8 Agriculture

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The Flemish agricultural sector is subject to strong economic, ecological and social changes (SALV 2017, LARA 2018, 2020, NARA 2020). Increasingly pronounced global warming, with more frequent and more intense heat waves and droughts, also contribute to this (IPCC 2019, Droogterapporten VMM). Coastal agriculture[1] is no exception and has experienced some noticeable changes in recent years (Regions datasets West Flanders Development Agency, provincies.incijfers.be, Department of Agriculture and Fisheries, Rede Gouverneur 2019). For example, there is a shift from traditional farm-based agriculture to large-scale, digital and sustainable agricultural practices, and cultivated land[2] is increasingly being used as a private garden or horse pasture. In addition, the sector is constantly seeking a balance with other user functions such as urbanisation, other economic developments and nature development. Nevertheless, as an inseparable part of the agro-food system, agriculture in the coastal zone still has an important economic value (Department of Agriculture and Fisheries). Many ecosystem services linked to agriculture also offer important societal advantages. Coastal agriculture forms a green oasis with various recreational assets, it is important in terms of water regulation and it offers a unique landscape with a typical biodiversity[3]. The large-scale historical land reclamations that resulted in today's typical landscape of waterways, dikes and agricultural landscapes with permanent grasslands have their origin in agriculture (Soens 2009).

However, agricultural activities also exert a significant impact on the marine environment. In particular, the nutrients (mainly nitrogen (N) and phosphorus (P)) coming from manure pose a problem. The situation is especially problematic in the southern part of the North Sea, the English Channel and close to shore (OSPAR QSR 2023). The most recent assessment of the Marine Strategy Framework Directive (MSFD, Directive 2008/56/EC) shows that about 30% of our North Sea contains an excess of nutrients (Desmit et al. 2018). The eutrophication problem however, is not entirely related to coastal agriculture. Nutrients from inland areas that reach the coast via waterways, also contribute to this problem. Conversely, marine influences can also put pressure on coastal agriculture, particularly through salinisation of the soil (TOPSOIL). However, there may be opportunities in the shape of halophile crops and smart water management (SALFAR, Rede Gouverneur 2019, Internet of Water).

8.1 Policy context

Within the framework of the European Green Deal (COM (2019) 640), the European Commission proposed a Farm-to-Fork Strategy (COM (2020) 381) for a fair, healthy and environmentally friendly European food system. This strategy includes both regulatory and non-regulatory initiatives, with the Common Agricultural and Fisheries Policy as the main instrument to support an equitable sustainable transition.

The Common Agricultural Policy (CAP) is the core of European agricultural policy and is determined by the Directorate-General for Agriculture and Rural Development (DG AGRI) of the EC, the European Council and the European Parliament (more information: De Europese Unie in het kort: landbouw 2017). A new CAP (2021-2027) will come into force in 2023, until then there is a transitional period. Unlike the CAP 2014-2020, Pillar I (income support and market measures) and II (rural development[4]) will be compiled in a single Strategic Plan (Flemish Rural Network, Department of Agriculture and Fisheries). The new CAP is based on nine objectives and aims at a vital and fully sustainable agricultural sector that can respond to major contemporary challenges such as climate change and biodiversity loss (IPCC, EEA 2020).

At the Flemish level, the agricultural policy is outlined by the Flemish minister of Agriculture (see also policy paper Agriculture and Fisheries 2019-2024), advised by the Strategic Advisory Council for Agriculture and Fisheries (SALV) and the Environment and Nature Council (Minaraad). The agricultural policy is oriented around eight strategic objectives that should guarantee a fair and viable income for the farmer towards a sustainable agricultural model. The policy also focuses on innovative business models, organic farming, agro-environmental/ climate measures, agro-ecology, and wants to support and stimulate short-chain farming (more on the current Flemish (policy) initiatives concerning the greening of agriculture, see **8.5 Sustainable use**). The Department of Agriculture and Fisheries is responsible for preparing, implementing and evaluation of the policy. The policy is supported by the Flanders Research Institute for Agriculture, Fisheries and Food (ILVO), the Flanders Agricultural Marketing Board (VLAM) and the SALV.

[1] Unless stated otherwise, the coastal zone comprises the ten coastal municipalities (Blankenberge, Bruges, Knokke-Heist, Bredene, De Haan, Middelkerke, Ostend, De Panne, Koksijde and Nieuwpoort) and nine hinterland municipalities (Damme, Jabbeke, Zuienkerke, Diksmuide, Lo-Reninge, Gistel, Oudenburg, Alveringem and Veurne).
[2] Cultivated land includes the space occupied by the crop as well as the associated uncultivated areas: meadows, hedges, verges, passages, etc.
[3] Because of the marine focus, the ecosystem services mentioned will not be discussed further here. The issues concerning tourism and recreation, and nature in the coastal area are dealt with in the respective thematic chapters of the **Knowledge Guide Coast and Sea 2022** (Dauwe et al. 2022).
[4] Up to 2020, this was implemented through the Rural Development Program III (VLM, Department of Agriculture and Fisheries).

The provincial agricultural policy is governed by three bodies: the Provincial Executive for Agriculture, the Beleidskern Economie and Inagro (policy implementation, practice-oriented research and advisory services). The provinces play an important role mainly through practice-oriented research and information centres. Moreover, the Province of West Flanders also supports innovation and short-chain agriculture. The provincial authorities also have indirect responsibilities with regard to permit policy, spatial planning and the maintenance (carried out by the public polder authorities) of 2nd category unnavigable waterways (see also websites Province of West Flanders, Meerjarenplan 2020-2025, Inagro, Waterlopenbeheer West-Vlaanderen).

Additionally, agricultural policy is connected to other policy areas and bodies such as the Flemish environmental policy (inspiration note) and the Federal Agency for the Safety of the Food Chain (FASFC). More on the developments in international/European and Flemish agricultural policy can be found in LARA 2014, 2018, 2020 and Investeren in landbouw in België: 2014-2016 (2016) and on the website of the Department of Agriculture and Fisheries. In the Codex Coastal Zone, theme Agriculture, you can find a comprehensive overview of the legal context related to agriculture.

8.2 Spatial use

The space reserved for agricultural activities in the coastal zone is under pressure due to strong urbanisation, other economic developments (e.g. port activities Zeebrugge) and increasing nature protection efforts. In Flanders, the areas reserved for agricultural purposes are registered in the Flemish Spatial Structure Plan (RSV) as 'agricultural structures'. The mandatory regulations of the RSV demand that the Flemish Region demarcates a specific area for agriculture (750,000 ha), as well as for nature and forest in the regional spatial structure plans or in the regional Spatial Implementation Plans (RSIPs, Geopunt Flanders). Regional plans were reaffirmed in case of a consensus between nature, forest and agriculture (AGNAS-strategy). In addition to the demarcation in the RSV and the reaffirmation of the agricultural area, it is possible to further refine this demarcation through the Spatial Implementation Plans (SIPs). The proposed timing of ten years to complete this demarcation (foreseen in 2007) was not achieved. This is due to the size of the assignment, the interference with other spatial processes and the area-specific consultation in drawing up the plans to implement the zoning changes (SIPs). Despite the fact that the deadlines have passed, the Flemish Department of Environment and Spatial Development (OMG) continues to work on this demarcation.

The process of the demarcation of the agricultural areas in the Coast-Polders-Westhoek region started in 2004. During this demarcation phase, a new integrated approach was used which took agriculture, nature and forest simultaneously into account. In consultation with the municipalities, provinces and stakeholders, a spatial vision was drafted in 2006 that indicated the most important structures: connected areas prohibited for agriculture, valleys for nature development, etc. The consultation process eventually resulted in 95,100 ha of reaffirmed agricultural area in the Coast-*Polders*-*Westhoek*[5] region (Danckaert 2013). The SIPs for agriculture, nature and forest in this region can be consulted on the website of RSV Flanders. Parallel to the further implementation of the RSV, the Government of Flanders is also preparing a new Beleidsplan Ruimte Vlaanderen. This plan is expected to contain the same demarcation objective as formulated in the RSV. The Strategic Vision document states that the aim is to work towards robust and resilient agricultural plots that, where possible, are kept free of buildings and given a multifunctional purpose. However, there's a trend towards turning agricultural land into private gardens or horse pastures[6], a phenomenon that also occurs in the polders (personal communication VMM, LARA 2020). Within the framework of the spatial development policy, OMG provides area-specific 'Territorial Development Programmes' with the aim of bringing together relevant stakeholders and realising short- and medium-term achievements based on common objectives. In this capacity, the Province of West Flanders has a cooperation agreement with OMG within the so-called T.OP. Kustzone (see thematic chapter **Social and economic environment**).

Areas of the agricultural structure are described in the Spatial Structure Plan of the Province of West Flanders (PRS W-VL). For coastal agriculture, the eastern and western polder areas are of particular importance.

A sound agricultural structure, as determined within the spatial planning processes (see above) can be realised,

[5] Not all hinterland municipalities are fully included in this region, for example parts of Diksmuide and Bruges are not part of it, but rather belong to the region '*Veldgebied Brugge en Meetjesland*'.

[6] These phenomena are linked to the decline in the number of agricultural enterprises (see **8.3 Societal interest**) and the increased vacancy rate. A reconversion to today's environmental and energy standards appears in many cases too costly for new starters. The vacant farms are often sold with a number of hectares of agricultural land that are subsequently used, for example, as gardens or grazing land for domestic animals. The current urban development framework, with its basic rights for zone-restricted buildings, places few restrictions on this, and the new instrument 'contractual covenant approach' also allows for a non-agricultural reconversion. However, research shows that many non-agricultural uses cannot be legally permitted. There is also a lack of enforcement. These zone-restricted activities often also lead to challenges for the remaining agricultural activities (Verhoeve et al. 2018).

among others, through land exchange consolidation and land development projects. In Flanders, the Flemish Land Agency (VLM) is responsible for the execution of land exchange consolidation projects and land development projects (VLM 2000, 2014). The aim of land exchange consolidation is to improve the economic exploitation of agricultural enterprises, on the one hand, and, on the other hand, to improve the use of land for nature and recreational purposes. An overview of all development projects (overall projects, rural projects, land development projects, land exchange consolidation projects and nature development projects) can be found in the VLM project database.

The cultivated land in the coastal zone has a total surface area of about 71,029 ha (2021) (figure 1). This corresponds to 11.4% of the utilised agricultural area in Flanders (Source: FPS Economy - Statbel). All parcels registered by the Department of Agriculture and Fisheries and their cultivation can be downloaded in GIS format from the Geopunt website and from the website of the Department of Agriculture and Fisheries.

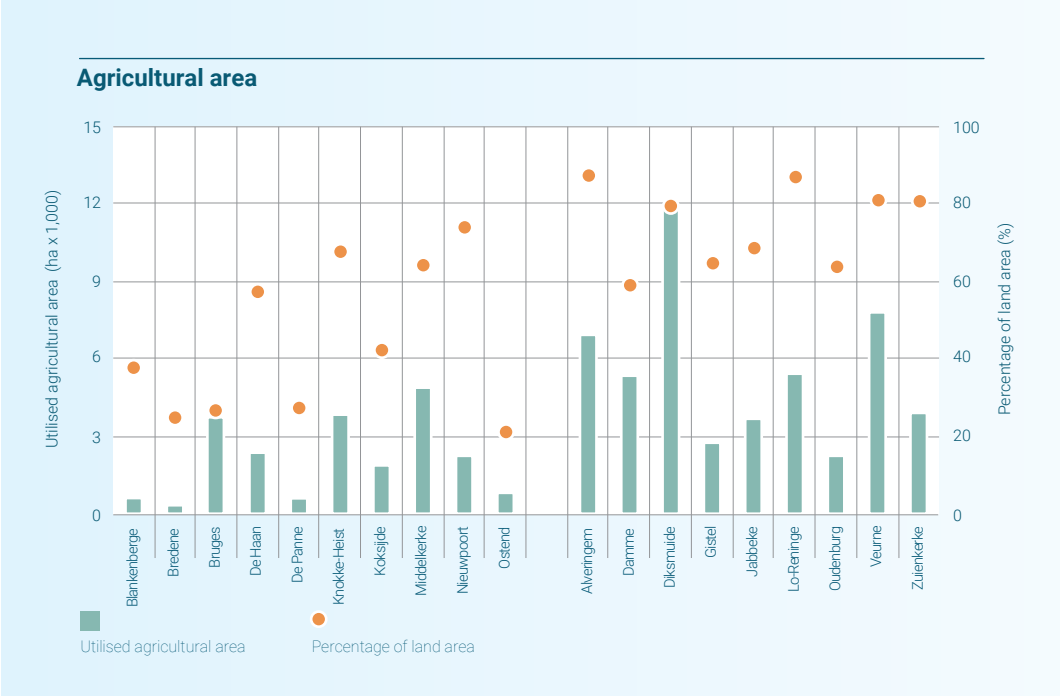

Figure 1. Agricultural area in ha in 2021 for the coastal and hinterland municipalities (Source: FPS Economy - Statbel, Coastal Portal)

8.3 Societal interest

In 2021, agricultural enterprises in the coastal zone (coastal municipalities + hinterland municipalities) generated a turnover[7] of 540.5 million euro, accounting for 24.4% of the total provincial sectoral turnover[8]. The largest revenue was realised by the various mixed farms which combine different sub-sectors of agriculture (132.1 million euro; 24.4%) followed by pig farms (122.0 million euro; 22.6%) and milk producing farms (98.0 million euro; 18.1%) (figure 2). These three industries generate circa 65% of the turnover of coastal agriculture on over half of the cultivated land. When comparing the turnover of the coastal zone to that of the entire province, the relative importance of farms with other grazing animals (5.0 million euro; 67.6% of the provincial total), milk producing farms (98.0 million euro; 18.1%) and mixed cattle farms (25.4 million euro; 38.3%) is particularly distinctive.

In the coastal and hinterland municipalities, 2,035 agriculture and horticulture enterprises were active in 2021, with 4,155 employees corresponding to 8.8% of all agricultural enterprises in Flanders and 6.4% of all employees in agriculture. In the coastal zone, agriculture represents approximately 2.2% of the workforce (Dataset regions 2022, Landbouwgegevens 2021 FPS Economy - Statbel). The majority of both the enterprises and employees in the coastal zone are located in the hinterland municipalities (table 1), which are mainly focused on arable farming (table 2). The farms in the coastal zone in 2021 had a total of 133,015 cattle, 663,157 pigs and 4,041,910 poultry (Landbouwgegevens 2021 - Statbel).

[7] This is not the actual turnover generated, but rather a standard output (SO), a calculated value based on SO coefficients and the area of the different crops and the number of animals.
[8] For an estimate of the impact of the Brexit on Flemish agriculture, see LARA 2020.

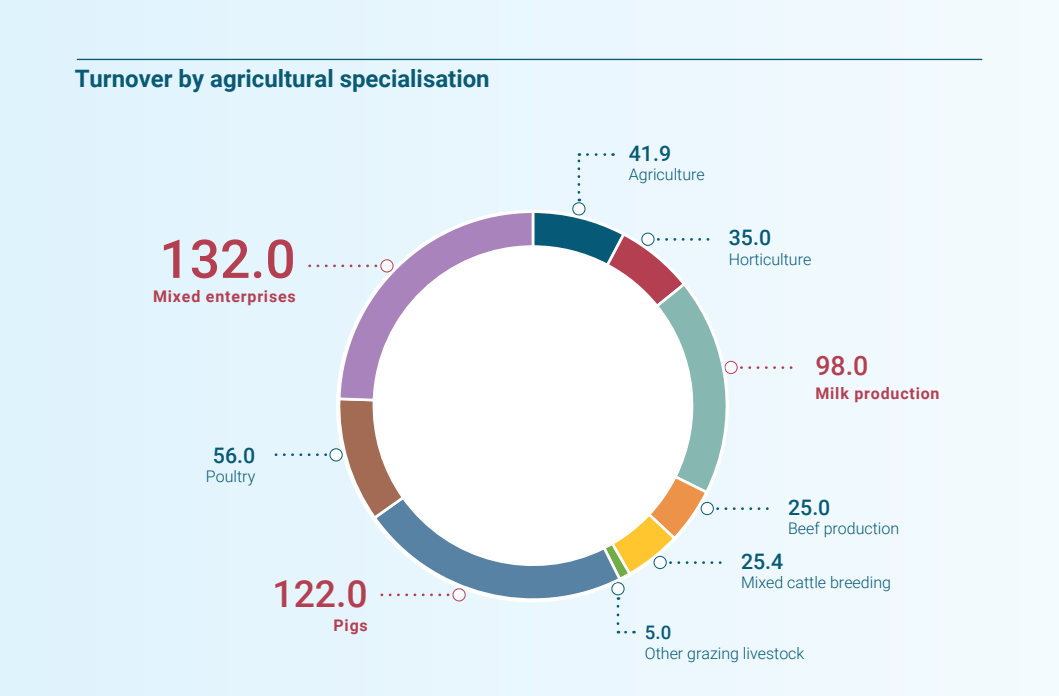

Figure 2. The total turnover (in euro) by specialisation (SO2017) for coastal agriculture in 2021 (Source: Department of Agriculture and Fisheries based on FPS Economy, SMEs, Self-employed and Energy - Statbel).

A small, yet strongly growing sector in Flanders and the coastal zone is that of organic farming (Flanders bioeconomy 2020, Timmermans and Van Bellegem 2022). In 2021, there were 43 organic farms in the coastal zone, 34 of which were located in the hinterland municipalities (Department of Agriculture and Fisheries). Organic farming takes place on 1,408 ha (including land in conversion), an expansion of 74% compared to 2017. When considered over the entire area of cultivated land (71,029 ha in 2021) in the coastal zone, this amounts to a modest 1.98% (figures requested from the Department of Agriculture and Fisheries and granted by TÜV Nord Integra and Quality Partner).

In addition to a direct economic value linked to food production, there is also a more indirect added value for society, such as activities linked to hinterland tourism (see thematic chapter **Tourism and recreation**) and the added value related to the various ecosystem services. However, these have not been quantified structurally to date[9].

For more figures on agriculture you can also visit the agricultural data website of the Department of Agriculture and Fisheries, the dienst Statistiek of the FPS Economy, SMEs, Self-employed and Energy, Statistiek Vlaanderen, Gemeentestatistieken VLM, West-Vlaanderen Ontcijferd of the West Flanders Development Agency and the website provincies.incijfers.be.

8.4 Impact

This section includes the (general) effects of agricultural activities on the ecosystem and the indirect effects of these activities on the marine environment (eutrophication). Additionally the effect of salinisation is discussed. Although salinisation is mainly the result of other human activities and climate processes, the phenomenon is of growing concern for agricultural activities in the coastal zone. It is also important to note that agriculture provides various beneficial ecosystem services with a producing, regulating and cultural function (vision note SALV 2020). For more information on agriculture and ecosystem services, see Van Gossum et al. 2016 and Dumez et al. 2017. A description of the ecosystem in the polder areas is included in the thematic chapter **Nature and environment**.

[9] More background on the socio-economic landscape, nature and the role of tourism in the coastal zone can be found in the dedicated thematic chapters of the **Knowledge Guide Coast and Sea 2022** (Dauwe et al. 2022).

Table 1. Number of agricultural and horticultural enterprises and employees in the coastal and hinterland municipalities in 2021 (Source: Dataset regions 2022, Landbouwgegevens 2021 FPS Economy - Statbel).

Municipality	Employees	Enterprises
Blankenberge	57	20
Bruges	460	130
Bredene	36	10
De Haan	127	58
De Panne	56	18
Knokke-Heist	280	90
Koksijde	138	49
Middelkerke	217	141
Nieuwpoort	122	53
Ostend	166	27
Coastal municipalities	**1,659**	**596**
% Coastal municipalities	**39.9%**	**29.3%**
Alveringem	315	213
Damme	300	180
Diksmuide	588	348
Gistel	182	79
Jabbeke	272	118
Lo-Reninge	267	159
Oudenburg	123	72
Veurne	314	190
Zuienkerke	135	80
Hinterland municipalities	**2,496**	**1,439**
% Hinterland municipalities	**60.1%**	**70.7%**

Table 2. The number of enterprises in the coastal zone in 2021 by specialisation (Source: Department of Agriculture and Fisheries, based on FPS Economy, Self-employed and Energy - Statbel).

Specialisation	Number of enterprises in the coastal zone (2021)
Agriculture	644
Horticulture	89
Milk production	257
Beef production	221
Mixed catle breeding	113
Other grazing livestock (sheep, etc.)	66
Pigs and poultry	249
Mixed enterprises	396
Total enterprises	**2,035**

8.4.1 Effects on the ecosystem

In a.o. the *Vlaams Regionaal Indicatorenrapport* (VRIND 2017), the MIRA systeembalans (2017), the LARA (2018, 2020), Milieuverkenning (2018) and NARA 2020, various effects of agricultural activities on the environment in Flanders are listed (not exclusively for the coastal zone). For an overview of the main effects on the ecosystem, see table 3. More figures and studies on the interaction between agriculture and the environment can be found on the website of the Department of Agriculture and Fisheries and the VMM.

Table 3. Non-exhaustive overview of studies describing the main environmental impacts of agricultural activities.

Impact	Literature
Chemical products for crop protection	Van Esch et al. 2012, Lenders et al. 2013, Lenders and Deuninck 2016
Water use	Lenders et al. 2013, Lenders and Deuninck 2016, Danckaert and Lenders 2018, Antea 2018, more information see **8.4.3 Salinisation of the coastal zone**
Energy use	Lenders et al. 2013, Lenders and Deuninck 2016
Soil quality	e.g. densification resulting in salinisation and erosion susceptibility: Reubens et al. 2010, MIRA Themabeschrijving Bodemkwaliteit 2014, Erosie in Vlaanderen 2015, Swerts et al. 2020
Eutrophying emissions	Overloop et al. 2011, Overloop 2013, Voortgangsrapport Mestbank 2013, Lenders and Deuninck 2016, Mestrapport 2022, VMM more information see **8.4.2 Eutrophication of the coastal waters**
Ammonia emissions	VMM
Greenhous gas emissions	VMM
Emission of dust particles	VMM
Litter production	Statbel
Spatial use	VMM
Biodiversity	Honnay and Ceulemans 2016

8.4.2 Eutrophication of the coastal waters

The use of agricultural fertilisers, which are transported towards coastal waters via waterways, is an important contributor to the increase of nutrients (nitrogen (N), phosphorus (P)) in aquatic ecosystems (State of Europe's seas 2015, OSPAR). Excessive input of nutrients or 'eutrophication' reinforces the processes regulating phytoplankton production, potentially causing excessive phytoplankton growth, which can lead to changes in ecosystem structure and functioning, habitat destruction and an impoverishment of biodiversity (Zhang et al. 2010, federal environmental report, OSPAR IA 2017, Bushinsky et al. 2019, OSPAR QSR 2023). The eutrophication issue falls under descriptor 5 of the Marine Strategy Framework Directive (MSFD) and is described by Ferreira et al. (2010) in which the conditions for good environmental status are outlined (see **8.5.1 Measures against eutrophication**).

In the 1990s there was a clear downward trend in the amount of dissolved N and P in our coastal waters, which has levelled off in recent years (2006-2018) (OSPAR IA 2017, Desmit et al. 2018). A trend that is confirmed by land-based measurements (Fysisch-chemische kwaliteit oppervlaktewater 2018, Milieuverkenning 2018, LARA 2020, Mestrapport 2022, Nutriënten in oppervlaktewater in landbouwgebied 2021-2022, VMM). The VMM has a monitoring network for water quality, which has expanded with specific measuring points for agriculture since 1999 (the so-called MAP measuring points, see Geoloket waterkwaliteit). The most recent assessment of the MSFD shows that for approximately 30% of the Belgian part of the North Sea, the threshold value of a Good Environmental Status is exceeded (Belgian State 2018, Desmit et al. 2018). The Belgian coastal waters (up to 1 nautical mile (nm)) score poorly, while the situation in the territorial waters (up to 12 nm) is slowly improving. Further offshore, the concentration poses no problem (Desmit et al. 2018). Next to the transport of nutrients by rivers, atmospheric inputs are also of concern (OSPAR QSR 2010, OSPAR Commission 2017, PAS).

The various aspects of the eutrophication problem in coastal waters were previously extensively studied in the Belspo projects: AMORE, AMORE II, AMORE III-(phase 1 and phase 2) and the TIMOTHY project (more information:

Lancelot and Rousseau 2004, Rousseau et al. 2006, Lancelot et al. 2007, Lancelot et al. 2009, Lancelot et al. 2011). A centralisation of knowledge and information on eutrophication in the southern part of the North Sea took place in 2014 within the framework of the ISECA project. The Belspo NewSTHEPS project carried out concentration measurements on chemical pollutants, including N and P, in the coastal zone in function of the MSFD. Finally, the Belspo SISCO project investigated, among other things, the problem of eutrophication for phytoplankton production in the Scheldt estuary (see thematic chapter **Scheldt estuary**).

8.4.3 Salinisation of the coastal zone

The phenomenon of soil salinisation has a significant impact on agriculture in the coastal zone. During hot, dry periods, the surface water in the fields can become saline, resulting in drinking water problems for animals. Additionally, brackish or saline groundwater can penetrate into the root zone of the soil (Zwaenepoel et al. 2016, De Bruyn 2020) with a detrimental effect on crops. Moreover, polder clay is very vulnerable to salt, which increases the risk of soil sealing (*verslemping*). Salinity is monitored by VMM, but several polders and De Watergroep also monitor conductivity. All measurement results are communicated through the provincial drought council (provinciaal droogteoverleg) in West Flanders.

A natural division of fresh and salt/brackish groundwater occurs in the coastal zone. In the phreatic groundwater zone, a freshwater lens lies above a layer of salt/brackish water. This freshwater lens enables traditional agriculture in the polders. The lens acts as a buffer against seawater intrusion to the hinterland (Van den Eynde et al. 2011 (CLIMAR project phase 1 and phase 2) and the CLIWAT project), but has interruptions along the coast (TOPSOIL). This division between fresh and salt water is the result of a complex history in which human activities, such as water extraction for drinking water supply, agricultural purposes, large-scale infrastructure works (e.g. land reclamation, port expansion, tunnels, drainage systems, etc.) and interventions in water management (e.g. water level management, drainage systems, etc.) play an important role. Hydrological interventions in the coastal zone can therefore lead to short- or long-term changes in the distribution of fresh and salt water, possibly resulting in salinisation (Vandenbohede et al. 2009, Vandenbohede et al. 2010, Vandenbohede 2012, River basin management plan Schelde en Maas 2022-2027). Additionally, the salinisation issue in the coastal zone is strongly linked to the drought issue. More frequent and more intense droughts linked to global warming are expected to increase the salt load on shallow ground and surface waters (Evaluatierapport waterschaarste en droogte 2020). On the long term, a higher sea level can generate an additional salt load (Vandenbohede 2012, Zwaenepoel et al. 2016, De Bruyn 2020).

The salinity maps of the coastal zone underwent several updates in the past years. This happened in 2010 (CLIWAT project) for the middle coast (Nieuwpoort-Zeebrugge) (Vandenbohede et al. 2010), in the framework of the ScaldWIN project (Lebbe et al. 2012), and in 2014 for the eastern coastal zone (VMM 2016). These studies concluded that the fresh-saltwater balance is currently relatively stable. A detailed determination of the fresh-saltwater balance for the entire coastal and polder area was last carried out as part of the TOPSOIL project (2015-2021). These results also concluded that the degree of salinisation in the coastal zone is not increasing for the time being, although problems can occur locally in the event of extreme weather conditions (Delsman et al. 2019, Evaluatierapport waterschaarste en droogte 2020, salinisation map DOV Vlaanderen, Coastal Portal).

8.5 Sustainable use

Sustainability in European agricultural policy has gained importance in recent years (Lisbon Treaty, EU-2020 Strategy, EU Farm2Fork Strategy, CAP, etc.). With the previous CAP (2014-2020), measures were already taken towards a more sustainable agricultural sector, a strategy that will be continued and strengthened in the CAP (2021-2027). This ensures that the environmental and climate objectives in this new policy strategy are in line with the Sustainable Development Goals[10] of the UN (SDGs) (see also **8.1 Policy context**). The sustainable co-existence of agriculture with various user functions of the coastal zone (housing, tourism, recreation, industry, nature, etc.) is part of the European recommendation for Integrated Coastal Zone Management (ICZM, 2002/413/EG), although this policy has had little influence at European level in recent years. There are, however, European projects such as the COASTAL project which aim to explore and optimise synergies between the hinterland and the coastal zone. A key element to the project is the reinforcement of sustainable activities in the hinterland.
The Flemish agricultural policy is committed to innovative and environmentally friendly agriculture practices. The policy aims to strengthen the economic situation of its stakeholders, a sustainable food production, and

[10] Within the context of the SDGs, Flanders developed 'Vizier 2030', a 2030 goal-oriented framework towards a sustainable Flanders, built around 48 goals that are monitored by 87 indicators.

a contribution to an overarching circular economic model (policy paper Agriculture and Fisheries 2019-2024, Flemish circular food chain). Within this context, there is the sustainable Flemish food strategy Go4Food, which is based on four strategic objectives: (I) a resilient food economy; (II) food connecting farmers and citizens; (III) circular and sustainable entrepeneuring and (IV) healthy and sustainable food for all (Roels et al. 2022). At the Flemish level there is also the bio-economy policy plan in which, among other things, a closer cooperation between industry and agriculture must result in new, sustainable agricultural activities.

The yearly agriculture reports of the Department of Agriculture and Fisheries also cover a number of current Flemish policy themes that are connected to sustainable agriculture, such as water management, the manure action plan (*mestactieplan*), biodiversity, circularity, the bio-economy, etc. The Department also carries out studies for more sustainable agricultural activities and publishes specific recommendations in thematic 'praktijkgidsen' (for a selection see table 4). Furthermore, the Department of Agriculture and Fisheries also offers sector advice on themes such as rational water use and promotes sustainable practice centres. A service that is also provided at the provincial level by Inagro.

Table 4. Non-exhaustive overview of publications aimed at making agricultural activities more sustainable (Source: Department of Agriculture and Fisheries).

Theme	Publications
Crop protection	Demeyere and Nuyttens 2016
Water	Danckaert and Lenders 2018, Verhassel and Debussche 2018, Lenders & Dumez 2022
Biodiversity	Zwaenepoel et al. 2016
Climate	Maertens et al. 2016
Agro-ecology	Bergen 2013
Food footprint	Cazaux et al. 2010, Bracquené et al. 2011, Danckaert et al. 2013
Agricultural challenges	Bergen et al. 2014, Van Buggenhout et al. 2016

Other projects in the region also aim at making agriculture more sustainable (project database Province of West Flanders, ILVO research). A number of reports and visions that propose recommendations on how to shift to a more sustainable agricultural model are also available. Some examples include: Mathijs et al. (2012), Dumez et al. 2014, the MIRA systeembalans 2017, the agriculture reports, Milieuverkenning 2018, Rede Gouverneur 2019, De Regt 2022, adviesnota's SALV. Studies like Gobin et al. (2008) and Maertens et al. (2016) also look at the adaptation opportunities and mitigation strategies of Flemish agriculture to climate change. Finally, there are quality systems that support the production of quality and sustainable agricultural products.

8.5.1 Measures against eutrophication

A further reduction in the use of nitrates and phosphates remains important for the achievement of a good environmental status in groundwater, surface waters and coastal waters (see thematic chapter **Nature and environment**) (Ferreira et al. 2010, Belgian State 2018, Nutriënten in oppervlaktewater in landbouwgebied 2021-2022, Mestrapport 2022, VMM). Within this context, OSPAR created a common procedure (2016) for estimating the eutrophication status of the North-East Atlantic (OSPAR Commission 2017). This unified monitoring and classification strategy is laid down in the eutrophication monitoring programme (see also OSPAR) and is in line with other European directives such as the MSFD and the Water Framework Directive (WFD, Directive 2000/60/EC) (see below). When the classification results in so-called problem areas, the OSPAR environmental strategy states that the contracting parties, individually or jointly, must take measures to reduce or eliminate the anthropogenic causes of eutrophication. The new OSPAR Strategy 2030 sets the objective of taking sufficient measures to avoid eutrophication in the OSPAR region by 2028. By 2030 nutrient concentrations should be sufficiently reduced to make sure that adverse eutrophication effects no longer occur (OSPAR 2021, OSPAR MAP 2021).

At the European level, the issue of eutrophication is addressed by various directives in the framework of the MSFD and WFD. The Nitrates Directive (Directive 91/676/EEC) is an integral part of the WFD[11], which *inter alia* imposes the obligation to achieve a good quality of surface and groundwater by 2015. This included substances that contribute to eutrophication, such as nitrogen and phosphorus, in its indicative list of main pollutants. The Nitrates

[11] The Good Environmental Status (GES) is determined within 1 nautical mile (nm) seaward of the base line (ebb mark), while the Good Chemical Status (GCC) reaches up to 12 nm seaward of the base line (see thematic chapter **Nature and environment**).

Directive therefore aimed at reducing the runoff of nitrates from agriculture (Goffin et al. 2007). Other directives under the umbrella of the WFD also have a link with eutrophication, such as Directive 91/271/EC on urban waste water and Directive 2010/75/EU on industrial emissions. In the MSFD, eutrophication was included as descriptor 5 for the determination of the good environmental status (Ferreira et al. 2010).

The MSFD has been incorporated into Belgian law by the RD of 23 June 2010 on the marine strategy for the Belgian marine areas. The Marine Environment division (FPS Environment) is responsible for the coordination in terms of implementation. The cooperation between the federal level and the regions occurs within the CCIM Working Group on North Sea and Oceans that represents the international component of the marine environment for Belgium. In 2018, the criteria and methodological standards for determining good environmental status with regard to eutrophication were revised (Belgian State 2018, Desmit et al. 2018).

At the Flemish level, the WFD was translated into the Decree on Integrated Water Policy (Decree of 18 July 2003 and legal framework for integral water policy in Flanders, for implementing decisions and amendments see Coordination Committee on Integrated Water Policy) and partially converted at the federal level into the RD of 23 June 2010 on the establishment of a framework for achieving good surface water status (see also River basin management plan Belgian coastal waters 2022-2027) (see thematic chapter **Nature and environment**). At the Flemish level, the Nitrates Directive was transposed into the Manure Decree that deals with the quality status of diffuse pollution of ground and surface water by agri- and horticulture. This decree was approved on 23 January 1991 and has been thoroughly amended several times since. The new Manure Decree (Decree of 22 December 2006) was enforced on 1 January 2007, with the sixth manure management plan (*Mestactieplan*) (MAP-VI) enforced during the period 2019-2022 (for implementation decrees and amendments see *Mestbank* VLM). This renewed manure management plan aimed to break the levelled decline in water quality in order to bring the concentrations in line with the European targets (6e Actieprogramma ter uitvoering van de Nitraatrichtlijn 2019, Mestrapport 2022). A MAP 7 is in preparation following dialogue sessions between the Flemish government and the agriculture and horticulture sector.

Nutrient limiting agricultural practices are also mentioned in the third Rural Development Programme (*Programma voor plattelandsontwikkeling,* PDPO III) in the framework of a sustainable CAP (see **8.3 Sustainable use**) and in MIRA systeembalans (2017). An up-to-date overview of the manure legislation can be found at the Mestbank website of the VLM.

Finally, efforts are being made to reduce atmospheric nitrogen deposition. On 23 April 2014, the Government of Flanders decided to set up a Programmatic Approach to address atmospheric nitrogen deposits (PAS). The PAS programme (2014-2031) aims to tackle the problem of the eutrophying and acidifying deposition of nitrogen in special protection areas (SPAs) as designated within the European Habitats Directive (Directive 92/43/EEC), of which about two thirds derive from agriculture. To this end, the focus is on source-based (on the emissions side) and effect-based measures. The first planning period runs from 2020-2025, a second planning period runs from 2025-2030. Monitoring is done by the VMM.

8.5.2 Measures against salinisation

The European Communication COM (2012) 46 provides an overview of the implementation of the Thematic Strategy for Soil Protection since its adoption in COM (2006) 231. Among other things, it discusses soil degradation through salinisation. Furthermore, intrusions of salt water have also been included in the WFD and the Groundwater Directive (Directive 2006/18/EC) as parameters for the quantitative and qualitative status of groundwater (see also VMM 2008).

In the River basin management plan Schelde en Maas 2022-2027, a number of measures are included in a 'Coastal and Polder System Action Programme' consisting of three groups of measures[12] describing a collection of groundwater body-specific actions to combat salinisation. A detailed overview of all actions can be consulted at the website sgbp.integraalwaterbeleid.be. Additionally, the WFD is partially incorporated into Belgian legislation by the RD of 23 June 2010 on the establishment of a framework for achieving good surface water status. The management and monitoring of groundwater and surface water quality is a core task of the VMM, Operational Water Management Department. See also Vandenbohede et al. (2010) and the legislation listed in the Codex Coastal Zone, themes Agriculture and Groundwater.

In 'Climate change in the polders - Choosing fresh or salt?' (Zwaenepoel et al. 2016), an overview of solution strategies is provided, based on domestic and foreign research projects (with a focus on the Dutch context). It

[12] The three measure groups: Protected and water-rich areas - groundwater section, Quantity ground water and Contamination of ground water.

also discusses the challenges posed by a changing hydrology and the current knowledge gaps in this regard in the field of agriculture in the Flemish polder region. Furthermore, phase two of the TOPSOIL project (2015-2021) is attempting to develop local pilot projects with the help of stakeholder participation in order to improve the freshwater availability for farmers. Within the context of sustainable freshwater use to the benefit of farmers, there is also the Fresh4Cs project (2019-2022). This project, which zooms in on efficient water use in the coastal zone, investigates the possibility of storing freshwater above and belowground for the benefit of agricultural activities in the coastal polders. Additionally, the SalFar project (2014-2020) tested innovative agricultural methods for growing crops on saline soils using test sites in different regions. In Flanders, the research focused on the socio-economic barriers to saline agriculture and, through stakeholder participation, the researchers explored the salinisation issue and the potential of saline agriculture in the Flemish coastal zone.

Salinisation is also strongly linked to drought. Given the recent increase in the occurrence of droughts (Climate Portal), the Government of Flanders is increasing its efforts to combat this issue. The policy for tackling water scarcity and droughts is in line with the objectives of the WFD and focuses on limiting the economic and ecological damage. Concerning this topic, the Government of Flanders introduced the Blue Deal strategy to counter water scarcity and droughts[13]. A circular water policy will be central along with a strong emphasis on agriculture and nature as part of the solution. This plan contains a series of measures that are also included in the Actieplan Droogte en Wateroverlast (2019-2021). For example, 'Action 11: Development of an Integrated Water System Model for Drought Risk Management' looks at the *Westhoek* as a pilot region given its history of drought problems, the characteristics of polder management, the buffering by agriculture and water reuse by industry. Furthermore, the plan mentions the establishment of a West Flemish Centre of Expertise for Coastal Polders (*West-Vlaams Kenniscentrum Kustpolders*) that will focus on combining relevant water expertise. The Internet of Water project fits in this action plan. This project uses a sensor network to continuously monitor the water quality of the soil, ground and surface water so that targeted measures can be taken more quickly. In order to realise the Blue Deal objectives, 75 million euro in resources will initially be made available, including through the *Vlaams Landbouwinvesteringsfonds* (VLIF) and the expansion of the Water-Land-Schap 2.0 land development project. For the coastal zone specifically, the Government of Flanders also approved the *Oudlandpolder* land development project (LIP Oudlandpolder) in December 2020. This plan focuses on tackling the water problems in the area between Bruges, Ostend and Zeebrugge. Within the framework of this LIP, a water balance study is being carried out and additional sensors are being installed to map water availability. The water usage and supply in the coastal zone has already been mapped (Antea 2018).

Finally, within LABO RUIMTE (a partnership between *Team Vlaamse Bouwmeester* and the Department of Environment and Spatial Development), research has been initiated within the project De Droge Delta on spatial levers in the fight against water scarcity. Within the context of sustainable water management in the coastal zone, there were also Metropolitaan Kustlandschap 2100 (De Waegemaeker et al. 2012) and Stedelijk Systeem Kust.

8.5.3 Protection of agricultural nature and historical permanent grasslands (HPGs)

Agricultural areas in the coastal zone often contain valuable natural elements that are protected and managed in certain places (Coastal Portal, Natura 2000, Geopunt Vlaanderen, see also thematic chapter **Nature and environment**). An important landscape element are the so-called historical permanent grasslands (HPGs). HPGs are defined in the Nature Decree (Decree of 21 October 1997) as "a semi-natural vegetation consisting of grassland characterised by long term use as grazing pasture or hay meadows with either cultural/historic value or a species-rich vegetation of herbs and grasses where the environment is characterised by the presence of ditches, streams, pools, prominent micro relief, springs or seepages". The decree and the subsequent Implementation Decisions stipulate that HPGs are subject to a prohibition on, or require authorisation for, the modification of the vegetation and physical features (relief and small landscape elements, such as pools and streams) depending on their destination status in spatial planning. For more information on the protection status, see website of the Agency for Nature and Forest (ANB).

In order to achieve an effective protection of these grasslands, an inventory was made with the exact location of the HPGs (De Saeger et al. 2013). In 2015, the Government of Flanders reached a final agreement on the protection of 8,000 of the 12,000 ha HPGs, with some parts being protected through nature legislation and other parts through European agricultural policy (ANB, Investeren in landbouw in België 2014-2020 (2016)).

[13] A first reactive assessment framework for priority water use has already been developed (Government of Flanders 2021).

Legislation reference list

Overview of the relevant legislation on European, federal and Flemish level. For the consolidated European policy context see Eurlex. The national legislation can be consulted on the Belgian official journal and the Justel-database, the Flemish legislation is available on the Flemish Codex.

European legislation and policy context			
Document number	**Title**	**Year**	**Number**
Recommendations			
2002/413/EG	Recommendation concerning the implementation of Integrated Coastal Zone Management in Europe	2002	413
Communications			
COM (2006) 231	Communication from the Commission: Thematic Strategy for Soil Protection	2006	231
COM (2010) 2020	Communication from the Commission: Europe 2020 - A strategy for smart, sustainable and inclusive growth	2010	2020
COM (2012) 46	Communication from the Commission: The implementation of the Soil Thematic Strategy and ongoing activities	2012	46
COM (2019) 640	Communication from the Commission: The European Green Deal	2019	640
COM (2020) 381	Communication from the Commission: A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system	2020	381
Directives			
Directive 91/271/EEC	Directive concerning urban waste water treatment	1991	271
Directive 91/676/EEC	Directive on the protection of waters against pollution caused by nitrates from agricultural sources (Nitrates Directive)	1991	676
Directive 92/43/EEC	Directive on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)	1992	43
Directive 2000/60/EC	Directive establishing a framework for Community action in the field of water policy (Water Framework Directive)	2000	60
Directive 2006/118/EC	Directive on the protection of groundwater against pollution and deterioration (Groundwater Directive)	2006	118
Directive 2008/56/EC	Directive establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008	56
Directive 2010/75/EU	Directive on industrial emissions (integrated pollution prevention and control)	2010	75
Conventions			
2007/C 306/01	Treaty of Lisbon amending the Treaty on European Union and the Treaty establishing the European Community	2007	306

Belgian and Flemish legislation		
Dates	**Title**	**File number**
Decrees		
Decree of 21 October 1997	Decreet betreffende het natuurbehoud en het natuurlijk milieu	1997-10-21/40
Decree of 18 July 2003	Decreet betreffende het integraal waterbeleid	2003-07-18/72
Decree of 22 December 2006	Decreet houdende de bescherming van water tegen de verontreiniging door nitraten uit agrarische bronnen	2006-12-22/32

Belgian and Flemish legislation (continuation)		
Dates	**Title**	**File number**
Royal Decrees		
RD of 23 June 2010	Koninklijk besluit betreffende de vaststelling van een kader voor het bereiken van een goede oppervlaktewatertoestand	2010-06-23/04
RD of 23 June 2010	Koninklijk besluit betreffende de mariene strategie voor de Belgische zeegebieden	2010-06-23/05