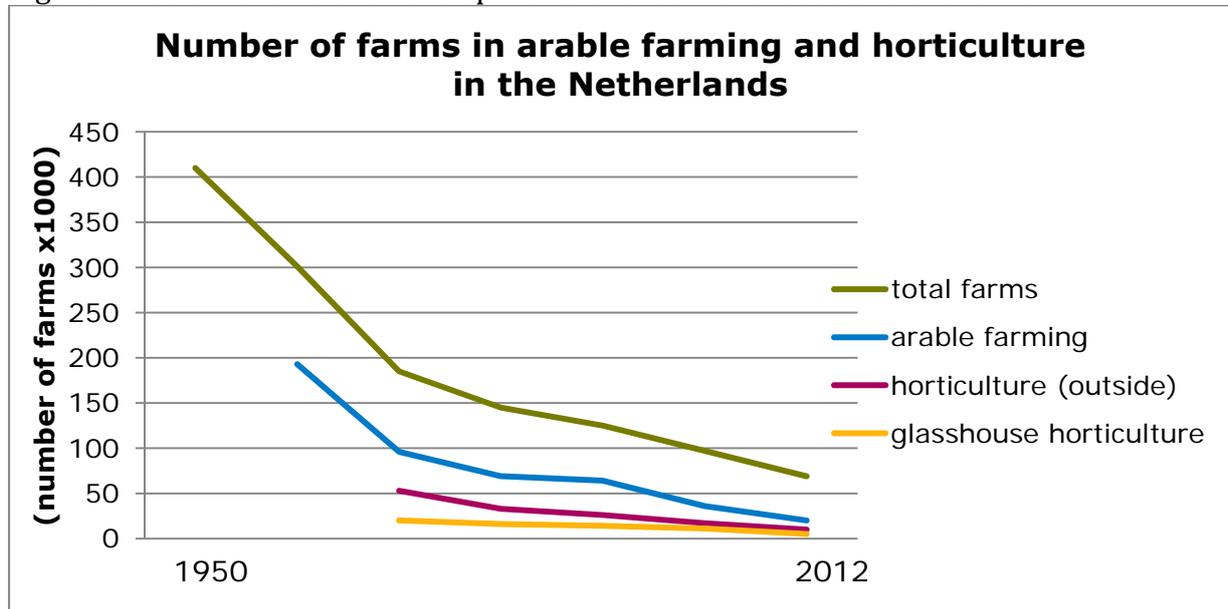


Figure 11 The arable farming and horticulture sector in the Netherlands (CBS, 2015b)

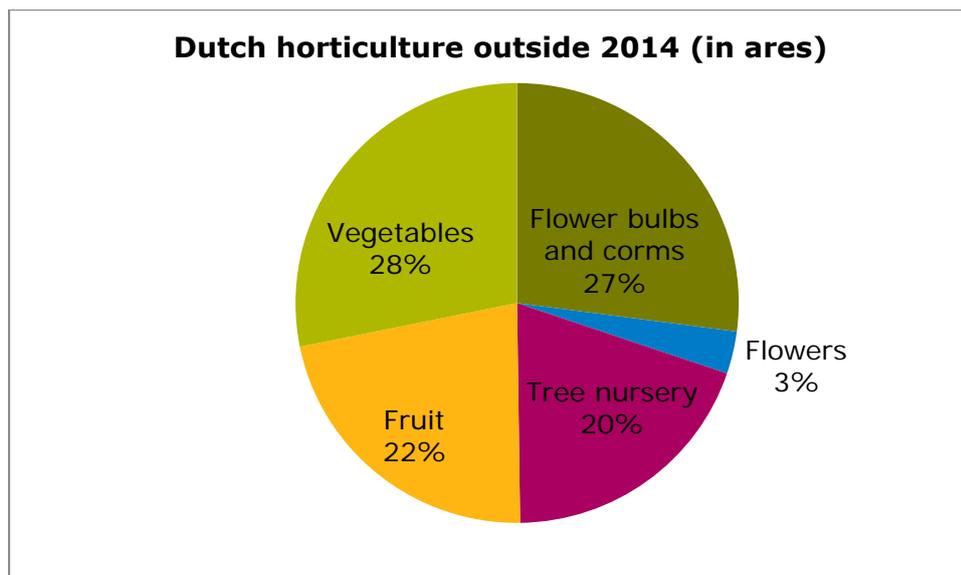


Figure 12 Horticulture in the Netherlands (CBS, 2015a)

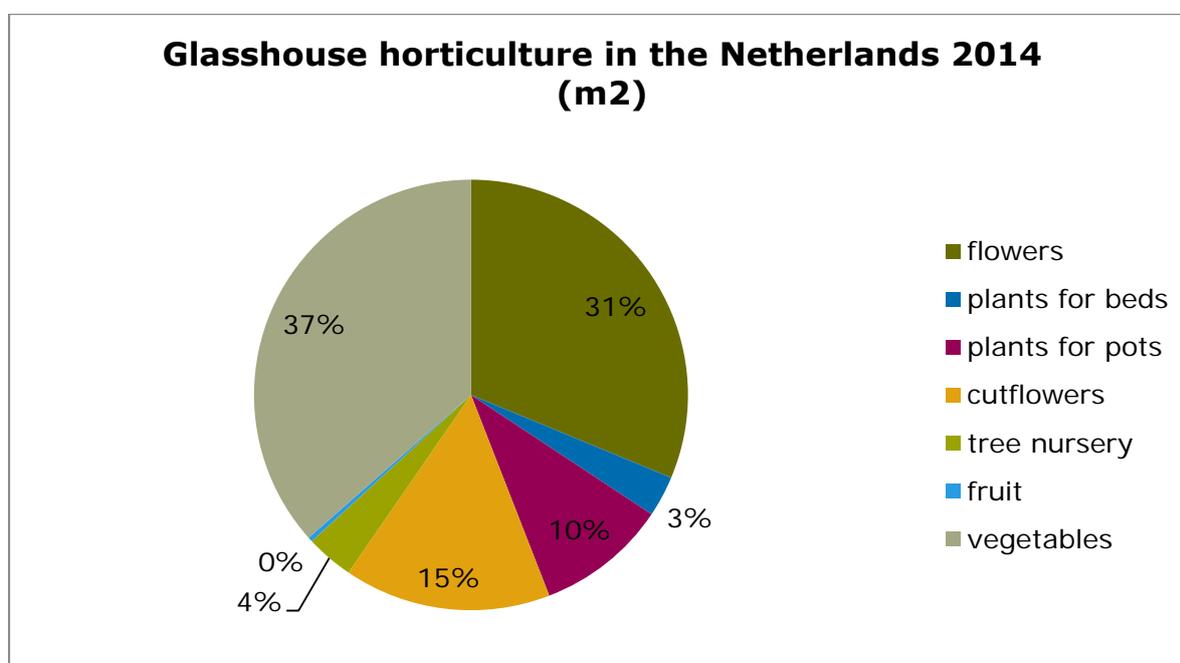


Figure 13 Glasshouse horticulture in the Netherlands (CBS, 2015a)

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”.

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.

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.

The vegetable farming regime is strongly locked in and has moderate cracks and tensions. The investments in the sector are high and long term. The awareness of the water quality and the high costs for energy create an incentive to change practices.

3.5.2. Scale of transition challenge and orientation towards environmental problems

The main environmental issues that need to be addressed by the vegetable farming regime are related to the use of pesticides, minerals, water use and emissions (in case of greenhouses) and landscape quality.

As vegetable farming typically concerns high-value crops, farmers have a tendency to have a risk-avoiding behaviour, which in case of minerals can lead to over-fertilization and consequent leaching of nutrients (for example of nitrate).

There are changes however, that try to deal with these challenges: 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.

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 their energy-use.

As for landscape quality, greenhouses are generally perceived negatively by the general public, also because of the abundant use of artificial light. Especially the presence of 'scattered' greenhouses is experienced negatively; therefore the national and local governments have policies in place to concentrate greenhouses.

3.5.3. Main socio-technical challenges

The main socio-technical challenges in the vegetable farming domain are reducing the energy use, maintaining the water quality and reducing the use of pesticides and over-use of minerals (both in the form of mineral fertilisers as well as in the form of manure).

The vegetable farming sector is in general a very innovative sector, as can be seen from developments 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.

High labour prices for example, can for example implicate that farmers will more likely choose for the use of herbicides (when possible) than for mechanical weeding. High land prices put a high pressure on crop yields.

For the greenhouse sector there is a program called: Greenhouse as energy producer (Kas als energiebron), in which the greenhouse sector and the government formulated goals to reduce emissions and energy in 2020. There is however also a strong lock-in: due to high investments in greenhouses, farmers cannot easily end their business. Also less-efficient greenhouses which are 20-30 years old are still being used, although these are not very energy-efficient.

The increasing competition on price, puts pressure on the existing farmers. The competition from countries that are able to produce products for lower prices compete with the Dutch production, with the high investments and land and labour. The geo-political issues, for example Russia closing the borders for Western European products, do influence this regime as well.

3.6. Summary of findings regimes

Overall, the trends in the Dutch agro-food domain continue as business as usual and only limited regime changes address environmental problems. There are no large scale transitions unfolding yet. The effects on the environment that can be seen are mainly caused by EU regulation. There are not many changes visible in the agro-food domain; however we do see some changes, mainly on the consumption side.

It is hard to measure the impact of niches on the environment, as many factors are influencing it and furthermore in many cases it is still too early to see what the effect is. 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.

The sense of urgency seems to be growing. However, what is needed for transitions to take off are more investments and probably political will can play a role as well. There is more environmental awareness in society and therefore social movements and NGOs play a big role in this transition. MSC and flexitarianism can be seen as successful niches. Interestingly both of the niches are partly the result of NGO or social movement actions.

It is hard to measure the impact of niches on the environment, as many factors are influencing it and furthermore in many cases it is still too early to see what the effect is. 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.

In the agro-food domain 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 most of the innovations belong to Pathway B. The table below summarises the findings for the studied regimes in the agro-food domain

Table 4 Summary of the studied agro-food regimes

	Lock-in, stabilizing forces	Cracks, tensions, problems in regime	Orientation towards environmental problems	Main socio-technical regime problems
Meat regime	Strong	Moderate	Moderate (some incremental change)	Has to do with habits that are hard to change. Large, long term investments
Fish regime	Moderate	Moderate	Moderate (some incremental change)	Discussion on the label system. Global character of the issue
Dairy regime	Strong	Moderate	Moderate (some incremental change)	Milk prices are under pressure
Retail regime	Strong	Moderate	Limited (BAU)	Some big players involved that are hard to change
Vegetable farming regime	Strong	Moderate	Moderate (some incremental change)	Reducing energy use, maintaining water quality and reducing the use of pesticides and over-use of minerals

4. Conclusions and wider discussion

In the agro-food domain there are hardly niche innovations that are about to break through at the moment. The niche innovations in Pathway A (Algae, Hybrid Meat and Cultured Meat) seem to be in the experimentation phase (phase 1 and 2), and do not have a high momentum yet. While the niche innovations in Pathway B (MSC, Dairy alternatives, flexitarianism, local food and organic food) seem to create a growing momentum. These innovations address the issues rose in society and therefore can be able to break through or generate an increasing interest. One could argue that MSC is the niche innovation with the highest momentum, and is already developed into a stabilised system. Table 5 summaries of the main findings for the different niches.

Table 5 Summary of findings niche innovations

	MSC fish label	Dairy alternatives	Flexitarianism	Local food	Organic food	Algae (fish feed)	Hybrid meat	Cultured meat
Are increasing investments needed?	minor	minor	Not relevant	minor	minor	yes	minor	Yes
Is there a positive widespread public debate?	yes	More or less	yes	More or less	More or less	no	no	More or less
Are there broader policy adjustments?	minor	no	no	minor	minor	minor	no	Minor
Is tackling issues within the existing regimes?	yes	No	yes	No	No	Yes	yes	Not yet
What is the internal momentum?	Med.	Med.	Med.	Med.	Med.	Med.	low	Very low
Pathway	B	B	B	B	B	A	A	A

In the agro-food domain, the transition towards a sustainable agro-food system is currently only moving at a very small pace. Figure 14 shows the current momentum of the niches and the expected direction of development. However, to what extent niches will develop into regimes is the question. Overall, the niche innovations lack potential or momentum, and the regime innovations largely lack direction and speed. The sector has strong lock-in forces, for example the dependency on land, the high investments in buildings and machines, the cultural aspects in consumer behaviour, the huge role of the agro-food sector in the Dutch economy and the strong lobby. There are many interests at stake, what makes discussions on substantial changes often very hard. Also from the policy side a clear perspective and support are lacking.

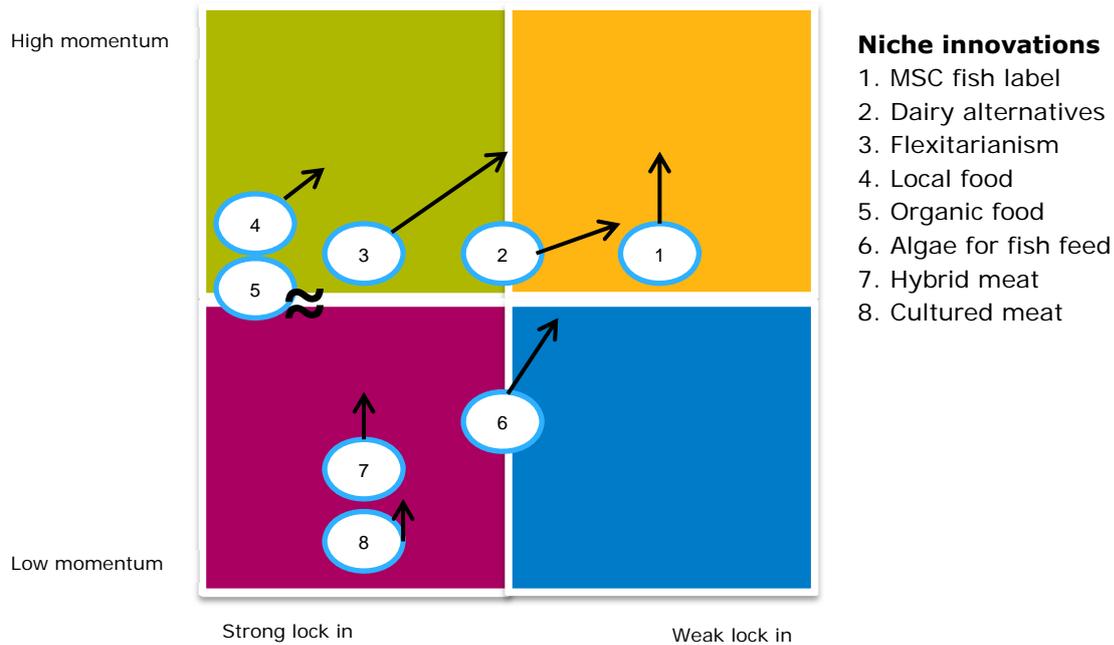


Figure 14 Momentum of niche innovations in 2015 and the expected direction of development

There is thus no transition unfolding yet. In the agro-food domain we can argue that change is occurring, but only in small steps, such as improvement of production efficiency. It seems that niche innovations do only have a minor effect on land use, greenhouse gas emissions and biodiversity, but in the agro-food sector a small step is already an improvement.

Wider discussion

Regimes are changing and are moving in the direction of sustainability. Many of the developments in the agro-food domain are only indirectly addressing sustainability goals. A typical example of an indirect possible effect is local food. The scale at which local food is produced and consumed is very limited; however, it does make people aware of their consumption and the impact on the environment or health, leading to different choices. So in that sense it can be a step forward to reach the sustainability goals.

As stated above, the most likely transition towards a more sustainable food system will exist of an adaptation of current regimes, in combination with upscaling of a number of niche innovations. This could be shaped in a number of ways, as expressed in for example in pathways A, with an emphasis on technical improvement and technical component substitution, or a Pathway B: a broader regime transformation, in which also consumption patterns are addressed.

In order for this transition to happen, a certain sense of urgency, clear vision and supporting policies are needed, a set of enabling conditions which is currently largely lacking.

Regarding the role of the government in transitions towards a sustainable agro-food system, there is a division in opinions: the government should not determine the choice of the consumer; however, the government is in most cases seen as the actor that needs to act in order to get innovation done. In the niches described the government is mainly involved via facilitation of platforms, as launching customer (local food), setting goals (organic food) or providing subsidies for R&D (cultured meat and hybrid meat). However, subsidies and goals set by the government are not always successful. The organic farming case shows that although there were payments available for farmers changing from conventional to organic production and there was a clear goal set by the government, the goal was not reached. Probably the momentum in the sector or in society was not high enough to increase the organic farming sector.

Interestingly many of the Pathway B innovations are increasing their momentum mainly due to societal debate on issues like animal welfare, health issues and environmental impacts. But interestingly there are issues as well in society that are not tackled by for example policy. Public attention is not always 'well aligned' with actions that would make a difference. There is for example societal attention for local food, urban farming or so-called 'superfoods', while with regard to solving sustainability challenges the application of manure or the efficiency of crops could be more influential. So, societal attention or public debates will not always deal with sustainability challenges.

Especially in the agro-food domain it has added value to look at the whole domain. For example a reduction of meat consumption will lead to an increase of the consumption of another product that in its turn has an impact on another regime. A comparative analysis of niche innovations in the agro-food domain can make these shifts visible.

Important to note is that the selection of niches determined the regimes that were analysed and therefore some more general changes at the regime level are not described in detail. It seems that in the agro-food context changes will not necessarily come from niche innovations (being completely different from existing regimes). As the agro-food domain is organised in chains with many components, a niche innovation will most likely relate to a part of the chain and therefore not be able to lead to a transition. Furthermore niche innovations are often addressing one or two goals (e.g. animal welfare, biodiversity, greenhouse gas emissions, food security or health) while the agro-food domain is facing many, often conflicting, goals. It seems that adaptations of current regime activities can lead to substantial changes as well. Examples are increasing efficiency of energy use in greenhouse horticulture, change of diets in animal husbandry leading to less emissions, using different species with a higher yield, solving food waste, or different practices for mowing. These types of changes can have a significant impact on land use or greenhouse gas emissions, without completely changing the system.

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