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Public goods and externalities: Agri-environmental Policy Measures in the Netherlands

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Abstract

**PUBLIC GOODS AND EXTERNALITIES:
AGRI-ENVIRONMENTAL POLICY MEASURES IN THE NETHERLANDS**

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Agriculture is a provider of commodities such as food, feed, fibre and fuel and, it can also bring both positive and negative impacts on the environment such as biodiversity, water and soil quality. These environmental externalities from agricultural activities may also have characteristics of non-rivalry and non-excludability. When they have these characteristics, they can be defined as agri-environmental public goods. Agri-environmental public goods need not necessarily be desirable; that is, they may cause harm and can be defined as agri-environmental public bads.

Public Goods and Externalities: Agri-environmental Policy Measures in the Netherlands aims to improve our understanding of the best policy measures to provide agri-environmental public goods and reduce agri-environmental public bads, by looking at the experiences of the Netherlands. This report provides information to contribute to policy design addressing the provision of agri-environmental public goods including the reduction of agri-environmental public bads. It is one of the five country case studies (Australia, Japan, Netherlands, United Kingdom, and United States), which provide inputs into the main OECD book, *Public Goods, Externalities and Agri-environmental Policy Measures in Selected OECD Countries*.

***Keywords*:** public goods, externalities, agri-environmental policies, Netherlands

***JEL classification*:** Q52, Q53, Q54, Q56, Q57, Q58

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Table of contents

Tables

Figures

Executive summary

This study presents an overview of current policy measures for agri-environmental public goods in the Netherlands. It is one of the first studies which synthesises a broad range of agri-environmental policies and agri-environmental public goods in the Netherlands.

The main agri-environmental public goods targeted by Dutch policy belong to one of nine broad categories: agricultural landscapes, biodiversity, water quality, water availability, soil protection and quality, air quality, carbon storage, greenhouse gas emissions and resilience to flooding. Agricultural landscapes and biodiversity are of great importance to Dutch citizens as it reflects their cultural identity, recreational needs, and other associated ecosystem services such as the provision of drinking water. The quality and availability of water are managed by a series of micro-level regulations of water tables. Other public goods affected by agriculture includes soil quality, upon which most of Dutch agricultural production relies. Good air quality and a stable climate are also public goods associated with agriculture. A wide range of agricultural practices can promote carbon storage and reduce greenhouse gas emissions. Agriculture can contribute to the resilience against flooding by its water retention capacity.

Most agri-environmental public goods are jointly produced with agricultural activities aimed at food production. However, some farming systems and agricultural practices produce more agri-environmental public goods than others. When "joint production" does not provide the desired levels and quality of public goods, other mechanisms, including policy instruments, are needed.

Legitimate government interference occurs only where there is a market failure that causes serious under provision of public goods. Although the Dutch Social and Economic Council provided a logical framework to identify these market failures, in practice it has proven to be very difficult to derive correct demand curves for agri-environmental public goods. Public opinion polls, such as the Euro-barometer, are limited in their accuracy to measure the demands, but they can be used by policy makers to test whether agri-environmental issues have public values or not. On the supply side, recent trends in the provision of agri-environmental public goods show an improvement for some goods such as water and air quality and greenhouse gas emissions, while other public goods such as landscapes, biodiversity and soil quality show a further decline.

In the Netherlands, a framework for environmental reference levels and targets is enshrined in legislation or in standards of good agricultural practice. Not all agri-environmental public goods, however, have clear reference levels and environmental targets. The costs associated with the provision of agri-environmental public goods need to be reviewed.

Dutch policy with respect to agri-environmental public goods is strongly rooted within the European legislative framework and common agricultural policy.

Regulations, payments, taxes and technical assistance are traditionally important agri-environmental policy measures in the Netherlands.

The Netherlands are unique in their collective approach to agri-environment measures via environmental co-operatives. At present, the government is taking this approach a step further to self-governance of agri-environment schemes by local co-operatives. This reflects the general shift "from government to governance" in Dutch policies, which gives more leeway for self-governance of social institutions and decentralisation of former national government tasks to regional and local governments.

1. Introduction

The Dutch primary agricultural sector is highly intensive in terms of inputs of labour and capital per hectare, and which is reflected in the Netherlands having the highest arable land prices in Europe (around EUR 50 000 per hectare). The percentage of Utilized Agricultural Area (UAA) is also relatively high — 57% as compared to 36% on average in OECD countries (OECD, 2013a) — with the result that agriculture seriously impacts on the quality of the environment. Not only are landscapes highly influenced by agriculture, but also other land use types such as recreational areas and nature reserves. While in the past decades government policies have increased the size of these latter areas at the expense of agricultural land use, air and water continue to be affected by nearby agricultural holdings.

Dutch agriculture has both positive and negative impacts on the environment. Positive impacts include its influence on agricultural landscape, biodiversity and water security, most of which are associated with extensive farming practices that have become exceptions in the Netherlands. The negative impacts include emissions of ammonia, pollution of surface waters and draining of nearby nature reserves, most of which are associated with high intensive farming systems, such as intensive livestock systems and greenhouse horticulture that are common in the Netherlands. Most of the environmental impacts associated with agriculture have the characteristics of public goods, i.e. non-excludability and non-rivalry.[1] In response, the Netherlands has implemented various agri-environmental policies, including strict spatial regulations to deal with its population density located, for the most part, on fertile delta soils. With respect to the broader issue of agri-environmental public goods, most Dutch policies are embedded within various European frameworks (directives, regulations and communications).

Ensuring the provision of agri-environmental public goods is generally seen as a government task (e.g. SER, 2008), although knowing what the desired levels of provision should be remains a problem. In the absence of functional markets, and therefore price information, there is no basis for setting the quantities that would be preferred by the Dutch. In addition, research covering the whole range of agri-environmental policies is scarce. For this reason, this paper addresses regulations and payments that target various kinds of agri-environmental public goods.

The following questions are addressed.

- Which agri-environmental public goods do Dutch policies target?
- How are these agri-environmental public goods provided for in the Dutch agricultural system?

1. For non-excludable and non-rival goods causing harm, the term *public bads* can be used.

- Does supply meet demand, i.e. does market failure associated with agri-environmental public goods exist?
- Where market failure exists, who should bear the costs for providing agri-environmental public goods? To what extent should farmers bear the costs of providing agri-environmental public goods, and to what extent should society bear the costs? How does the Netherlands set agri-environmental targets and reference levels?
- What agri-environmental policy measures are implemented for agri-environmental public goods in the Netherlands and which policy measures target which agri-environmental public goods?

This paper is organised as follows. Section 2 summarises the main agri-environmental public goods targeted in the Netherlands. Section 3 discusses the provision mechanisms of these public goods. Section 4 examines the market failure of these goods. Section 5 provides a reference level framework in the Netherlands to identify to what extent costs should be borne by farmers or by society. Section 6 shows how Dutch agri-environmental policies are organised. Finally, Section 7 concludes the discussion.

2. Agri-environmental public goods targeted in the Netherlands

Agri-environmental public goods are firmly rooted in the EU Common Agricultural Policy (CAP). Agenda 2000 divided the CAP into two pillars: Pillar 1 for production support and Pillar 2 for rural development. In 2003, Pillar 1 support was decoupled from production with the introduction of the Single Payment Scheme (SPS), which in turn became subject to cross compliance conditions relating to environmental, food safety and animal welfare standards. Many of these were already either good practice recommendations or separate legal requirements regulating farm activities.

The current rural development regulation is *Commission Regulation (EC) No 1698/2005*, although it will likely be revised in the near future in line with recent political agreement on CAP 2014-2020. *Commission Regulation (EC) No 1257/1999* outlines the criteria for support to agri-environment measures that go beyond "good agricultural practice." In the Netherlands, the measurements taken by farmers include meadow bird protection and transition to organic farming. This regulation targets *positive impacts* from agriculture (public goods).

Commission Regulation (EC) No 73/2009 describes good agricultural practice standards through a series of reference levels for the cross compliance rules. This regulation targets the *negative impacts* from agriculture ("public bads").

In 2008 the Dutch administration issued a so-called "charcoal sketch" for the EU Common Agricultural Policy (MLNV, 2008). The government envisioned a shift in support to agriculture based on added value of services to society, instead of historical rights based on production levels. The Dutch agenda for the CAP was built on two policy documents which addressed the various agri-environmental policies of the Netherlands. First, the Council for the Environment and Infrastructure (member of the European Environment and Sustainable Development Advisory Councils, EEAC) suggested that the legitimacy of the future CAP lies within protecting public interests in the environment, landscape and animal welfare in an effective and efficient way through targeted payments and an integrated areal approach (RLG, 2007). Secondly, the Social and Economic Council advised the Dutch government (SER, 2008) to target only public goods that

could not be sufficiently supplied without collective action. The Social and Economic Council specifically mentioned a list of environmental and social public goods associated with agriculture. Narrowed down to agri-environmental public goods, nine broad classes are targeted in the Netherlands (Table 1).[23] It is important to note that these nine goods are not always public goods, i.e. non-excludable and non-rival, but can be private goods (e.g. soil quality that affects only one farm). It is therefore important to examine each case individually to determine whether the characteristics inherent to public goods are present.

Table 1. Main agri-environmental public goods targeted in the Netherlands

Agricultural landscapes	Climate change – carbon storage
Biodiversity	Climate change – greenhouse gas emissions
Water quality	Air quality
Water quantity/availability	Resilience to flooding
Soil protection and quality	

Agricultural landscapes and **biodiversity** are of great importance to Dutch citizens as it reflects their cultural identity, their recreational needs, and other ecosystem services such as the provision of drinking water. Most biodiversity in the Netherlands is related to past agricultural practices. At the beginning of the 20th century, most of the country consisted of so-called semi-natural habitats, created and used by humans. These habitats included heathlands and marches, bio diverse grasslands, tree hedgerows and permanent rye culture. Due to modern agricultural practices, only a small percentage of the former rich habitats remain and have been largely purchased by the government and protected as nature reserves (Box 1). Other areas are still officially farmland and counted as UAA, but may appear in inventories of High Nature Value (HNV) Farmland (Van Doorn and Elbersen, 2012). However, the distinction between HNV Farmland and nature reserves can be artificial because farmers are increasingly involved in the management of agricultural habitats in nature reserves, and land owned by farmers can have a "nature" zoning status. This makes both farming and policy making complex.

The Dutch agricultural system has strong linkages with both **water quality** and **availability** because of the micro level regulation of the water tables in the country. Located on the delta area of the Meuse and Scheldt rivers coming from the south and the Rhine and the Ems from the east, much of the country would be flooded each year if there were no dikes. This surplus of water is a blessing because water availability for agriculture and drinking is not a big issue in the Netherlands, apart from the exceptional dry summers. However, maintaining the balance between too much or too little is a

2. Although social public goods (e.g. rural vitality, animal welfare and food security) are important policy targets in the Netherlands, this study focuses on agri-environmental public goods. The purpose of this study is to contribute to the development of better agri-environmental policies, and dealing with social public goods would necessitate a broader discussion beyond the field of agri-environmental policies.

3. Data in the Netherlands is collected for both reasons of international obligations and national policies. A rapid overall view of the most recent data and indicators is provided by fact sheets compiled in a compendium for the living environment. These are available only in Dutch.

difficult task, especially because different (spatial) functions require different amounts of water.

Box 1. The Dutch land retirement programme for the establishment of the National Ecological Network (NEN)

During the 1970s and 1980s, there were broad discussions on the functions of agriculture and nature. Since little was left of the biodiversity richness of man-made agricultural landscapes, the question arose if modern agriculture was compatible with nature. Could those two functions be integrated or should they be separated?

In 1990, it was decided to have a bit of both worlds. The nature policy plan announced the development targets for a National Ecological Network (NEN): by the year 2015 roughly 10% (184 000 ha) of the UAA should *change* its main function from agriculture to nature (i.e. various semi-natural habitats as well as new wilderness areas) while another 5% (90 000 ha) of the UAA agriculture should be *integrated* with nature. Together with existing natural habitats, such as forests and marchlands, this would amount to a total of 728 500 ha NEN. The function change to nature should be done by land acquisition in targeted areas, first on a voluntary basis but if necessary (to acquire the last pieces in a specific area for instance) enforced through expropriation. Between 1990 and 2011, a total of 104 000 ha (56% of the original target) was established in this way. The integration of nature and agriculture on 5% of the UAA had to be established by agri-environment schemes. In 2011, approximately 45 000 ha (50% of the original target) was contracted. The policy was revised that same year and targets were re-adjusted from 728 500 ha to 638 500 ha NEN by the year 2021.

This exceptional Dutch programme explains to a certain extent the relatively low expenditure of the Netherlands in Pillar 2 of the CAP. Other European member states spend more on payments to farmers in Less Favoured Areas (LFA). Landscape and biodiversity within the Dutch NEN carry much similarities with LFA elsewhere in the European Union. The Netherlands has chosen a strategy of land purchase and management by professional nature organisations without European co-financing. Only the part of the NEN that is still farmland and where agri-environment schemes are in force is Pillar 2 financing used. A relatively small area is designated as LFA. There is a strong overlap with areas where agri-environment schemes are in force (Terluin et al., 2008).

In some areas, agriculture has an impact on water availability in adjacent nature reserve areas. Modern agriculture requires relatively low water tables, especially in spring when field work is planned. Low water tables in adjacent agricultural areas cause serious drought problems for nature reserves, since much of Dutch biodiversity belongs to wetter habitats that are typical to delta, riverine and moor landscapes. In addition, water quality in terms of nitrate contents is not sufficient in some regions when measured against the European standards of the EC Water Framework Directive (CBS, PBL, Wageningen UR, 2012a). This is largely due to the relatively high nutrient loads applied on farmland. Despite recent improvements there are still surface water locations with too high concentrations of pesticides (CBS, PBL, Wageningen UR, 2012b). Nevertheless, Dutch water companies are able to provide good drinking water to all households (CBS, PBL, Wageningen UR, 2013a).

Agriculture affects **soil quality**. Depending on the soil type and the type of land use, i.e. permanent grassland or arable culture, there are issues with the inappropriate use of fertilisers and pesticides, and decreasing soil organic matter content and soil compaction due to the use of heavy machinery. Soil erosion is a minor issue in the Netherlands. Water erosion occurs in parts of the hilly area near Maastricht and wind erosion can be a problem in the open arable landscape of the north-east. For the most part, soil issues can be regarded as private problems, related to unnecessary management practices and mainly affecting the land manager himself.

Good **air quality** and **a stable climate** are also public goods affected by agriculture. Odours and fine dust from livestock can reduce air quality. Larger farms in the Netherlands therefore have to adopt specific farm management practices (air cleaning techniques). Although agriculture is a net contributor of greenhouse gas emissions, a wide

range of agricultural practices can promote **carbon storage** and reduce **greenhouse gas emissions**. This is particularly true for the peaty areas of the Netherlands. By adapting higher water tables, mineralisation of peat can be reduced. This would considerably reduce carbon emissions, but at the cost of higher emissions of methane and nitrous oxide (Hendriks et al., 2012a).

Another main agri-environmental public good in the Netherlands is **resilience to flooding** by the water retention capacity of the agricultural area. This capacity increases with lower water tables, so there is an offset with other public goods such as biodiversity and agricultural landscape which favours higher water tables (Kleijn et al., 2009). However, the most cost effective method to prevent flooding of the lower part of the Netherlands lies by improving the quality of dykes (Deltares, 2011), which are already of high standards (RIVM, 2004).

3. The provision mechanisms of agri-environmental public goods

Most agri-environmental public goods are jointly produced with agricultural activities aimed at food production. However, some farming systems and agricultural practices produce more agri-environmental public goods than others. When "joint production" does not provide the desired levels and quality of public goods, other mechanisms are needed. These may include policy instruments. **Biodiversity** and **landscapes** are among the main agri-environmental public goods. All agricultural systems, with the exception of greenhouse horticulture, have in common that they keep the landscape open. People prefer (half) open historic landscapes over cities and peri-urban landscapes (De Vries et al., 2007). However, the openness of modern agricultural landscapes can go beyond the desired level, especially in agricultural areas that were traditionally half-open, such as the bocage landscape of the sandy soils in the east and south of the Netherlands. Here, the modernisation of agriculture has resulted in the enlargement of parcels and the removal of tree hedgerows; this has changed the landscape considerably. Homogenisation of the landscape has been further re-enforced by specialisation of farm enterprises, as opposed to combinations of animal husbandry and arable production which were common in the past. Farming practises have also intensified leading in general to lower biodiversity (Ozinga, 2008; Melman et al., 2013). Extensive farming practices are still common in Europe (Opperman et al., 2012), but scarce in the Netherlands.

To protect and wherever possible to restore the remaining "pristine" agricultural landscapes with high nature value (HNV) or high cultural heritage value, various strategies have been developed. These include partial de-intensification of a single farm, voluntary[4] land retirement by selling land to a state agency, whole farm adaptation (such as organic farming and "Farming For Nature" which aims to restore traditional low input mixed farming systems with infields and outfields (Westerink et al., 2013), and environmentally-friendly farming through agri-environmental co-operatives (Schouten et al, 2013).

The provision of agri-environmental public goods other than landscape and biodiversity is more complex. The provision of climate change, for instance, involves both positive and negative impacts from agricultural activities. Agriculture is, however, not the only sector contributing to **climate** change, making it difficult to attribute the

4. When privately-owned farmland lies within the boundaries of the planned ecological framework, the government agency (BBL) tries to acquire the land at market prices. Only in exceptional cases is coercion used.

share of agriculture in the negative impact on the environment, particularly at local levels. **Flood prevention**, for example, is provided by a large system of dykes and ditches which are (for a large part) owned and managed by public water boards. The water boards are a Dutch institutional innovation of the 13th century. They are regional authorities with their own taxation system, regulations, subsidies and democratically elected councils, in which farmers are strongly represented. The regulation of water tables in much of the agricultural and (semi) natural areas is managed by these water boards. Increasingly, water boards try to prevent floods through temporary inundation of farmland in return for a financial compensation. Some have subsidy schemes for farmers to improve the **water quality** in ditches.

Soil protection is, as argued above, mainly a private matter. In the Netherlands, farmer's groups have taken up this issue and the government mainly supports them with research.

Similar to other OECD countries,[5] the Dutch system of provision of public goods consists of drivers (farm inputs, farm practices and intermediary goods) that ultimately produce a certain amount of each of the public good listed in Table 1.

4. Market failure for agri-environmental public goods

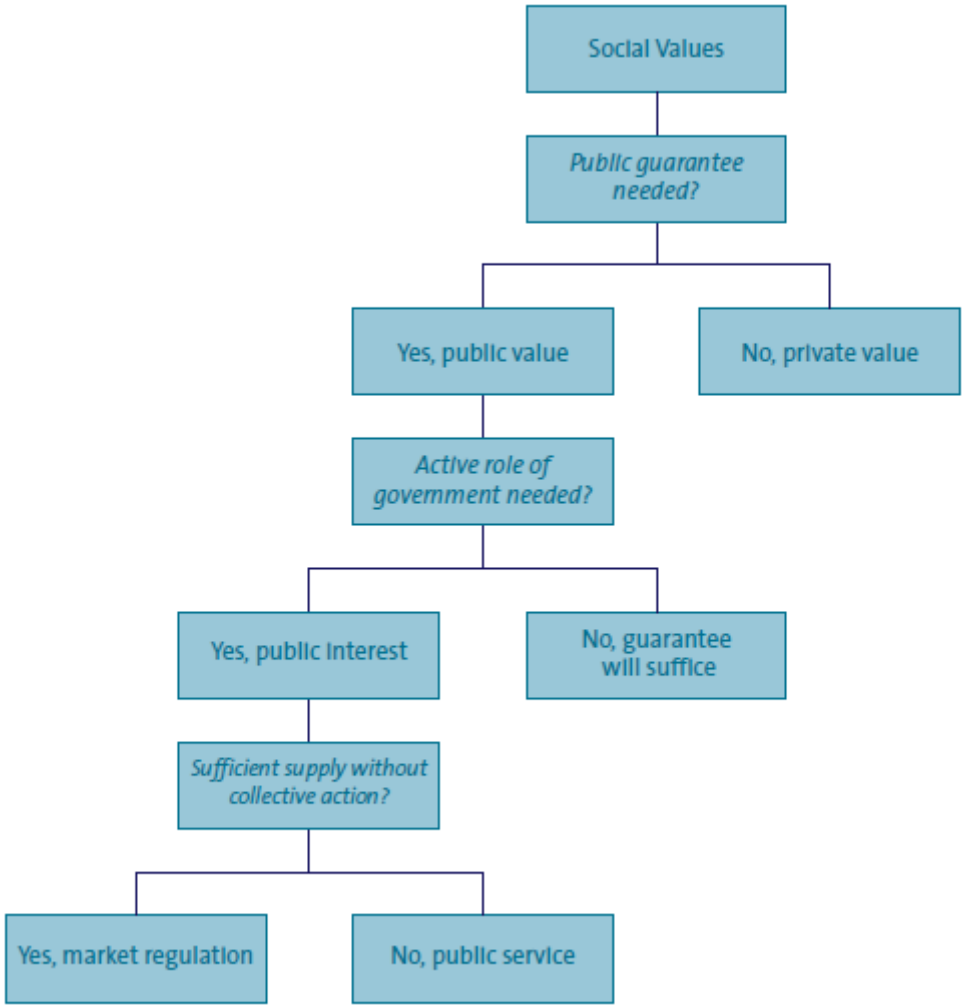
Figure 1 is a simple framework by the Social and Economic Council (SER, 2008) to guide public intervention. It shows that the provision of agri-environmental public goods does not always require government intervention.

The general Dutch view is that legitimate government interference occurs only where there is market failure that causes serious under provision of public goods. According to the SER, the first step is to determine whether public values are at stake (Figure 1). Public values are related to collective preferences (Lamy, 2004). When a majority thinks that a public guarantee is needed (e.g. this can be confirmed, for example, through public opinion polls such as Eurobarometer Surveys), it follows that public values are at stake. The next step is to decide if public values are of public interest and if there is a need for an active government role. This "political" decision can be motivated by the existence of complex externalities causing market failures (SER, 2008). There are some goods that have public values (step one), but do not call for an active government role. For instance, the supply of daily bread may have public values, but under normal circumstances the supply of this private good can be left to the market. Thus this second step examines whether goods have the characteristics of public goods (i.e. non-excludability and non-rivalry) and call for an active role by the government to secure its provision. A final step is to examine whether or not the incidental provision of agri-environmental public goods by individual farmers meets public demands. Agri-environmental public goods are not like a regular good on a market place that can be negotiated, bought and sold. They are often place-bound, so the farmer(s) needed for its provision is not arbitrary. Furthermore, a farmer producing agri-environmental public goods cannot simply demand payment from people enjoying the good because he/she cannot exclude people from enjoying it. On the other hand, if a farmer produces "public bads," he/she cannot easily be made to compensate the people affected as they cannot always be identified. Market failures in the provision of agri-environmental public goods can often be summarised as problems of

5. See, for example, the Japanese case study on policy measures for providing agri-environmental public goods in *Public Goods and Externalities: Agri-environmental Policy Measures in Japan* (Uetake, 2015).

free-riding. In many cases, the incidental provision of agri-environmental public goods by individual farmers does not meet public demand because of multiple market failure problems. Since collective action can leverage resources among farmers and non-farmers and bring larger environmental benefits to society in general, the Dutch government specifically promotes collective action to provide agri-environmental public goods.

Figure 1. Steps needed to be examined before government intervention



Source: SER (2008), CAP Reform and Public Services of Agriculture, Abridged version of advisory report "Waarden van Landbouw", SER, Den Haag.

It is difficult to estimate the scale of demand and supply of agri-environmental public goods because of the absence of markets. On a national level, the problem concerns budget and spatial distribution questions, and the absence of markets poses problems for the proper pricing of public goods. In practice, a variety of methods is used in the Netherlands to address all these problems in an integrated way.

The most common method applied involves the use of reference data. Historic reference data are mostly used to underpin public goods such as the agricultural landscape

with its characteristic and historic elements. For public bads resulting from agriculture, technical references are used more often, reflecting state of the art production possibilities per farm type. For instance, the maximum fertiliser application levels of phosphorus on arable land are set to lower values in cases of high actual satiety. To estimate desired levels of production of agri-environmental public goods, the reference level can also be found by conducting surveys among stakeholders to assess the relative value of a set of public goods. Cost price calculus of different sets of activities with different sets of outcomes regarding the bundle of goods can be used as a pricing mechanism. In practice, these techniques are used on an *ad hoc* basis and important issues must be resolved.

It is not always easy to establish which producer provides what amount and quality of a public good. In rural areas where many farms share resources such as ditches, it is not easy to attribute water quality to an individual pollution level.

The proxy-based evaluation techniques used to estimate desired reference levels for demand are hampered by lack of uniformity in their valuation base. Since different methods (e.g. stated preference through the Contingent Valuation Method (CVM), revealed preference through hedonic pricing, travel cost or market prices) can yield different estimates for the same component, the relative value of various components in their comparison is affected by the choice of the evaluation technique. Moreover, the methods address different notions of value (Chan et al., 2012) and are subject to various biases (TEEB, 2010).

Moreover, whether there is undersupply of agri-environmental public goods or not must be examined for each good at an appropriate scale. In fact, most demand and supply occur at the local level, thus the estimation should be done on a local scale for each good.

With these limitations in mind, this study tries to estimate the demand and supply of agri-environmental public goods in the Netherlands on a national scale. Although careful interpretation of the indicators presented is needed, they can nevertheless give a broad picture of the demand and supply that exists for agri-environmental public goods.

4.1. Demand for agri-environmental public goods

Demand curves for agri-environmental public goods are notoriously difficult to estimate. Due to lack of market information other sources must be used, e.g. information gathered in various Social Benefit Cost Analysis (SBCA). Despite the number of studies and the progress in applied techniques major problems remain in ascertaining demand for the public goods listed in Table 1. These include the following.

- The goods listed in Table 1 are not specific. Within each category, there are still numerous possibilities to further specify the public goods and to develop indicators and criteria for delivery. For instance, High Nature Value Farmland (which is already a sub of "agricultural landscape") can come in many varieties for which demand can differ. In the Netherlands, HNV farmland type 1 (farmland with a high proportion of semi-natural vegetation) has become rare (Van Doorn and Elbersen, 2012) but is highly valuated.
- Demand for agri-environmental public goods not only varies by location (locally), but is also characterised by different levels of "scale" (local, regional, national, international). For instance, the demand for climate change mitigation can be effectuated on a global scale.

One approach to ascertaining public demand for agri-environmental public goods is to use a public opinion poll as a proxy indicator. This approach will reveal a general public preference and interest, although it cannot provide an accurate demand in terms of a demand curve related to quantifiable units. Nevertheless, it would help policy makers to test step one of Figure 1 (whether there are public values or not). For instance, the 2010 European survey to measure public opinion of the CAP (EC, 2010) revealed that a large majority of Dutch respondents (91%) think that agriculture and rural areas are important for the future. This percentage is comparable to the EU27 (90%) average. A majority (60%) recognised protection of the environment to be among the top priorities for the European Union, and 26% found this to be the most important priority, against 14% on average in Europe (EC, 2010). These figures are consistent with other Eurobarometer polls which measured the attitudes of European citizens. Similar surveys were carried out in 2004, 2007 and 2011 (Table 2). Compared to the 2004 survey (EC, 2005), the 2011 survey (EC, 2011a) revealed that Dutch citizens were less worried about climate change and pollution issues. However, the concern about the depletion of natural resources had increased. Dutch respondents were less worried about losses of biodiversity in 2007 (EC, 2008) than they were in 2004; after 2007, this concern increased again.

The same public-opinion poll on the CAP (EC, 2010) showed that about 89% of respondents in Europe and the Netherlands were in favour of new objectives to help farmers face the consequences of climate change and 87% supported the cross compliance policy. New objectives to preserve to countryside or to develop the economy in rural areas could also count on high support rates (91% and 80% respectively in the Netherlands). Most respondents did not think agriculture was a major cause of climate change: 61% of the European and 74% of the Dutch respondents tended to disagree with a statement in that direction. At the same time, they did think agriculture would suffer from climate change (77% European and 63% Dutch). A large majority agreed that the European Union should help farmers to change the way they worked in order to address climate change (82% European and 83% Dutch); a smaller majority (58% European and 61% Dutch) was even willing to pay 10% more for agricultural products if they were produced in a way that did not increase climate change. The results of this Eurobarometer clearly show collective preferences with respect to at least some of the agri-environmental public goods, which means that public values are at stake (step one of Figure 1).

Demand for agri-environmental public goods is also reflected in support for voluntary associations active in landscape and biodiversity. This support has a long history in the Netherlands. The first citizen initiatives for biodiversity stem from the nineteenth century (e.g. *Vogelbescherming*). A milestone was the acquisition of the first nature reserve the "Naardermeer" in 1905 by the private association *Natuurmonumenten*. Today *Natuurmonumenten* has over 750 000 members. Some people participate in voluntary landscape management, such as the 66 000 members of *Landschapsbeheer Nederland.* Many of the local environmental co-operatives that co-ordinate agri-environmental measures of farmers have membership for non-farmers as well. An example is "Water, *Land en Dijken*" with 500 farmers and 150 non-farmers as members (Box 3). Non-farmers participating in environmental co-operatives are often active in the monitoring of biodiversity. Altogether; the combined membership of nature, environmental and animal-friendly associations is 3.8 million people or almost a quarter of the population.

Table 2. Evidence of concern for environmental issues (demand for agri-environmental public goods)

Agri-environmental public goods	Category of the Environment Survey	Percentage of Dutch respondents to the Environment Survey concerned about particular environment issues		
		2011	2007	2004
Agricultural landscapes	Depletion of natural resources	49	38	36
Water quality	Water pollution	40	42	46
Climate change –carbon storage / greenhouse gas emissions	Climate change	37	53	53
Air quality	Air pollution	34	45	50
Biodiversity	Loss in biodiversity	29	27	32
Water quantity/availability	NA	NA	NA	NA
Soil quality	NA	NA	NA	NA
Resilience to flooding	NA	NA	NA	NA

Source: EC (2011a), *Attitudes of European Citizens towards the Environment*, Special Eurobarometer 365, European Commission, Brussels.

EC (2008), *Attitudes of European Citizens towards the Environment*, Special Eurobarometer 295, European Commission, Brussels.

EC (2005), *The Attitudes of European Citizens towards the Environment*, Special Eurobarometer 217, European Commission, Brussels.

Few studies in the Netherlands have given attention to the demand for one or more agri-environmental public goods. Hendriks et al. (2012b) in their work for The Economics of Ecosystems and Biodiversity (TEEB) presented an overview of studies that focused on ecosystem services linked to the physical environment. From a list of 53 regional studies in the Netherlands that evaluated investments through Social Benefit Cost Analysis (SBCA) or Environmental Impact Assessments (EIA), only two related explicitly to an agricultural area and only a limited number of agri-environmental public goods was addressed. None of the selected cases was sufficient to adequately measure the value of effects of changes in ecosystem services, thus they do not present a clear demand curve showing varying amount of the goods in numbers with varying price levels of the goods.

There have been efforts to estimate demand of agri-environmental public goods at the local level. An example to assess demand and supply of recreational services at a local scale is presented in Box 2.

Box 2. A Dutch demand and supply model for recreational daytrips

Stichting Recreatie (a foundation for recreation) developed a model to assess shortages of recreational facilities at a local level. It is based on recreational behaviour on the demand side and the carrying capacity of (agricultural) landscapes on the supply side (Stichting Recreatie, 2006).

In this model, the demand for daytrips of the local (urban) population is based on observed behaviour related to characteristics such as age, gender and ethnic origin. Studies showed that the majority of daytrips occur within a perimeter of 10 km from home (for walking) or 15 km (for cycling). In this way, an aggregated demand per postal code location is developed.

On the supply side, the carrying capacity is limited by landscape features. Forests have the highest carrying capacity, both for walking and cycling, while industrial terrain and small recreational objects have no carrying capacity at all (Table 3).

Table 3. Carrying capacity per category of terrain and activity

Supply category	Carrying capacity norm[1]	
	Walking	Cycling
Natural terrain (wet)	3	1
Natural terrain (dry)	6	2
Agricultural area high accessibility & enclosed	0.6	1.8
Agricultural area high accessibility & open	0.3	0.9
Agricultural area average accessibility & enclosed	0.2	1
Agricultural area average accessibility & open	0.1	0.5
Agricultural area low accessibility & enclosed	0	0.4
Agricultural area low accessibility & open	0	0.2
Forest	9	3
Beach	8	0
Public gardens & parks	8	2
Small recreational objects	0	0

1. Number of persons per hectare per day.

Source: Stichting Recreatie (2006). *Recreatie in de MKBA*, Stichting Recreatie, Kennis- een Innovatiecentrum, Den Haag (translated from Dutch).

By comparing the carrying capacity with the aggregated demand, the model revealed the shortages in recreational capacities. This model has been applied in various regions in the Netherlands. The highest shortages in recreational capacities are mainly found near the agglomeration of the Randstad, which encompasses the country's four largest cities (Amsterdam, Den Haag, Rotterdam and Utrecht). The result can then be used in SCBA studies (MinLNV, 2006).

4.2. Supply of agri-environmental public goods

Assessing the supply for agri-environmental public goods is also a challenge due to the lack of appropriate data. At the European level, some work on the development of common proxy indicators to estimate the supply of agri-environmental public goods has been established by IRENA (EC, 2006). The indicators are linked to the production system and focus on the impact of agricultural activities on the environment. Although no indicator can be used to directly assess the desired levels of supply, they do provide some proxies about the desired quantities. Table 4 provides an overview of some relevant IRENA IFS proxy indicators.

Table 4. Relevant IRENA proxy indicators and their Indicator Fact Sheet (IFS) numbers per agri-environmental public good

Agri-environmental public good	Local and regional proxy indicators	Farm level proxy indicators
Agricultural landscapes	Share of HNV farmland (IFS 26)	Number of crop types, number of linear elements and patch density (IFS 32)
Biodiversity	Area land use change (IFS 12); area under support or protection (IFS 01, 04, 07); Farmland bird index (IFS 28); Share of HNV farmland (IFS 26)	-
Water quality	Nitrates / pesticides concentrations in water (IFS 30)	Gross nutrient balance per ha split into major input and output components (IFS 18)
Water quantity/availability	Total irrigable area per UAA (IFS 10); Share of agriculture in water use (IFS 34.3)	-
Soil protection and quality	Share of agricultural area managed by low-input, medium-input or high-input farm types (IFS 15); Annual soil erosion risk by water (IFS 23)	Area landuse change (IFS 12); Livestock stocking densities (IFS 15); Topsoil organic carbon content (IFS 29)
Climate change – carbon storage	-	Topsoil organic carbon content (IFS 29)
Climate change – greenhouse gas emissions	Aggregate annual emissions of methane and nitrous oxide from agriculture (IFS 19)	-
Air quality	Aggregate annual ammonia emissions from agriculture (IFS 18sub)	-
Resilience to flooding	Area land use change to more vulnerable types (IFS 12)	-

Source: EC (2006), *Development of Agri-environmental Indicators for Monitoring the Integration of Environmental Concerns into the Common Agricultural Policy*, COM(2006)508 final, European Commission, Brussels.

At the Dutch level, indicators are available on the national and regional level for a number of agri-environmental public goods. Table 5 summarises the trends of agri-environmental public goods in the Netherlands. However, little is known at the farm level and this hampers the design of meaningful (market-oriented) policies. The overall picture is mixed with some public goods increasing and others decreasing.

Table 5. Trends of agri-environmental public goods in the Netherlands

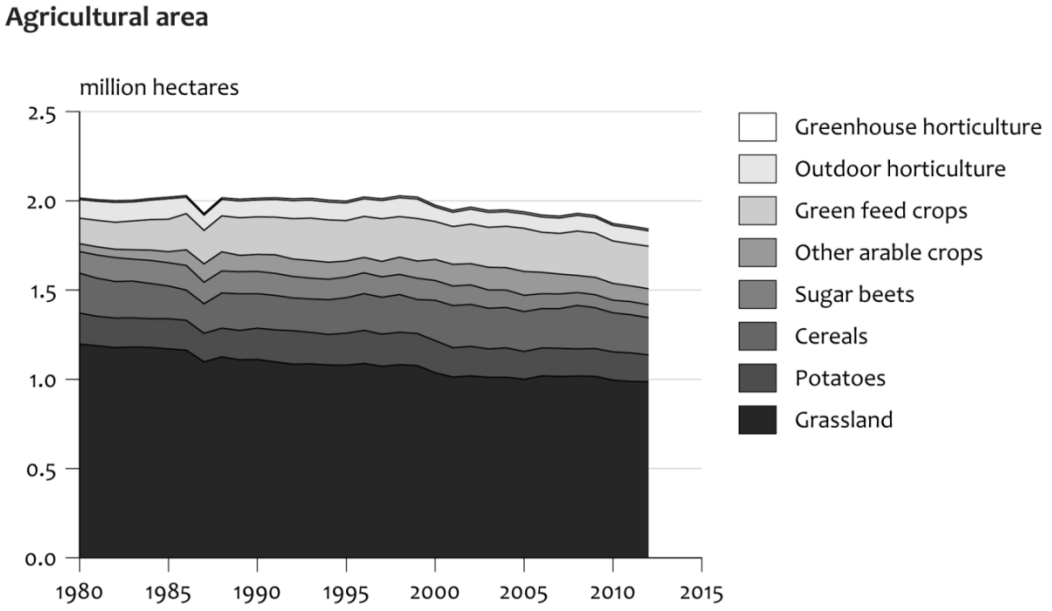
	Trends	Related indicators		Sources
Agricultural landscapes	↘	• Farmland • High Nature Value farmland / Uptake of agri-environment schemes	• -0.3% p.a. (1990/92-2010/12) • Negative trend in most province	• OECD(2013a) • IRENA IFS 26 / PBL (2012)
	~	• Average parcel size / patch density • Recreational facilities on farms	• Impacts are complex	• IRENA IFS 32 / PBL (2012)
Agricultural biodiversity	↘	• Conversion of farmland to urban use etc • Farmland bird index	• 2.9% between 1990 and 2000 • -49% (1990/92-2010/12)	• IRENA IFS 12 • OECD(2013a)/ IRENA IFS 28
	+/-	• High Nature Value farmland • Certified organic farm management	• Low shares (0-3%) already • Slight increase from 2004-2010	• IRENA IFS 26 • OECD(2013a) / IRENA IFS 7
Water quality	↗	• Gross nitrogen balance • Gross phosphorus balance • Pesticides in water	• -41% (from 1990/92 to 2006/08) • -65% (from 1990/92 to 2006/08) • -45% (from 1990/92 to 2008/10)	• OECD(2013a) / IRENA IFS 18.1 • OECD(2013a) / IRENA IFS 30.2 • OECD(2013a)
Water quantity/ availability	~	• Water retaining capacity	• -	• -
	↘	• Protected nature reserve area affected by draining or eutrophication	• Decrease of pressures (desiccation, eutrophication) levelled off	• PBL (2012)
	+/-	• Water use intensity / share of agriculture in water use	• Low share of 1% of the total water use	• IRENA IFS 10 / IRENA IFS 34.3 / CBS /PBL/WUR (2012c) website in Dutch
Soil protection and quality	↘	• Farmland change to artificial surfaces • Land use intensity	• 2.9% between 1990 and 2000 • Further intensification	• IRENA IFS 12 • IRENA IFS 15
	~	• Organic soil content • Area suffering Soil compaction	• No data on development • New (upcoming) theme	• IRENA IFS 29 • -
	+/-	• Soil erosion	• Stable at very low levels in the Netherlands	• IRENA IFS 23
Climate change /Carbon storage	↘	• Oxidation of peat land	• At a rate of 5 -15 Mton carbon per year	Kuikman (2004)
Climate change – greenhouse gas emissions	↗	• Total GHG emissions from agriculture • Methane emissions from agriculture • Nitrous oxide emissions from agriculture	• -27% (from 1990 to 2010) • -14% (from 1990 to 2011) • -42% (from 1990 to 2011)	• OECD(2013a) • RIVM (2013) • RIVM (2013)
Air quality	↗	• Ammonia (and nitric oxide) emissions from agriculture • Number of affected people in their living environment related to offensive livestock odours	• -65% ammonia (from 1990 to 2010) • From over 20% in 1990 to under 10% in 2010[1]	• OECD (2013a) / IRENA IFS sub 18 • CBS /PBL/WUR (2013b) website in Dutch
	~	• Shares of livestock farms with adequate manure treatment facilities	• Inadequate monitoring / supervision by local authorities	• RIVM (2012
Resilience to flooding	~	• National program "room for the river"	• No data on contribution of agriculture	• Rijkswaterstaat website[2]
	↘	• Conversion of farmland to urban use etc.	• 2.9% between 1990 and 2000	• IRENA IFS 12

Notes: ↘ Decreasing ↗ Increasing +/- Both increasing and decreasing data ~ No data

1. www.compendiumvoordeleefomgeving.nl/indicatoren/nl0290-Geurhinder-per-bron.html?i=13-45.
2. www.roomfortheriver.nl/.

More than half the surface area in the Netherlands is used for agricultural purposes. Between 1980 and 2012, almost 10% changed to other uses, mostly build-up areas (69% between 1996 and 2003) and reforestation, rebuilding nature and recreational areas (23%). The decline in farmland, especially after 2000 (Figure 2), is reducing agriculture's capacity to provide various ecosystem services, not only because of the decline itself, but also because urban expansion is fragmenting the landscape. However, land use changes under the national programme to establish an ecological network also offers opportunities for low input farming practices. Land acquisition has been aimed in part at the reconstruction of semi-natural habitats, such as species rich grasslands and heathlands, and new landowners (nature organisations) tend to hire out this land to neighbouring farmers with restrictions (Melman et al., 2013). The number of private agri-environmental associations [6] is also rapidly growing from less than ten in 1994 to approximately 100 in 2001 (Oerlemans et al., 2001), and approximately 200 in 2013. Today, environmental co-operation is active in a large part of the Netherlands, with groups of farmers and citizens trying to promote the delivery of agri-environmental public goods.

Figure 2. Development of farmland in the Netherlands



Source: CBS, PBL, Wageningen UR (2013c). Land- en tuinbouw: ruimtelijke spreiding, grondgebruik en aantal bedrijven, 1980-2012 (indicator 2119, versie 04, 14 juni 2013). www.compendiumvoordeleefomgeving.nl. CBS, Den Haag; Planbureau voor de Leefomgeving, Den Haag/Bilthoven en Wageningen UR, Wageningen..

The most vulnerable and economically least feasible semi-natural habitats offering public goods related to **biodiversity** are protected in "nature reserves" and no longer considered as utilised agricultural area (UAA). However, outside and between these strictly protected reserves, conventional agriculture provides public goods, especially landscape and biodiversity associated with agricultural landscapes. The green landscape (where small forests, wooden banks and hedgerows are involved) and the blue landscape

6. In international literature, they are sometimes indicated as environmental co-operatives.

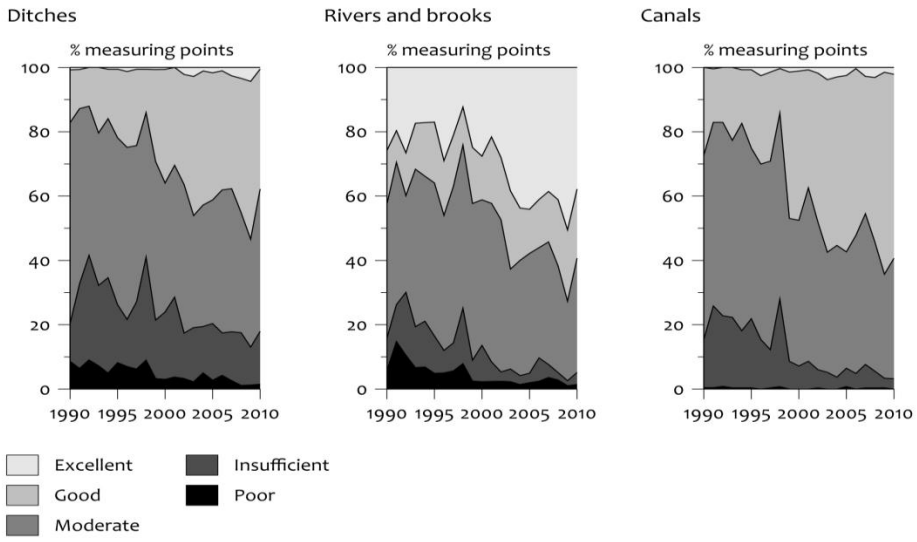
(where water is involved) elements on agricultural land are key infrastructure for the migration of fauna (Opdam et al., 2006)

Modern agriculture requires ever larger fields to work efficiently. This puts pressure on existing **landscape** features, especially in protected zones such as "National landscapes" where farmers are confronted with relatively small-sized parcels (Sanders et al., 2013). There is a steady decline in the number of farms and older ones are usually broken up into small parcels and sold to neighbouring farms. The number of scattered plots is increasingly complicated to manage by farmers. For a growing number of dairy farmers this means they must keep their cattle inside year-round. To design agricultural landscapes which combine intensive and large-scale practices with sufficient small-scale landscape elements is one of the great challenges in the Netherlands (Rienks et al., 2008).

Despite efforts by many farmers to protect birdlife with the commitment to apply agri-environmental measures according to specific schemes, the farmland birds index has fallen dramatically by over 50% in the last decade. It seems that measures undertaken under are not far reaching enough to make a difference and that they need to be better spatially targeted (RLI, 2013; Sanders et al., 2013).

Improving **water quality** is a key challenge because in many areas the criteria set out by the EC Water Framework Directive are not met. Although recent trends in farmland nitrogen and phosphorus levels have been favourable, the rate of improvement is slowing (CBS, PBL, Wageningen UR, 2012a). Figure 3 shows there are still many water bodies, especially ditches, where concentrations of nitrogen and phosphorus are too high. Water quality is also negatively affected by pesticides, much in the same way as nitrogen and phosphorus. Despite improvements, the operational targets for reduced levels in 2010 were not achieved (CBS, PBL, Wageningen UR, 2012a).

Figure 3. Water quality based on nitrogen concentrations



Source: CBS, PBL, Wageningen UR (2012a), Vermesting in regionaal water, 1990 – 2010 (indicator 0552, versie 04, 12 september 2012). www.compendiumvoordeleefomgeving.nl. CBS, Den Haag; Planbureau voor deLeefomgeving, Den Haag/Bilthoven en Wageningen UR, Wageningen.CBS, PBL, Wageningen UR, 2012a.

In terms of **water quantity**, water withdrawals for agricultural purposes amount to 1% in the Netherlands. Withdrawals are mainly done by douching the crops in dry periods. Together with groundwater subtraction for drinking water and industrial purposes, douching accounts for 30% of the desiccation problems of nature reserves (CBS, PBL, Wageningen UR, 2008). Drainage of agricultural areas, which accounts for 60% of withdrawals, is the predominant cause of desiccation problems. In 2000, almost half a million hectares of (nature) land were desiccated, threatening approximately 40% of the endemic plant species (CBS, PBL, Wageningen UR, 2003).

Soil losses from cultivated and other land are generally low in the Netherlands but can be locally important. Water erosion can occur mainly in the hilly parts of southern Limburg on approximately 40 000 ha. Other parts of the Netherlands (mostly in the northeast) can be susceptible to wind erosion, approximately 4 700 ha is very vulnerable (Hessel et al., 2011). About 2.5% of the UAA in all is at risk, predominantly arable land. Soil organic matter can decrease when land use changes significantly, especially when it changes from permanent grassland to an arable production system. There is no scientific evidence for decreasing rates of organic matter in the Netherlands when fixed rotation crop schemes are applied over longer periods (Smit and Kuikman, 2005). A relatively new issue related to **soil quality** concerns compaction through improper management (e.g. the use of heavy machinery under wet weather conditions). Large parts of the Netherlands are highly susceptible to soil compaction (SoCo Fact Sheet N°2, EC JRC, 2009). Soil compaction can reduce the yields of arable produce considerably and in the case of subsoil compaction this can lead to persistent problems (Van den Akker et al., 2012; Van den Akker, 2004)

There is limited data on **carbon storage**. Soils are a huge store of carbon (C). The current pool of soil organic carbon (SOC) in the world is estimated at 1 500 Pg (petagrams), i.e. approximately two times larger than the total amount of C in the atmosphere and nearly three times larger than the amount of C in terrestrial vegetation (Kuikman, 2004). The total amount of SOC in the Netherlands is approximately 285 Tg (teragrams) C in the top 30 cm of all soils in agriculture, forest and nature conservation areas (Kuikman et al., 2003). Peat soils contain the largest amounts, but oxidation causes considerable annual losses in the order of 5 – 15 Megaton CO_2, accounting for 5% of total Dutch emissions (Kuikman, 2004). Land use changes in the past, especially conversion of permanent grassland (with relatively high SOC content) to cropland also contributes to loss of SOC as it generally takes many years to reach a new equilibrium.

Greenhouse gas emissions from agriculture have decreased in recent years. Methane emissions dropped 14% between 1990 and 2011 and the emissions of nitrous oxide decreased by 42% over the same period. The reduction of methane emissions in agriculture were mainly attributed to a shrinking livestock population until 2007. Nitrous oxide emissions from agriculture decreased from 1995 onwards due to lower application of (artificial) fertilisers. The share of agriculture in total GHG emissions is 8% (OECD, 2013a).

Air quality associated with agriculture has improved. Ammonia is the key pollutant associated with agriculture, especially (intensive) livestock farming, and ammonia emissions decreased by 65% between 1990 and 2010 (OECD, 2013a). The number of people adversely affected by odours from agriculture was approximately halved between 1994 and 2011 (CBS, PBL, Wageningen UR, 2012d). To further reduce the nuisance from odours, farmers need licenses to produce and air cleaners are required to obtain

permits for expansion of intensive livestock. However, supervision by local authorities is insufficient and many installations do not function properly (Min IenM, 2012a).

4.3. Drivers causing changes in Dutch agri-environmental public goods and market failure

While the demand or need for agri-environmental public goods is probably increasing because of the Netherland's growing population and changing lifestyles, evidence suggests a mixed picture in terms of supply. Some agri-environmental public goods show an improvement in supply, especially those associated with negative impacts from agriculture, (such as water quality, reduction of greenhouse gas emissions, and air quality), while others, especially those associated with positive influences from agriculture, appear to be deteriorating (biodiversity, soil quality) or mixed (water quantity). Most agri-environmental public goods are probably underprovided, suggesting that in many cases the three steps illustrated in Figure 1 are passed in terms of overall demands and supply of agri-environmental public goods in the Netherlands. However, the national scale at which agri-environmental public goods were examined in this study has limitations. Whether or not there is undersupply should be examined at the appropriate scale. This scale may be national or global, but more often local.

To some extent, the undersupply of agri-environment public goods results from impacts on the provision mechanism such as a reduction in the agricultural area (Section 2). However, the specialisation, intensification and increased scale of farming are also important. These adversely affect the supply of agri-environmental public goods such as agricultural landscapes, biodiversity, water quality and soil quality. A shrinking and ageing agricultural labour force also has an impact on the maintenance of certain farming systems and management practices (e.g. cattle grazing and shepherding) and infrastructure (e.g. the maintenance of hedges and wooden banks) which are beneficial for agri-environmental public goods such as landscape and biodiversity.

Even taking the above into account, the biggest challenge relating to the provision of agri-environmental public goods in the Netherlands as well as elsewhere in Europe is that farmers do not have the incentive to provide these goods. If enough private income could be obtained from providing agri-environmental public goods, individual farmers could provide these with no public support. However, with limited or no private benefits, some form of public intervention is required in order to secure the provision of agri-environmental public goods at the scale required to match demand and need (Pannell, 2008; Cooper et al., 2009; OECD, 2010a). For these reasons, the Netherlands has developed and implemented various agri-environmental policies that target collective action. Since many factors affecting the provision of agri-environmental public goods are drivers (input-based or means), most Dutch agri-environmental policies target the means rather than directly the ends (agri-environmental public goods). Dutch agri-environmental policies are discussed in Section 5.

5. Reference levels and agri-environmental targets of agri-environmental policies

Government intervention may be necessary in the case of market failure. However, questions remain as to the extent that government should intervene. To consider this point, a framework concerning reference levels is useful (OECD, 2001).

Environmental reference levels are defined as the minimum level of environmental quality that farmers are obliged to provide at their own expense; reference levels can be

set in terms of environmental outcome or appropriate farming practice. Environmental targets, on the other hand, are defined as minimum (mandatory) levels of environmental quality for the agricultural sector in a country or region or desired (voluntary) levels of environmental quality that go beyond minimum requirements. Environmental targets depend on society's preferences for environmental quality, while reference levels depend on the country's traditions or laws in defining property rights.

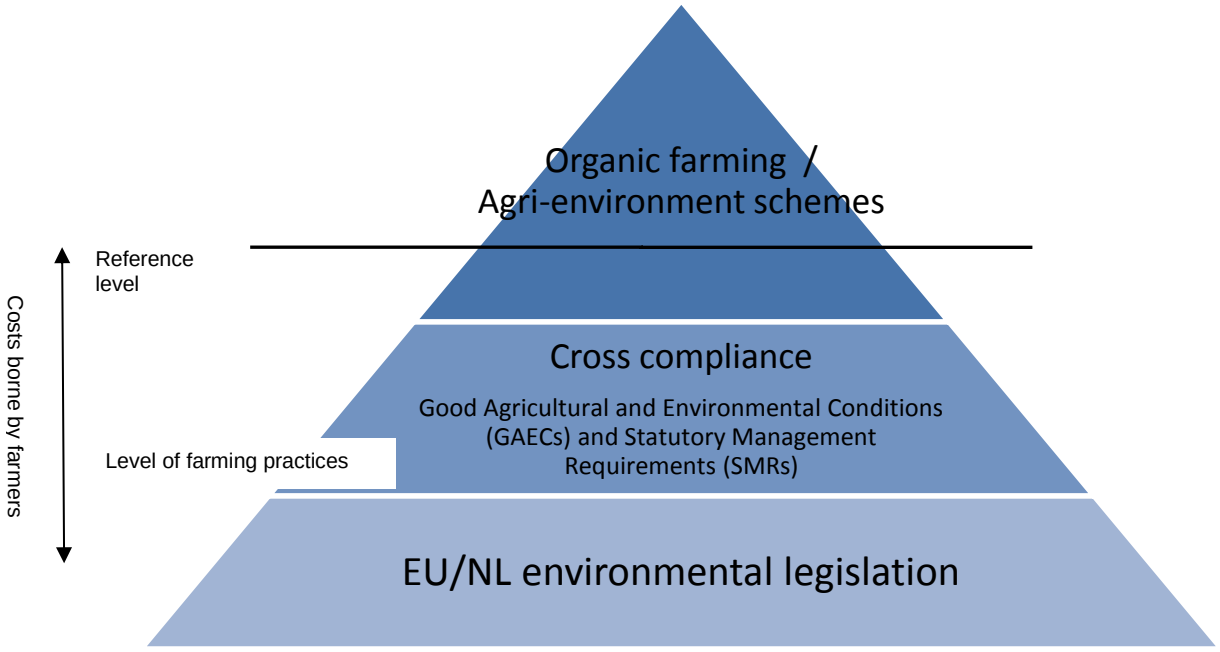
In European agriculture such a framework is offered by EC regulations on cross compliance. In the Netherlands (and more widely the European Union), the environmental reference level is either enshrined in legislation setting out legal requirements in relation to minimum standards which must be adhered to by law, or is expressed in standards of good agricultural practice which, although not enforceable in a legal sense, are practices that are expected of all farmers. In the Netherlands, the EC framework is complemented mainly by national spatial law and by the choice of measures under Pillar 2 of the CAP for support of farming practices that go beyond the levels set by the cross compliance for Pillar 1, and therefore provide additional services to society. The Dutch rural development plan (MinELI, 2006) includes a number of goals for agri-environmental public goods, such as preservation of valuable man-made landscapes and increased biodiversity in rural areas.

The legislative baseline specifies those actions which are compulsory for the farmer to undertake and for which he/she should bear the cost. In most cases, EU legislation is in the form of Directives, which provide a broad framework for transposition to national laws and implementation at the Member State level. Many of these national legislative requirements are included within the Statutory Management Requirements (SMRs) and to a certain degree within the Good Agricultural and Environmental Conditions (GAEC) standards under cross compliance (Cooper et al., 2009).

Figure 4 illustrates the environmental reference levels in the Netherlands and corresponding farming practices and policy mechanisms. All farmers must meet the environmental requirements set by EU and Dutch legislation. Cross compliance enforces compliance with the requirements set out in the EU and national legislation that apply to farmers who receive agricultural income support payments (SPS), and it adds additional environmental requirements to those farmers. Agri-environmental schemes (Pillar 2) are set to further improve the environmental quality beyond the reference levels and with which farmers will need to commit to. Table 6 shows the reference levels and environmental targets for nine agri-environment public goods in the Netherlands (Annex Table 1 provides a more detailed description of reference levels and environmental targets).

There are specified reference levels and environmental targets for biodiversity, water quality and quantity, soil and air quality. For these public goods, the reference levels relate to cross compliance while the targets are based on international or EC commitments. These commitments are informed by and based on scientific evidence (e.g. water quality).

Figure 4. Agri-environment reference levels and policy mechanisms in the Netherlands



Source: Adapted from Jones, et al. (2015), *Public Goods and Externalities: Agri-environmental Policy Measures in The United Kingdom*, OECD, Paris.

In the Netherlands, areas with outstanding natural and cultural values are designated as "National landscapes." In total, there are 20 such designated **landscapes**, covering more than 20% of the total surface area.[7] The main environmental target is to retain the core qualities and where possible include some restoration. Large-scale industrial developments are not allowed in these areas and the policy also aims to keep the number of inhabitants at a stable level. The "National landscapes" were designated by the central government in 2004 and, until recently, the central government was responsible for this policy. Since decentralisation in 2012, the Dutch provinces govern this policy and make budgetary decisions. A system of permits under spatial law protects the landscape to some extent. Changes to (often complex) landscape features are not allowed without a permit. The Dutch government started this spatial policy, which involved a zoning concept, in 1956. In some zones, agriculture prevailed and there were little restrictions. In other zones, agriculture was combined with other values such as landscape elements and biodiversity, and thus more restrictions were placed on farmland. Regarding **biodiversity**, halting the further loss of biodiversity values and when possible restoring them (through the establishment of the National Ecological Network) are the most important environmental targets. The environmental targets on landscape and biodiversity put emphasis on preserving the current status of the environment. In both cases, since preserving current status is the main environmental public good, most costs (e.g. keeping landscape elements) are borne by farmers.

7. http://www.cbs.nl/nl-NL/menu/themas/dossiers/nederland-regionaal/publicaties/artikelen/archief/2011/2011-3443-wm.htm.

Table 6. Summary of reference levels and agri-environmental targets in the Netherlands

	Agri-environmental public goods				
	Agricultural landscapes	**Biodiversity**	**Water quality**	**Water quantity/ availability**	**Soil protection and quality**
Environmental targets	National targets only in ”National landscapes”; Regional targets based on spatial law / retention of features	National ecological network (EHS) set environmental targets including biodiversity	“Good” water quality under EC Water Framework and nitrate directives	Sustainable use of water and drought mitigation under EC Water Framework Directive	Sustainable use of soil under EC Soil Thematic Strategy
Reference level	Keeping current state is farmer’s obligation (depending on spatial zone) GAECs	SMRs 1,5 and GAECs under cross compliance, partly in specified areas	SMRs 2,4 and GAECs under cross compliance	Control of water tables in hands of the water board districts / GAEC for water protection	SMR 3 and GAECs under cross compliance/ Soil protection act
	Agri-environmental public goods				
	Climate change-Carbon storage	**Climate change-Greenhouse gas emissions**	**Air quality**	**Resilience to flooding**	
Environmental targets	EU Renewable Energy Directive (RED)[1]	40% reduction (conditional) by 2030 (compared to 1990).[2]	Set by national emission ceilings (Ammonia is relevant for agriculture)	Reduce probability of flooding under EC Flood Directive. National program water safety 21st century	
Reference level	Current farming practices are equal to reference levels	Current farming practices are equal to reference levels	SMRs 3,4 and GAECs under cross compliance. Farm expansion is conditional based on certain criteria	Measures on project base. Adapting of farming practises is just one of the options	

1. Although the RED is not directly targeting agri-environmental public goods, the policy is using agricultural production as an instrument to achieve environmental public goods (i.e. climate change).
2. National target over all sectors.

The European Water Framework Directive and Nitrate Directive set environmental targets and reference levels for **water quality** (Min IenM, 2012b). Water quality is addressed per water district and management plans are developed together with various stakeholders. The implementation of the nitrate directive is integrated with soil protection in national laws on the application of fertilisers which set out the reference levels based on nutrient inputs. Farmers are obliged to meet these reference levels (e.g. appropriate fertiliser applications, nitrate management) by their own costs, but environmental targets set out by the Directives which go beyond the reference levels environmental payments are implemented.

There are no specific national targets with respect to **water quantity**. Environmental targets and reference levels (for extraction) are set per basin/water catchment area based on the EU Water Frame Directive. In general, there is abundant water in the Netherlands and the water board districts are appointed with the task to regulate water tables for agriculture, i.e. sufficient drainage when it is too wet and sufficient retention or when possible water supply in dryer periods. Management of water control, for instance keeping ditches free from scrubs, is done by farmers at their own expense. In this case, the reference level is based on practices. There remain many conflictual situations where farms adjacent to nature reserves require higher water tables. These issues are usually resolved by spatial planning policies.

There are no specific national targets related to **soil quality** and the amount of **carbon storage** in the soil. Although soil quality is of great concern indicators but difficult to adequately target, they are not yet available (Smit and Kuikman, 2005). To prevent potential losses of carbon and pollution, individual farm reference levels are set to the current farming practice (e.g. retention of permanent grassland).

The long-term perspectives for a competitive low carbon economy in 2050 are outlined in an EC road map (EC, 2011b) in which the national targets for **greenhouse gas emission** are set to a conditional 40% reduction in a Cabinet climate letter (Min IenM, 2011). The reduction target is conditional because of uncertainties with regard to international efforts and success. The target applies to all sectors in the economy and climate policy is comprised of a mix of covenants, regulations and financial incentives. There are no specific targets set for agriculture with the exception of horticulture greenhouses. The aim of this innovation programme for the greenhouses is to become "climate neutral" by 2020.

With respect to **air quality**, the EC National Emission Ceiling Directive and Gothenburg protocol set a national target for ammonia emission reduction to 13% compared to 2005 which equals 122 kilotons. In addition, a special policy will be developed for the protection of Natura-2000 areas, aiming for minimal impact of ammonia based on a zoning concept. This involves a cap on total emission levels of all farms combined within a certain distance from the perimeter of the nature reserves.

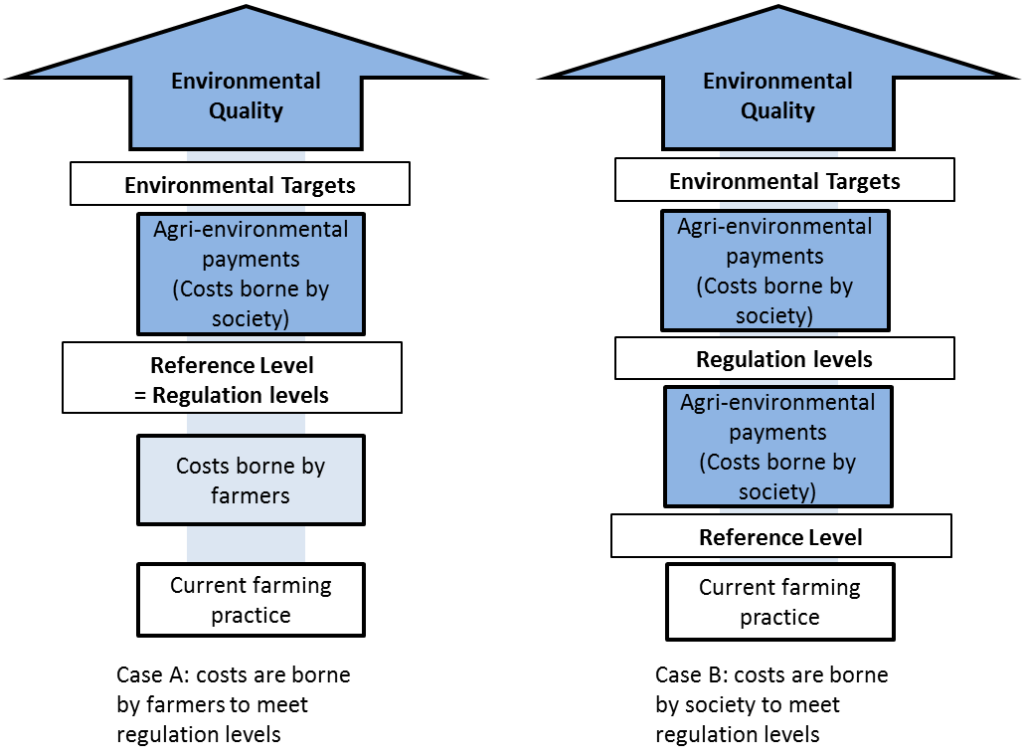
Resilience to flooding is targeted by the national water safety 21st century programme which is based on factors such as the economic importance and number of inhabitants affected the risks of flooding to higher or lower levels. As part of the strategy, agricultural lands can be used as a temporary relief area. This is done on a project basis.

When farmers emit pollution (e.g. soil, water and air pollution), the Polluter Pays Principal (PPP) applies and farmers are obliged to meet the reference level at their own expense. Reference levels are often set at the sector level, because identifying the polluters can be problematic due to the public nature of the produced "bad." On the other hand, when farmers provide benefits (e.g. agricultural landscape or biodiversity), current farming practices tend to be equal to reference levels (some programmes require cross-compliance), and environmental payments are used to achieve environmental targets.

Reference levels are not always equal to regulation levels. Sometimes regulation levels can be set beyond reference levels. In these cases, governments may choose to provide payments to help farmers meet the regulation levels (Case B of Figure 5). For example, to improve water quality and mitigate environmental problems associated with livestock, farmers are required to install suitable facilities to store livestock manure and slurry. The authorities provide technical advice and assistance, and in some cases grant aid, to help farmers meet the enhanced standards.

With regard to environmental targets, some agri-environmental public goods do not have explicit targets in the Netherlands. This may be because it is difficult to set quantitative targets for some agri-environmental public goods (e.g. agricultural landscapes), or because issues are relatively new (e.g. carbon storage). Ideally, Environmental targets should try to improve the environment; however, maintaining the current level of provision could also count as an environmental target given the market forces driving deterioration in the quality and quantity of some agri-environmental public goods.

Figure 5. Reference levels and agri-environmental targets



Environmental targets and reference levels are set by the government and/or devolved authorities, and informed by international and EC commitments and policies, scientific evidence, expert analysis and public consultation. For many agri-environment public goods, this process takes place in the context of the development of country Rural Development Programmes (RDPs). The RDPs for 2014-2020 are presently being developed.

Environmental targets and reference levels are not always set clearly for all agri-environmental public goods. Ideally, environmental targets should be output based or directly related with the status of the agri-environmental public goods provided. However, in many cases, proxy indicators (e.g. targeted area for organic farming) are used. In some cases, there are no quantitative targets, and instead qualitative targets are set. This makes it difficult to evaluate policy measures. Even if there are overall environmental targets (e.g. preserving biodiversity), it is not clear to what extent each policy measure (e.g. direct payments for environmentally-friendly farming) tries to address the targets, and to what extent other policy measures try to contribute to achieve the targets. Agri-environmental targets and reference levels are necessary to develop better policy measures and to identify better cost-sharing between farmers and society.

Once environmental targets and reference levels are set, policy intervention may be necessary to provide agri-environmental public goods. In the next section, current Dutch policy measures for agri-environmental public goods are reviewed.

6. Policy measures for agri-environmental public goods

Regulations, payments, taxes and technical assistance traditionally are important agri-environmental policy measures (OECD, 2010b). Table 7 summarises their relative

importance. Regulatory requirements and payments based on farming practices are still predominant, although there are numerous experiments with other policy instruments. Since Table 7 reflects only the present situation it should be read with care. The policies with regard to agri-environmental public goods in the Netherlands are characterised by high dynamics in terms of governance as expressed by the number of major revisions in environmental laws and agri-environment schemes in recent years. The Netherlands are unique in their collective approach to agri-environment measures via Environmental Cooperatives (Franks and McGloin, 2007). At present, the government is taking this approach a step further towards self-governance of agri-environment schemes by local co-operatives. This reflects the general shift "from government to governance" in Dutch policies, which give more leeway for self-governance of social institutions and a decentralisation of former national government tasks to regional and local governments.

Section 6 examines regulatory measures, financial incentives and facilitative measures respectively, and discusses how these measures target agri-environmental public goods in the Netherlands.

Table 7. Overview of agri-environmental policy measures in the Netherlands

Measure/Country	Importance
Regulatory measures	
Regulatory Requirements	XXX
Environmental taxes/charges	X
Environmental cross-compliance	XX
Financial incentives	
Payments based on farming practices	XXX
Payments based on land retirement / acquisition	X
Payments based on farm fixed assets	X
Payments based on outcomes	NA
Tradable rights/permits	X
Community based measures	X
Facilitative measures	
Technical assistance/extension	X
Support to institutions (environmental cooperatives, research and innovation programmes)	XX

NA-not applied or marginal; X-low importance, XX-medium importance, XXX-high importance.

Source: Adapted from OECD (2010b), "Policy Measures Addressing Agrienvironmental Issues", *OECD Food, Agriculture and Fisheries Papers*, No. 24, OECD Publishing, Paris.

6.1. Regulatory measures

There are three types of regulatory measures: regulatory requirements, environmental cross-compliance and environmental taxes/charges. Among these three types, the regulatory requirements are of high importance, followed by environmental cross-compliance (which partly incorporates regulatory requirements) and environmental taxes/levies. Regulatory measures (permits or licenses to produce) are used for maintaining landscape features such as wooden banks and hedgerows, water quality, water availability, soil quality and air quality, while EU environmental regulations mainly address biodiversity and (ground) water quality. Most regulatory measures target specific agri-environmental public goods, rather than targeting multiple public goods.

Environmental cross-compliance attaches agricultural income support payment to regulations and therefore mixes a financial with a regulatory measure. In order to receive full EU agricultural income support payments under Pillar 1 of the CAP, farmers must meet the cross compliance requirements. Included in cross compliance are regulations on spatial planning and environmental quality which, in the Netherlands, vary at the regional level. In general, the cross compliance requirements of the European Union comprise Statutory Management Requirements (SMRs), Good Agricultural and Environmental Conditions (GAECs), and permanent pasture preservation rules. SMRs are based on EC Directives and are thus based on legislation; they apply to all farmers regardless as to whether they receive SPS support or not. Furthermore SPS support is made conditional on meeting the requirement to preserve permanent pasture. GAECs are subject to greater Member State discretion and there is more scope for subsidiarity. The SMR and GAEC cross compliance requirements in the Netherlands are summarised in Table 8. The first five SMRs and SMR9 of Table 8 address environmental issues.

Much of the SMR coverage relates to regulating agricultural production for the purpose of disease control, traceability and welfare. The environmental aspects are related to protection of water quality (SMR3 and SMR4 based on the EC Water Frame Directive and Nitrate Directive), use of agricultural land to dispose of sewage (SMR3), control of the use of agri-chemicals (SMR9), and protecting wildlife and habitats (SMR1 and SMR5 covering the EC birds and habitat directives). Included also is legislation protecting special designated areas recognised at national and EU level as key habitats for wildlife (SMR5). The importance of birdlife as part of farmland ecology at Dutch and EU levels is evidenced by the inclusion of general requirements to protect wild birds (SMR1). SMR2 prohibits discharging waste water without a licence.

Most regulatory measures are included in the SMR under cross compliance. Dutch regulations include, for example, special thresholds for large intensive livestock units (i.e. over 40 000 places for poultry, 2 000 places for production pigs (over 30 kg) and/or 750 places for sows). Larger units require a permit from the municipality to operate (Infomil, 2002). Within vulnerable zones near ecological networks additional restrictions on development override some of the exceptions that are generally granted to development and activities related to agriculture. In the Netherlands, the Integrated Pollution Prevention and Control (IPPC) guidelines that regulate these thresholds are implemented in the Ammonia and Livestock Act / General Environmental Act (WAV/WM) environmental legislation (Infomil, 2002). Other regulatory measures involve the protection of some landscape features through local spatial zoning plans.

Table 8. GAECs and SMRs in the Netherlands

Good Agricultural and Environmental Conditions		Statutory Management Requirements	
GAEC 1	*Soil Protection against erosion*	*SMR1*	*Wild birds*
GAEC 2		*SMR2*	*Ground Water*
GAEC 3	*Soil organic content*	*SMR3*	*Sewage sludge*
GAEC 4	*Minimum maintenance and retention of habitats*	*SMR4*	*NVZs (Nitrate Vulnerable Zones)*
GAEC 5	*Water protection and water management*	*SMR5*	*Habitats/Special Protection Areas (SPAs)*
GAEC 6	*Fertilisation application*	*SMR6*	*Pig identification and traceability*
	Pesticides application	*SMR7*	*Cattle identification and traceability*
		SMR8	*Sheep and goat ID & traceability*
		SMR9	*Plant protection products*
		SMR10	*Hormones in animals*
		SMR11	*Food and animal feed safety*
		SMR12	*BSE prevention*
		SMR13	*Foot and Mouth Disease (FMD) prevention*
		SMR14	*Swine Vesicular Disease (SVD) prevention*
		SMR15	*Blue tongue disease prevention*
		SMR16	*Pig animal welfare*
		SMR17	*Calves animal welfare*
		SMR18	*Farmed animals welfare*

Dutch GAEC cross compliance requirements are mostly supportive of legal requirements for all farmers receiving SPS payments. The exceptions are the soil protection review (GAEC 1) which applies only to farmers in the hilly parts of the province of Limburg and water management (GAEC 4). The latter prohibits irrigation in cases where a permit is required. This requirement depends on the criteria set by the regional water board.

Taxes, the third category of regulatory measures, are mainly used by water boards and municipalities in relation to real estate. One of the most important tasks of the water boards is to keep land behind the dykes safe from flooding and provide sufficient drainage in wet periods. For these services, the land is taxed according to a classification system. Nature reserves and land outside the dykes have lower levies than for instance agricultural land. Other Dutch environmental taxes are applied on fuels and energy. In addition to the Value Added Tax (VAT) these goods are taxed with an environmental excise duty.

6.2. Financial incentives

Financial incentives mainly apply to agri-environmental public goods provided beyond the reference levels, such as landscapes and biodiversity. The CAP provides governments with the possibility to use part of the national financial envelope of support to grant specific support to farmers for (statutory) activities among others in the field of nature, the environment, water or landscape (Council Regulation (EC) No 73/2009, Article 68). For 2010-13, the Netherlands budgeted EUR 122 million for the protection or

enhancement of the environment, animal welfare, specific disadvantages affecting vulnerable types of farming, and insurance (ECA, 2013). For landscape and biodiversity, a broad range of agri-environment measures are designed. Although there is some national co-ordination, the schemes are different in each province, with some focusing more on landscape features and botanical measures, while others focus mainly on meadow bird protection.

Since 2007, the Dutch provinces are responsible for most landscape and biodiversity policies, including land acquisition for new nature reserves within the ecological network. The decentralisation resulted due to a change in policy style based on the principles of subsidiarity. These principles are also embraced by institutions such as the European Landscape Convention (Roetemeijer, 2005). There are three types of Agri-Environment Schemes (AES): landscape schemes that address the maintenance of landscape features outside the productive area of the farm; standard area-based schemes that impose some restrictions on normal farming practices, such as a delayed mowing regime or restricted fertiliser use; and a land retirement facility to change the function in the spatial zoning plan to nature, similar to the acquisition programme described in Box 1. A variant is the current experiment with the concept of "Farming for Nature." With this concept a low nutrient cycle is established within the whole farming system by prohibiting fodder and fertiliser purchases in return for a yearly payment per hectare (Stortelder et al., 2001). All agri-environmental payments to farmers are based on the principle of income foregone and costs incurred (plus up to 20% for transaction costs). The schemes are normally co-financed under Pillar 2.

Box 3. An example of providing agri-environmental public goods through collective action

Grassland birds are the most important public good provided by regional farming co-operatives in the Netherlands. The Water, Land & Dijken (WLD), the province of North Holland and other non-governmental parties, such as farmers, volunteers and conservation organisations, work collectively for preserving grassland birds in Laag Holland (Lower Holland). The implementation of the scheme by the WLD takes place close to farms, thus substantially increasing the uptake. For example, the WLD makes individual contracts with participating farmers to selectively cut and re-distribute part of the payments they receive from the National Paying Agency. This "skimmed" budget is used for result-oriented payments (according to the number of nests protected) and for private conservations contracts, especially last-minute measures. For example, when a field is going to be mowed, but is still densely populated with birds, the WLD can agree with the farmer to postpone mowing.

The European Commission's proposals for the CAP 2014-2020 include a new formal position for collective action, mentioning "groups of farmers" as potential applicants and beneficiaries under the agri-environmental part of the proposals for rural development. The proposals also mention broader possibilities for EU support for co-operative actions, including the organisational costs involved. The WLD is pleased with these possibilities and is now formulating ideas for the following.

- The practical implementation of these new possibilities.
- Extending the role of regional co-operatives to first pillar CAP payments (direct payments), where 30% of the budget is reserved for environmental measures. Co-operatives could also play an important role in developing an effective "collective delivery."

Source: OECD (2013b), *Providing Agri-environmental Public Goods through Collective Action*, OECD Publishing.

The Dutch government is experimenting with new institutional arrangements such as environmental co-operatives. Meadow bird protection works best when concentrated and applied in large areas. To achieve this, farmers in such areas need to co-operate with each other. The first agri-environmental associations were founded in the 1990s. Today there are almost 200 such associations acting as communities of practice and some are experimenting with new contract forms with the government with the idea of generating

better results through self-organisation of the necessary ecological connectivity of the community. The government will then have a contract with the farmers' agri-environmental association instead of with individual farmers. In 2011, the Ministry of Economic Affairs issued four pilot projects in different parts of the Netherlands. The agri-environmental association Water, Land & Dijken (WLD) was one of the chosen environmental cooperatives. This case was also presented in the OECD study on collective action (OECD, 2013b).

6.3. Facilitative measures

The Netherlands has a long standing history of a "golden triangle" policy. In the past, the combination of policy, research and farm extension services made the Dutch AgroFood sector very successful. With the government gradually drawing back from major subsidy programmes in favour of self-regulation by different sectors, there is a greater role for facilitative measures. However, most facilitative programmes for support of agri-environmental public goods are short-lived, linked to specific projects on an *ad hoc* basis. Furthermore, farm extension services are no longer under government control and it is up to individual farmers to acquire their knowledge and advisory services of the market.

On biodiversity, a facilitative programme of the Ministry of Economic Affairs called Business and Biodiversity grants subsidies to enterprises (not only to agricultural enterprises) to engage in pilot projects that reduce negative impacts on biodiversity. The subsidy Cooperation in Innovation projects specifically targets farmers and small and medium enterprises (SME) in the agricultural sector. The costs of innovation projects in the field of climate change, water management, renewable energy or biodiversity should be at least EUR 10 000 for a project to become eligible. At least one farmer should participate in the project.

Through the Rural Development Programme, Pillar 2 subsidies have been used to stimulate the founding of environmental co-operatives. In addition, part of the agri-environmental payments can be used for organisational costs of environmental cooperatives.

To reduce emissions of ammonia from agriculture, there is a specific subsidy from the Communities of Practice which is aimed at networks with at least eight participants. Farmers, SME Agro-businesses and knowledge institutions can participate. The programme offers a maximum grant of EUR 250 000 and a minimum of EUR 100 000, and a 70% contribution towards costs.

A recent top sector policy in the Netherlands, in which the Dutch government seeks Public Private Partnerships with the whole production chain to innovate and acquire a strong position in the world, is "Agro Food". Sustainability is a key issue for the Top Sector AgroFood and after consulting important stakeholders, such as farmers' organisations and environmental NGOs, much of the combined R&D budget is directed to it.

For the top sector policies, "AgroFood" and "Horticulture" emission reductions of greenhouse gasses is a key element in their sustainability agenda, and their research and innovation agenda pays much attention to this.

6.4. Agri-environmental public goods and policy measures

Table 9 summarises agri-environmental policy measures and their targeted agri-environmental public goods. To date, the emphasis in the Netherlands has mainly been in

finding a balance between regulations, much of which is included in cross compliance within the CAP, and payments for voluntary agri-environment measures. Both types of instruments will be modified by the recent CAP reforms; new measures are not yet finalised and are not covered in this section.

Table 9 reveals that the Dutch government is presently aiming at multiple targets and using multiple instruments to achieve these targets. This policy mix is driven by the quest for proper alternatives for government financing of agri-environmental goods. Many questions remain related to measuring agri-environmental public goods and to the way in which they interfere which each other. This explains the high number of experiments of the Dutch government.

Another transition affecting Dutch agri-environmental policies is the general aim of the Dutch government to support a greater role for the civil society and give room for the self-organisation of sectors. This implies a retreat from top-down regulation and subsidy programmes and suggests a shift towards facilitative policies. The Dutch experiments with community-based agri-environment measures and decentralised structures for consultation also fit into this picture. It is expected that new institutional arrangements in accordance with the principles of self-regulation and subsidiarity will yield better results in terms of mutual trust, motivation and transaction costs (Polman, 2002). Although the changes will probably be evolutionary rather than revolutionary, the transition can be expected to alter the balance between regulatory measures, financial incentives and facilitative measures. These policy changes are still at an early stage and not evaluated extensively; it would therefore be premature to draw conclusions. Early results show a mixed picture and many issues need to be resolved (Termeer et al., 2013).

Cross compliance influences agricultural landscapes, bio-diversity, soils and water quality and quantity. It is an instrument that prevents farmers who do not comply with the minimum EU-standards from receiving income support. Many of these measures are statutory requirements affecting all farmers. Some farmers are not in SPS and therefore not subject to cross compliance (but are fully subjected to the existing statutory requirements), particularly in some intensive livestock systems (pigs and poultry) and horticulture sectors. This is a result of the focus of SPS on farms with a history of claims in the production support era. Following the CAP reforms, farmers will receive flat rate payments regardless of previous historical claims, as is the case in England. This will hardly affect the intensive agricultural systems in the Netherlands (with the exception of calf fattening) since those systems do not rely on land.

Recently, agri-environmental subsidy schemes in the Netherlands have been heavily criticised as being ineffective in protecting endangered species (RLI, 2013). The lack of results re-opens the discussion on approaches based on effort (measure) or results (outcome). The arguments of farmers associations to favour the effort-oriented approach have always been that the fundamental unpredictability of nature and factors from outside the farm could not guarantee that efforts would pay off. With future agri-environment schemes largely in control of environmental co-operatives, acting as a collective in co-ordinating measures within a larger area, some elements of outcome-based payments might be re-considered.

Table 9. Agri-environmental Policy Measures in the Netherlands

AE public goods	Measures									
	Regulatory			Financial						Facilitative
	Regulatory requirements	Environmental taxes/ charges	Environmental cross-compliance	Payments based on farming practices	Payments based on land retirement	Payments based on farm fixed assets	Payments based on outcomes	Tradable rights /permits	Community based measures	Technical assistance/ extension/ R&D/ labelling/ standards/ certification
Agricultural landscapes	Wro, Boswet	WSH	CC	SNL	SNL			RvG (experimental)	GLB pilots (experimental)	Most facilitative subsidies are on ad hoc basis at present
Biodiversity	FFW, NBW, WBD, HD		CC	SNL, BvN	SNL, BvN	MIA +Vamil		RGP	GLB pilots (experimental)	B+B, CI, TSAF
Water quality	MW, WW, WBB. ND, IPPCD, WFD		CC							
Water quantity/ availability	WW, WSW, WFD	WSH	CC	GBDA	GBDA					
Soil protection and quality	WW		CC							
Climate change – carbon storage						MIA +Vamil			TSAF	TSAF
Climate change – greenhouse gas emissions	NECD	MH	CC			MIA +Vamil		RED	TSAF	TSAF, TST
Air quality	WAV /WM, NECD		CC			MIA +Vamil				SP
Resilience to flooding			CC							FD

Source to Table 9: Matrix format is developed based on Ribaudo, M., L. Hansen, D. Hellerstein and C. Greene (2008), *The Use of Markets to Increase Private Investment in Environmental Stewardship*, United States Department of Agriculture, Economic Research Service, Economic Research Report Number 64, Washington D.C. and OECD (2010b), "Policy Measures Addressing Agrienvironmental Issues", *OECD Food, Agriculture and Fisheries Papers*, No. 24, OECD Publishing, Paris.
Acronyms: B+B –Biodiversiteit en Bedrijfsleven (Biodiversity and Business), Boswet (Forest Act), BvN – Boeren voor Natuur (Farming for Nature), CC – Cross Compliance, CI – Cooperation and Innovation , FD – (EC) Flood Directive, FFW – Flora en Faunawet (Flora and Fauna Act) , GBDA – GroenBlauwe dooradering (Green veins), GLB pilots – pilots gemeenschappelijk landbouwbeleid (Common Agricultural Policy pilots), HD – (EC) Habitats Directive, IPPCD – (EC) Integrated Pollution Prevention and Control Directive, NBW – Natuurbeschermingswet (Nature Protection Act), ND – (EC) Nitrates Directive, NECD – (EC) National Emission Ceiling Directive, MIA + Vamil – Milieu Investeringsaftrek + willekeurige afschrijving milieuinvesteringen (Environmental tax reduction programmes), MH – Milieuheffing (Environmental levy on energy / fuel) MW – Meststoffenwet (Fertilizer application law), RED – (EC) Renewable Energy Directive, RGP – Regeling GroenProjecten (Green Projects – fiscal arrangement for green projects), RvG – Rood voor Groen (Red for Green), SNL – Subsidieregeling Natuur en Landschap (Subsidies scheme for Nature and Landscape), SP – Subsidieregeling Praktijknetwerken (Subsidy for Community of Practise to reduce ammonia emissions), TSAF – TopSector AgroFood, TST – Topsector Tuinbouw (Topsector Horticulture), WAV – Wet Ammoniak en veehouderij (Ammonia and Livestock Act) , WBB – Wet bodembescherming (Soil Protection Act) , WBD – (EC) Wild Birds Directive, WFD – (EC) Water Framework Directive, WM – Wet milieubeheer (Environmental Management act), Wro – Wet ruimtelijke ordening (Spatial planning act), WSH – Waterschapsheffing (Water board districts levy), WSW – Waterschapswet (Water Board District Act), WW – Waterwet (Water act).

The implementation of the new CAP for the period 2014-2020 continues the greening process of the agricultural sector. It requires that farmers wishing to make use of direct payments to put greening measures in place that were agreed to at the European level (Ministry of Economic Affairs, 2013).

- Crop diversification. Farmers will be required to cultivate a diversity of (three) crops on their arable land, with exceptions made for small farms. National discretion is not allowed.
- Maintenance of permanent grassland.
- Farmers must designate 5% of arable land as an Ecological Focus Area (EFA). These areas include landscape elements (e.g. wooded banks, hedgerows, and ponds), field margins, buffer zones and land with nitrogen fixing crops.

7. Conclusion

This study reviews policy measures for providing agri-environmental public goods in the Netherlands. It is one of the first studies to try to synthesise a broad range of agri-environmental policies and agri-environmental public goods in the Netherlands.

Dutch agri-environmental policies target nine agri-environmental public goods: agricultural landscapes, biodiversity, water quality, water quantity/availability, soil protection and quality, climate change – carbon storage, climate change – greenhouse gas emissions, air quality and resilience to flooding.

Most agri-environmental public goods are jointly produced with agricultural and food production activities. In the absence of functioning markets for these agri-environmental public goods, their provision levels are mainly affected by various government incentives (regulatory, financial and facilitative). The greatest range and quantity of agri-environmental public goods is associated with extensive grazing livestock farms. Some of these farms are associated with High Nature Value farming. Arable cropping and intensive grazing livestock farms deliver limited, but nonetheless important agri-environment public goods. Intensive livestock systems and greenhouses are mainly associated with environmental costs. The objective of agri-environmental policy should be to minimise those negative impacts from agriculture and in doing so contribute to the provision of agri-environmental public goods elsewhere. Some agri-environmental public goods are delivered through historic or cultural infrastructure and management practices which may no longer be directly linked to mainstream agriculture (for instance, landscape elements such as tree hedgerows and ditches). In order to secure an adequate amount of provision, policy measures have targeted the drivers influencing the provision of agri-environmental public goods, rather than the agri-environmental public goods themselves.

Limited proxy data suggest there is a strong demand for agri-environmental public goods in the Netherlands, and which is even increasing because of the deterioration of the environment. There is, however, a mixed picture in terms of the supply of these goods, with some increasing, others decreasing, and a number that are unclear. Overall, this implies that some if not all agri-environmental public goods (agricultural landscape, biodiversity, soil quality and carbon storage) are under-provided. However, we did not find solid evidence for the undersupply of agri-environmental public goods. This study is based on the national level, but most agri-environmental public goods are demanded and supplied at a local scale. Whether there is undersupply of agri-environmental public

goods or not has to be examined for each good at an appropriate scale. More detailed analysis is left for future study.

In order to achieve agri-environment priorities in the Netherlands, there is a combination of regulatory (much of which is included in cross compliance with CAP payments), financial and facilitative incentives. However, there is a tendency to simplify regulations and to give an enhanced role to civil society. Through the concept of self-regulation the government also expects that transaction costs can be lowered. The reform of the CAP and the general trend towards deregulation means that the nature and balance of programmes will be altered over the period 2014-2020.

For some agri-environmental public goods (logically those which are mainly negatively affected by agriculture, such as water quality and climate change), farmers are required to meet reference levels at their own costs via regulatory measures. Negative financial incentives (taxes or charges) are used at present only for fuel and energy consumption affecting all sectors. Some discussion on expanding their scope might be useful. In addition, policy measures that target environmental outcomes (output-based policy measures) should be adopted to increase the cost-effectiveness of agri-environmental policy measures, as long as agri-environment management can collectively be organised in larger areas. The co-ordination of different policy measures to secure the effective and efficient delivery of agri-environmental public goods could also usefully be discussed.

The costs associated with the provision of agri-environmental public goods also need to be reviewed. Not all agri-environmental public goods have clear reference levels and environmental targets; where this is the case, they are not presented and communicated clearly and coherently. While cross compliance conditions comprise the reference levels for most goods, the reference levels for the remaining goods are based on current farming practices. This implies that the government may need to make payments to achieve more sustainable farming practices. There could be value in discussing and reviewing to what extent farmers should bear the costs and to what extent governments/society should bear the costs. In addition, some agri-environmental public goods have use values which could be taken into account. Community-based approaches can be particularly important in this case as they can involve some beneficiaries of these use values.

Annex Table 1. Reference levels and agri-environmental targets in the Netherlands

1) Agricultural landscapes	
Environmental targets	There are national targets only in "National landscapes" (areas with outstanding natural and cultural values), but not in other areas. However, the Netherlands is a signatory to the European Landscape Convention which provides a framework for landscape-focused activity. Landscape is a key objective of agri-environment schemes and integrated into priorities for agri-environment scheme targeting. Provinces and municipalities are responsible for the landscape quality. The national government offers assistance (providing guidelines, monitoring, support for landscape organisations and research among others).
Reference level	GAECs covering hedges, rows of trees and other landscape features under cross compliance.
2) Biodiversity	
Environmental targets	Key targets in the Netherlands are the further and integrated development of the National Ecological Network and Natura2000 sites. In some parts agriculture can play a significant role. The Netherlands also endorsed to the EU Biodiversity Strategy. One of the goals of the framework is to reduce the direct pressures on biodiversity and promote sustainable use, which includes agricultural land.
Reference level	GAECs covering special sites, environmental impact assessments, over/under grazing and burning, as well as SMRs covering wild birds and habitats (SMRs 1 and 5), all under cross compliance.
3) Water quality	
Environmental targets	The Netherlands is implementing the EC Water Framework Directive (WFD) which seeks to establish a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters (to one nautical mile) and groundwater. The overall aim is for the "water bodies" and "protected areas" within each River Basin District to achieve good ecological status by 2015. Reduction of diffuse water pollution from agriculture is key to meeting WFD targets in many catchments.
Reference level	GAECs covering soil protection, and no spread zones, as well as SMRs covering groundwater and nitrate vulnerable zones (SMRs2 and 4), all under cross compliance. This includes a maximum of 170kg N/ha for livestock manure, although this is subject derogations, awarded on a country by country basis, to permit up to 250kg N/ha in certain conditions.
4) Water quantity/ availability	
Environmental targets	No national targets. However, there is an EU target to promote the sustainable use of water and mitigate the effects of drought under the EC Water Framework Directive.
Reference level	GAEC covering water abstraction under cross compliance. This links to farmer compliance with water abstraction licences in accordance with the CAP income support regulation of 2006.
5) Soil protection and quality	
Environmental targets	No national targets. However, the EC Soil Thematic Strategy seeks to ensure the sustainable use of soils by preventing further degradation and restoring degraded soils.
Reference level	GAECs covering soil protection, stubble management, green manure crops, under grazing, as well as SMRs covering ground water, sewage sludge and nitrates (SMR 2,3 and 4), all under cross compliance.
6) Carbon storage	
Environmental targets	No national targets. However, the EC Soil Thematic Strategy seeks to ensure the sustainable use of soils and the Kyoto Protocol seeks to protect soils as carbon stores.
Reference level	No national baseline (Current farming practices are equal to reference levels)
7) Greenhouse gas emissions	
Environmental targets	A conditional 40% reduction of greenhouse gas emissions from all sectors in 2030. For agriculture this means a reduction from approximately 17 MtCO2e in 2010 to 10 MtCO2e in 2030. The government is pursuing a voluntary approach, based on covenants with the sector. In the 2008 covenant "Schoon en Zuinig" (Clean and Efficient), the sector agreed upon a reduction target of 30% from 1990 to 2020.
Reference level	No national baseline (Current farming practices are equal to reference levels)
8) Air quality	
Environmental targets	EC National Emission Ceiling Directive and Gothenburg Protocol set national target for ammonia. As of 2010, the EU ceiling for ammonia emissions amounts to 128 kton. The projected ammonia emission amounts to 118 kton in 2020 (bandwidth 102-138), 102 kton of which is emitted by agriculture. Between 2010 and 2020 the ammonia emission will decrease with about 10% (ECN, 2010).
Reference level	GAECs covering soil protection and burning, as well as SMRs covering sewage sludge and nitrate vulnerable zones (SMRs 3 and 4), all under cross compliance. Also Integrated Pollution Prevention and Control (IPPC) requirements for intensive industrial agricultural units (mainly pigs and poultry).
9) Resilience to flooding	
Environmental targets	The EC Flood Directive seeks to reduce the probability of flooding and its potential consequences. National targets are set by the program water safety 21st century. This program seeks to reduce the probability of flooding and its potential consequences.
Reference level	No national baseline (Current farming practices are equal to reference levels)

References

CBS, PBL, Wageningen UR (2013a), *Productie van drinkwater, 1950-2011* (indicator 0045, versie 11, 15 mei 2013). www.compendiumvoordeleefomgeving.nl. CBS, Den Haag; Planbureau voor de Leefomgeving, Den Haag/Bilthoven en Wageningen UR, Wageningen.

CBS, PBL, Wageningen UR (2013b), *Emissies broeikasgassen, 1990-2011* (indicator 0165, versie 22, 26 maart 2013). www.compendiumvoordeleefomgeving.nl. CBS, Den Haag; Planbureau voor de Leefomgeving, Den Haag/Bilthoven en Wageningen UR, Wageningen.

CBS, PBL, Wageningen UR (2013c). *Land- en tuinbouw: ruimtelijke spreiding, grondgebruik en aantal bedrijven, 1980-2012* (indicator 2119, versie 04, 14 juni 2013). www.compendiumvoordeleefomgeving.nl CBS, Den Haag; Planbureau voor de Leefomgeving, Den Haag/Bilthoven en Wageningen UR, Wageningen.

CBS, PBL, Wageningen UR (2012a), *Vermesting in regionaal water, 1990 – 2010* (indicator 0552, versie 04, 12 september 2012). www.compendiumvoordeleefomgeving.nl. CBS, Den Haag; Planbureau voor deLeefomgeving, Den Haag/Bilthoven en Wageningen UR, Wageningen.

CBS, PBL, Wageningen UR (2012b), *Gewasbeschermingsmiddelen in oppervlaktewater, 2010* (indicator 0547, versie 03, 15 februari 2012). www.compendiumvoordeleefomgeving.nl. CBS, Den Haag; Planbureau voor de Leefomgeving, Den Haag/Bilthoven en Wageningen UR, Wageningen.

CBS, PBL, Wageningen UR (2012c), *Waterwinning en watergebruik in Nederland, 1976-2009* (indicator 0057, versie 09, 2 juli 2012). www.compendiumvoordeleefomgeving.nl. CBS, Den Haag; Planbureau voor de Leefomgeving, Den Haag/Bilthoven en Wageningen UR, Wageningen.

CBS, PBL, Wageningen UR (2012d), *Geurhinder per bron, 1990-2011* (indicator 0290, versie 10, 26 juli 2012). www.compendiumvoordeleefomgeving.nl. CBS, Den Haag; Planbureau voor de Leefomgeving, Den Haag/Bilthoven en Wageningen UR, Wageningen.

CBS, PBL, Wageningen UR (2008), *Oorzaken en effecten van verdroging* (indicator 0278, versie 03, 4 April 2008). www.compendiumvoordeleefomgeving.nl. CBS, Den Haag; Planbureau voor de Leefomgeving, Den Haag/Bilthoven en Wageningen UR, Wageningen.

CBS, PBL, Wageningen UR (2003), *Verdroogde gebieden in Nederland, 2000* (indicator 0280, versie 03, 2 December 2003). www.compendiumvoordeleefomgeving.nl. CBS, Den Haag; Planbureau voor deLeefomgeving, Den Haag/Bilthoven en Wageningen UR, Wageningen.

Chan, K.M.A., T. Satterfield and J. Goldstein (2012), "Rethinking Ecosystem Services to Better Address and Navigate Cultural Values". *Ecological Economics*, Vol. 74, pp. 8-18.

Cooper, T., K. Hart and D. Baldock (2009), *The Provision of Public Goods through Agriculture in the European Union*, report prepared for DG Agriculture and Rural Development, Contract No 30-CE-023309/00-28, Institute for European Environmental Policy, London.

De Vries, S., J. Roos-Klein Lankhorst and A. E. Buijs (2007), "Mapping the Attractiveness of the Dutch Countryside: a GIS-based Landscape Appreciation Model". *Forest Snow and Landscape Research*, Vol. 81, No. 1/2, pp. 43-58.

Deltares (2011), *Maatschappelijke kosten-batenanalyse Waterveiligheid 21^{e} eeuw*, Deltares, Delft

EC (2011a), *Attitudes of European Citizens towards the Environment*, Special Eurobarometer 365, European Commission, Brussels

EC (2011b), *A Roadmap for Moving to a Competitive Low Carbon Economy in 2050*, COM(2011) 112 final, European Commission, Brussels

EC (2010), *Europeans, Agriculture and the Common Agricultural Policy*, Special Eurobarometer 336, European Commission, Brussels

EC (2008), *Attitudes of European Citizens towards the Environment*, Special Eurobarometer 295, European Commission, Brussels

EC (2006), *Development of Agri-environmental Indicators for Monitoring the Integration of Environmental Concerns into the Common Agricultural Policy*, COM(2006)508 final, European Commission, Brussels

EC (2005), *The Attitudes of European Citizens towards the Environment*, Special Eurobarometer 217, European Commission, Brussels

ECA (2013), Common agricultural policy: is the specific support provided under article 68 of council regulation (ec) no 73/2009 well designed and implemented?, Special Report No 10, Publications Office of the European Union, Luxembourg

EC JRC (2009), *Water Erosion and Compaction*, SoCo fact sheet no 2, European Commission Joint Research Centre, Brussels

ECN, PBL (2010), *Reference Projection Energy and Emissions 2010-2020*, ECN / PBL, Petten / Den Haag

Franks, J. R. and A. Mc Gloin (2007), "Environmental Co-operatives as Instruments for Delivering across-farm Environmental and Rural policy objectives: Lessons for the UK". *Journal of Rural Studies*, Vol. 23, pp. 472-489.

Hendriks, D.M.D, G. de Lange en G. Erkens (2012a), *Broeikasgasuitstoot en peilbeheer in het veenweidegebied: Verkenning van effecten van flexibel peilbeheer op broeikasgasuitwisseling in pilotgebieden van het Flexpeil*, Deltares, Delft

Hendriks, K., L. Braat, A. Ruijs, P. van Egmond, D. Melman, M. van der Heide, C. Klok, A. Gaaff en F. Dietz, (2012b), *TEEB voor Fysiek Nederland. Voorstudie*, Alterra-rapport 2358, Alterra, Wageningen

Hessel, R. J. Stolte en M. Riksen (2011), *Huidige maatregelen tegen water- en winderosie in Nederland*, Aterra rapport 2131, Alterra, Wageningen.

Infomil (2002), *Handreiking: Ammoniak en veehouderij*, Infomil, Den Haag

Jones, J., P. Silcock and T. Uetake (2015), "Public Goods and Externalities: Agri-environmental Policy Measures in The United Kingdom", *OECD Food Agriculture and Fisheries Papers*, OECD Publishing.

Kuikman, P.J. (2004), *Soil Organic Matter*, in: Römkens, P.F.A.M. and O. Oenema (eds). *Quick Scan Soils in The Netherlands. Overview of the Soil Status with Reference to the forthcoming EU Soil Strategy*, Alterra-rapport 948. 96 blz. 13 figs.; 6 tables, Alterra part of Wageningen UR, Wageningen

Kuikman, P. J., W. J. M. de Groot, R. F. A. Hendriks, J. Verhagen and F. de Vries (2003), *Stocks of C in Soils and Emissions of CO^2 from Agricultural Soils in the Netherlands*, Alterra-rapport 561, Wageningen.

Kleijn, D., W. Dimmers, R. van Kats and D. Melman (2009), "Het belang van hoog waterpeil en bemesting voor de Grutto: 1. de vestigingsfase", *De Levende Natuur*, Vol. 110, No. 4, pp. 180-183.

Lamy, P. (2004), *The Emergence of Collective Preferences in International Trade: Implications for Regulating Globalisation*, address 15-9-2004, Brussels

Melman, Th. C.P., W. A. Ozinga, A. G. M. Schotman, H. Sierdsema, R. A. M. Schrijver, G. Migchels and T. A. Vogelzang (2013), *Agrarische bedrijfsvoering en biodiversiteit; kansrijke gebieden, samenhang met bedrijfstypen, perspectieven*. Alterrarapport 2436, Alterra,Wageningen.

Ministry of Economic Affairs (2013), *Implementation Common Agricultural Policy*, letter to the House of Representatives on 6 December 2013, The Ministry of Economic Affairs, The Hague.

MinELI (2006), *Netherlands' Rural Development Strategy 2007-2013*, The Managing Office for the Rural Development Programme, The Ministry of Economic Affairs, Agriculture and Innovation (MinELI), Utrecht / The Hague.

Min IenM (2012a), *Toezicht- en naleeftekorten bij de IPPC branche intensieve veehouderij: Onderzoek naar luchtwassystemen en het effect op de ammoniakemissie*, Inspectie leefomgeving en transport, Min IenM (Ministry of Infrastructure and Environment), Den Haag.

Min IenM (2012b), *Werkprogramma stroomgebiedbeheerplannen 2015*, Min IenM (Ministry of Infrastructure and Environment), Den Haag.

Min IenM (2011*), Klimaatbrief 2050: uitdagingen voor Nederland bij het streven naar een concurrerend, klimaatneutraal Europa*, Min IenM (Ministry of Infrastructure and Environment), Den Haag.

MinLNV (2006), *Kentallen Waardering Natuur, Water, Bodem en Landschap Hulpmiddel bij MKBA's*, Min LNV (Ministry of Agriculture, Nature and Food quality), Den Haag.

MLNV (2008), *Houtskoolschets Europees landbouwbeleid 2020*, Ministerie van Landbouw, Natuur en Voedselkwaliteit, Den Haag

OECD (2013a), *OECD Compendium of Agri-environmental Indicators*, OECD Publishing. DOI: 10.1787/9789264186217-en.

OECD (2013b), *Providing Agri-environmental Public Goods through Collective Action*, OECD Publishing.
DOI: 10.1787/9789264197213-en.

OECD (2010a), *Guidelines for Cost-effective Agri-environmental Policy Measures*, OECD Publishing.
DOI: 10.1787/9789264086845-en.

OECD (2010b), "Policy Measures Addressing Agrienvironmental Issues", *OECD Food, Agriculture and Fisheries Papers*, No. 24, OECD Publishing, Paris.

OECD (2001), *Improving the Environmental Performance of Agriculture: Policy Options and Market Approaches*, OECD Publishing.
DOI: 10.1787/9789264033801-en.

Oerlemans, N., Guldemond, A., van Well, E. (2001), *Agrarische Natuurverenigingen in Opkomst, Een eerste verkenning naar natuurbeheeractiviteiten van agrarische natuurverenigingen*, Centrum Landbouw en Milieu, Culemborg.

Opdam, P.F.M., E.G. Steingröver and S.A.M. de Rooij (2006), "Ecological Networks: A Spatial Concept for Multi-actor Planning of Sustainable Landscapes", *Landscape and Urban Planning*, Vol. 75, No. 3/4, pp. 322-332.

Opperman, R., Beaufoy and G. Jones (2012), *High Nature Value Farming in Europe: 35 European countries – Experiences and Perspectives*, Verlag Regionalkultur, Ubstadt-Weiher.

Ozinga, W.A. (2008), *Assembly of Plant Communities in Fragmented Landscapes: the Role of Dispersa*l. Phd thesis, Radboud University Nijmegen, Nijmegen. Alterra, Wageningen.

Pannell, D. (2008), "Public Benefits, Private Benefits, and Policy Mechanism Choice for Land-Use Change for Environmental Benefits", *Land Economics*, Vol. 84, No. 2, pp. 225-240.

Polman, N. B. P. (2002), *Institutional Economics Analysis of Contractual Arrangements; Managing Wildlife and Landscape on Dutch Farms*. PhD thesis Wageningen University, Wageningen.

PBL (2012), *Assessment of the Human Environment 2012*, PBL Netherlands Environmental Assessment Agency, The Hague.

Ribaudo, M., L. Hansen, D. Hellerstein and C. Greene (2008), *The Use of Markets to Increase Private Investment in Environmental Stewardship*, United States Department of Agriculture, Economic Research Service, Economic Research Report Number 64, Washington D.C.

Roetemeijer, W. (2005), *The European Landscape Convention and the Netherlands, A Perfect Match? - Revised Version: An Ex-ante Evaluation of the Implementation of the European Landscape Convention in the Netherlands*, Wageningen University, Wageningen.

Rienks, W.A., W.J.H. Meulenkamp, D. de Jong, R.J.W. Olde Loohuis, P.F.M.M. Roelofs, W. Swart and T.A. Vogelzang (2008), *Grootschalige landbouw in kleinschalig landschap*. Alterra-rapport 1642, Alterra Wageningen UR, Wageningen

RIVM (2013), *Greenhouse gas emissions in The Netherlands 1990-201: National Inventory Report 2013*, National Institute for public Health and the Environment (RIVM), Bilthoven.

RIVM (2004), *Risico's in bedijkte termen: een theamtische evaluatie van het Nederlandse veiligheidsbeleid tegen overstromen*, RIVM – Milieu- en Natuurplanbureau, Bilthoven.

RLG (2007), *Publieke belangen centraal. Advies over de toekomst van het Gemeenschappelijk Landbouwbeleid*, RLG, Den Haag

RLI (2013), *Nature's imperative: Towards a robust nature policy*, Council for the Environment and Infrastructure (Rli), The Hague.

Sanders, M., W. Nieuwenhuizen, J. Dirkx, R. Schrijver en R. Smidt (2013), Bedrijfsvoering zit in de weg: landbouw slechts beperkt inzetbaar voor natuur- en landschapsbehoud. *Landschap*, Vol. 30, No. 2, pp. 57-66.

Schouten, M.A.H., N.B.P. Polman and E.J.G.M. Westerhof (2013), *Exploring Green Agricultural Policy Scenarios with a Spatially Explicit Agent-based Model*, Statutory Research Tasks Unit for Nature and the Environment (WOT Natuur and Milieu), Wageningen.

SER (2008), *CAP Reform and Public Services of Agriculture*, Abridged version of advisory report "Waarden van Landbouw", SER, Den Haag.

Smit, A. en P. Kuikman (2005), *Organische stof: onbemind of onbekend?*, Alterra raport 1126. Alterra, Wageningen.

Stichting Recreatie (2006), *Recreatie in de MKBA*, Stichting Recreatie, Kennis- een Innovatiecentrum, Den Haag.

Stortelder, A. H. F, R. A. M. Schrijver, H. Alberts, A. van den Berg, RG.M. Kwak, K.R. de Poel, J. H. J. Schaminée, I. M. van den Top en P.A.M. Visschedijk (2001), *Boeren voor natuur; de slechtste grond is de beste.* Alterra-rapport 312, Alterra, Research Instituut voor de Groene Ruimte, Landbouw-Economisch Instituut en LNVO, Wageningen / Den Haag.

TEEB (2010), *The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations*, Edited by Pushpam Kumar. Earthscan, London and Washington.

Terluin, I. J., A. Gaaff, N. B. P. Polman, J. H. Post, P. J. Rijk and M. A. H. Schouten (2008), *Bergboeren in Nederland: tegen wil en dank? (LFA farmers in The Netherlands: willy-nilly?).* Report 2008-23. LEI, part of Wageningen UR, The Hague.

Termeer, Catrien J.A.M., M. Stuiver, A. Gerritsen and P. Huntjens (2013), "Integrating Self-Governance in Heavily Regulated Policy Fields: Insights from a Dutch Farmers' Cooperative", *Journal of Environmental Policy and Planning*, DOI:10.1080/1523908X.2013.778670.

Uetake, T. (2015), "Public Goods and Externalities: Agri-environmental Policy Measures in Japan", *OECD Food Agriculture and Fisheries Papers*,OECD Publishing.

Van den Akker, J.J.H. (2004), *Soil compaction* in: Römkens, P.F.A.M. and O. Oenema (eds). *Quick Scan Soils in The Netherlands. Overview of the soil status with reference to the forthcoming EU Soil Strategy*, Alterra-rapport 948. 96 blz. 13 figs.; 6 tables, Alterra part of Wageningen UR, Wageningen.

Van den Akker, J.J.H., F. de Vries, G.D. Vermeulen, M.J.D. Hack-ten Broeke en T. Schouten (2012), *Risico op ondergrondverdichting in het landelijk gebied in kaart.*, Alterra-Rapport 2409, Alterra, Wageningen.

Van Doorn, A. and B. Elbersen (2012), *Implementation of High Nature Value farmland in agri-environmental policies. What can be learned from other EU member states*?, Alterra Report 2289, Alterra part of Wageningen UR, Wageningen.

Westerink, J., A.H.F. Stortelder, F.G.W.A. Ottburg, T.A. De Boer, R.A.M. Schrijver, C.K. de Vries, M. Plomp, E.A.A. Smolders, A.T.W. Eysink en G.H. Bulten (2013). *Boeren voor Natuur; Hoe werkt het en wat levert het op?* Wageningen, Alterra Wageningen UR (University & Research Centre), Alterra-rapport 2472. 144 blz.; 27 fig.; 22 tab.; 89 foto's; 61 ref.