Global greenhouse update 2025

Positive outlook for greenhouse production

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Global greenhouse update summary

North America
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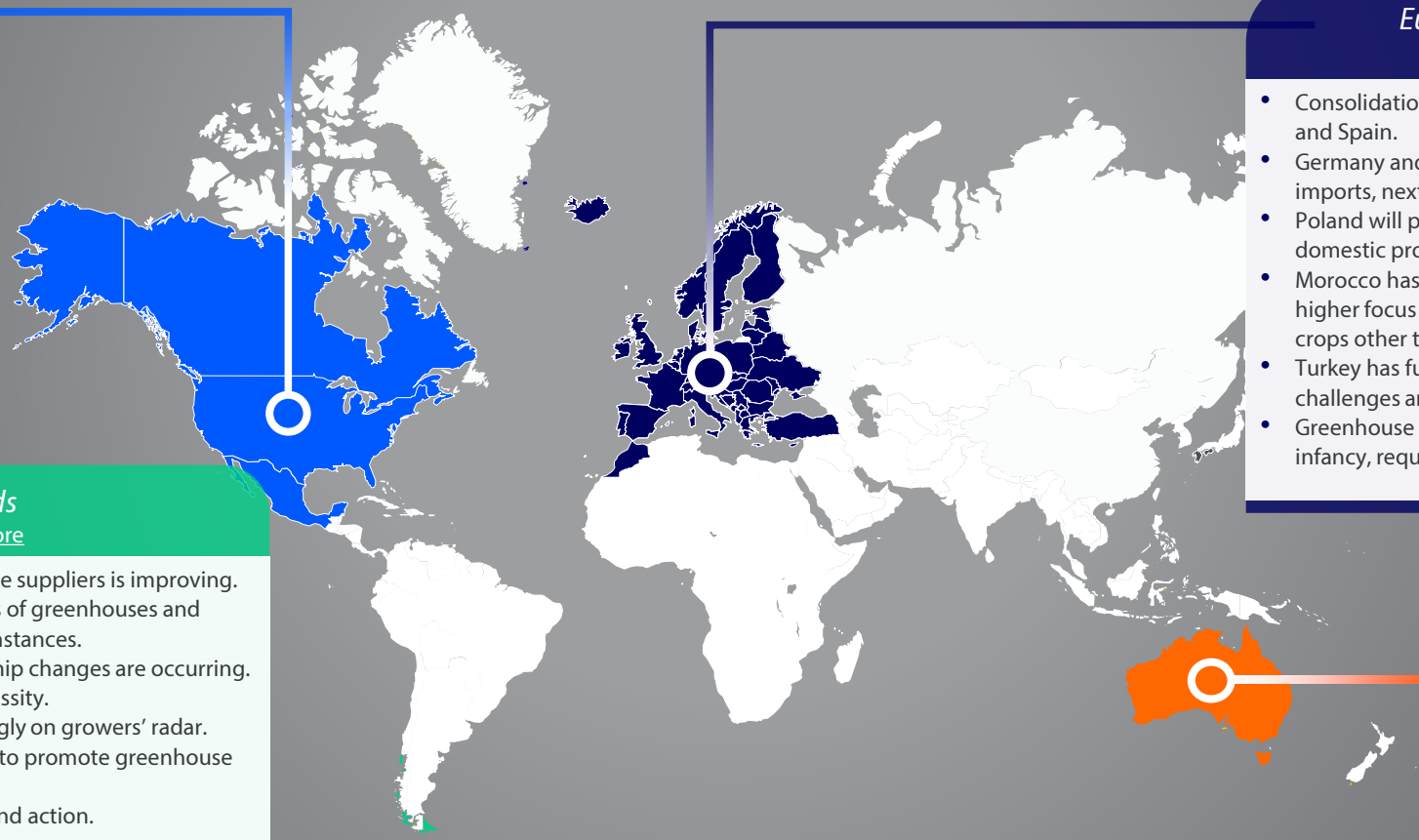
- Greenhouse area in Canada and parts of the US, particularly the Midwest, expands steadily.
- Strawberry cultivation in glass greenhouses shows significant growth potential.
- Mexico's greenhouse industry is consolidating and upgrading its technology.

Europe and North Africa
click here for more

- Consolidation continues in the Netherlands, Belgium, and Spain.
- Germany and France remain highly dependent on imports, next to domestic production.
- Poland will primarily grow as an import market, as domestic production is stabilizing.
- Morocco has opportunities to grow further with a higher focus on sustainability and diversification into crops other than tomatoes.
- Turkey has further growth potential if current challenges are addressed.
- Greenhouse cultivation in the Balkans is still in its infancy, requiring investments in scale and technology.



Global trends
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- Sentiment among global greenhouse suppliers is improving.
- There is a huge diversity in the types of greenhouses and crops grown, tailored to local circumstances.
- Ongoing consolidation and ownership changes are occurring.
- Automation is becoming a dire necessity.
- Environmental footprint is increasingly on growers' radar.
- Social media can be a powerful tool to promote greenhouse vegetables.
- Climate change requires attention and action.

Australia
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- High-tech greenhouses are primarily targeting premium markets.
- Virus pressure in tomato production is challenging current production.

Source: *RaboResearch 2025*

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Greenhouse suppliers more optimistic for 2025

Persian Gulf and North Africa are among the regions considered most promising

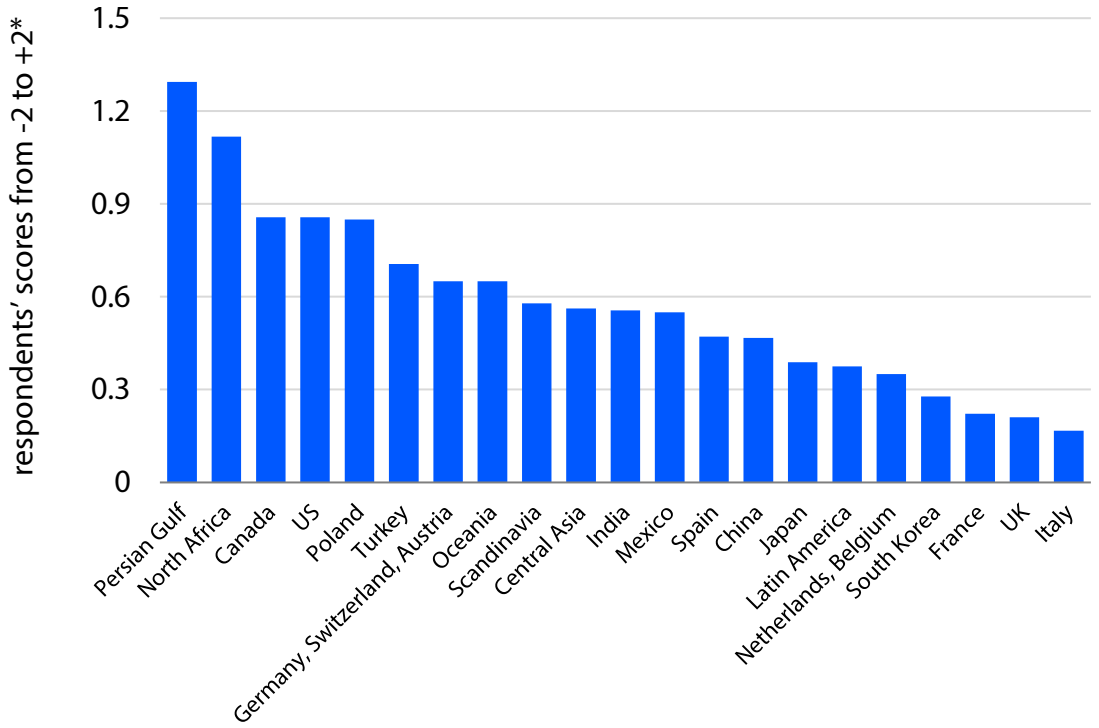
Greenhouse suppliers show slight optimism for 2025

Suppliers to the global greenhouse industry, including those providing seeds, technology, advisory services, and construction, have a modestly positive outlook on the economic situation. According to our RaboResearch survey, they rated the current sentiment in the global greenhouse industry at 6.7 on a scale of 1 to 10. When asked about their expectations for 2025 compared to 2024, the average outlook is positive (see figure 1). Two regions stand out with particularly positive views on opportunities: the Persian Gulf region and North Africa (Morocco, Algeria, Tunisia). Sentiment in North America (Canada, US, and Mexico) is also clearly positive. However, the sentiment regarding opportunities and the investment climate in the Far East (Japan, South Korea, China) and Europe is much more cautious.

Consumables suppliers are more optimistic than investment goods suppliers

Our survey also revealed differences in sentiment based on the type of goods or services provided. Breeding companies and other suppliers of consumables (such as growing media, fertilizers, and crop protection) are somewhat more positive than those dealing with investment goods (such as lighting, greenhouse structures, and technology).

Figure 1: Sentiment among greenhouse suppliers for selected regions, 2025 vs. 2024



Note: Explanation of survey scores: -2 = strong deterioration, -1 = slight deterioration, 0 = no change, +1 = slight improvement, +2= strong improvement
Source: *RaboResearch greenhouse survey 2024*

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Global greenhouse area diversity to persist

Europe dominates high-tech greenhouse production

Ongoing diversity in greenhouse crops and technology

The global greenhouse industry is highly diverse in terms of crops and technologies. We expect greenhouse area to continue growing in the long term, driven by various factors such as the need to protect crops against climate change and demand for high-quality, consistent produce, though in Latin America and Africa flowers and plants are also important greenhouse crops. However, the regions and types of greenhouses that will see the most growth and the extent of technology applied will depend on local conditions. As the type of greenhouse used is closely related to local growing conditions (climate), this diversity will persist in the future.

Europe dominates high-tech greenhouse production

Currently, about half of the world's high-tech greenhouses are located in Europe, mainly in countries with a temperate or somewhat colder climate (see figure 2). Low- and mid-tech greenhouses are more common in the Mediterranean region. This pattern is also seen in North America, where high-tech greenhouses are mostly found in Canada and the northern part of the US, while low- and mid-tech greenhouses dominate in the southern states of the US and in Mexico. Additionally, high-tech greenhouses are present in specific countries in Asia (Persian Gulf region, Kazakhstan, South Korea, Japan, and China) and Oceania (Australia, New Zealand).

Figure 2: Latest estimates of global greenhouse area by region*

	Total	Vegetables*	Ornamentals	Low- and mid-tech	High-tech
Europe	188,772	167,962	20,810	155,135	33,637
North America	71,155	57,683	13,472	60,785	10,370
South America	32,810	18,503	14,317	31,547	1,263
Asia (excluding China)	300,594	279,956	20,638	285,735	14,859
China	1,000,000-3,500,000	800,000 - 3,200,000	200,000 – 300,000	995,000 – 3,495,000	Ca. 5,000
Africa	68,512	59,164	9,348	67,363	1,149
Oceania	2,509	1,132	1,377	1,385	1,124
Total (in hectares)	**3,720,000**	**3,370,000**	**350,000**	**3,650,000**	**70,000**

**Note: Data from various years, compiled in 2024. In some sources, certain fruits (like strawberries) are included under vegetables. For an explanation on the definitions of low-, mid-, and high-tech greenhouses, see the appendix.*
Source: Industry sources, national statistics, RaboResearch 2024

Tomatoes are the primary crop in greenhouses

Greenhouse type must fit the crop and purpose

Type of crops, market demands, and growing conditions determine the type of greenhouse needed

As crops have different needs and varying growing and market conditions, greenhouses vary widely by crop. Tomatoes are the main crop in global greenhouse cultivation, accounting for about 36% of total area (see figure 3). Their share is higher in high-tech greenhouses, reaching 50%.

Melons and zucchini show the opposite trend. They are commonly cultivated in low-tech greenhouses rather than in high-tech ones. For these crops, it is especially important to protect them from hail or excessive rainfall. Additionally, they are often grown in regions where the natural climate is warm enough, making high-tech greenhouses unnecessary.

Cucumbers, peppers, and soft fruits occupy an approximately equal share of the global surface area across all types of greenhouses. When a crop is frequently grown in high-tech greenhouses, it is likely because the benefits of using advanced technology significantly increase productivity. This higher yield or better quality justifies the additional costs associated with high-tech greenhouses. Furthermore, for some crops like tomatoes, growers can achieve a premium for higher quality, off-season produce, or premium varieties grown in high-tech greenhouses.

In countries where climatic conditions allow for different types of greenhouses, like Australia, high-tech glasshouses are mainly used for targeting premium products (see page 26).

*Figure 3: Latest estimates of global greenhouse area by crop**

	Low-tech	Mid-tech	High-tech	Total
Tomatoes	35%	40%	50%	36%
Cucumbers	8%	8%	6%	8%
Peppers	5%	5%	5%	5%
Eggplants, zucchinis, melons	15%	10%	2%	14%
Leafy greens	20%	10%	8%	18%
Soft fruits	10%	10%	10%	10%
Ornamentals	7%	17%	15%	9%
Total (in hectares)*	**3,000,000**	**650,000**	**70,000**	**3,720,000**

**Note*: *Data from various years, compiled in 2024. Data sources and estimates on China's greenhouse area vary widely, which is why this total differs from the one in figure 2.*
Source: *Industry sources, national statistics, RaboResearch 2024*

Ongoing consolidation and ownership changes

Some case studies from the Netherlands

Increase in scale

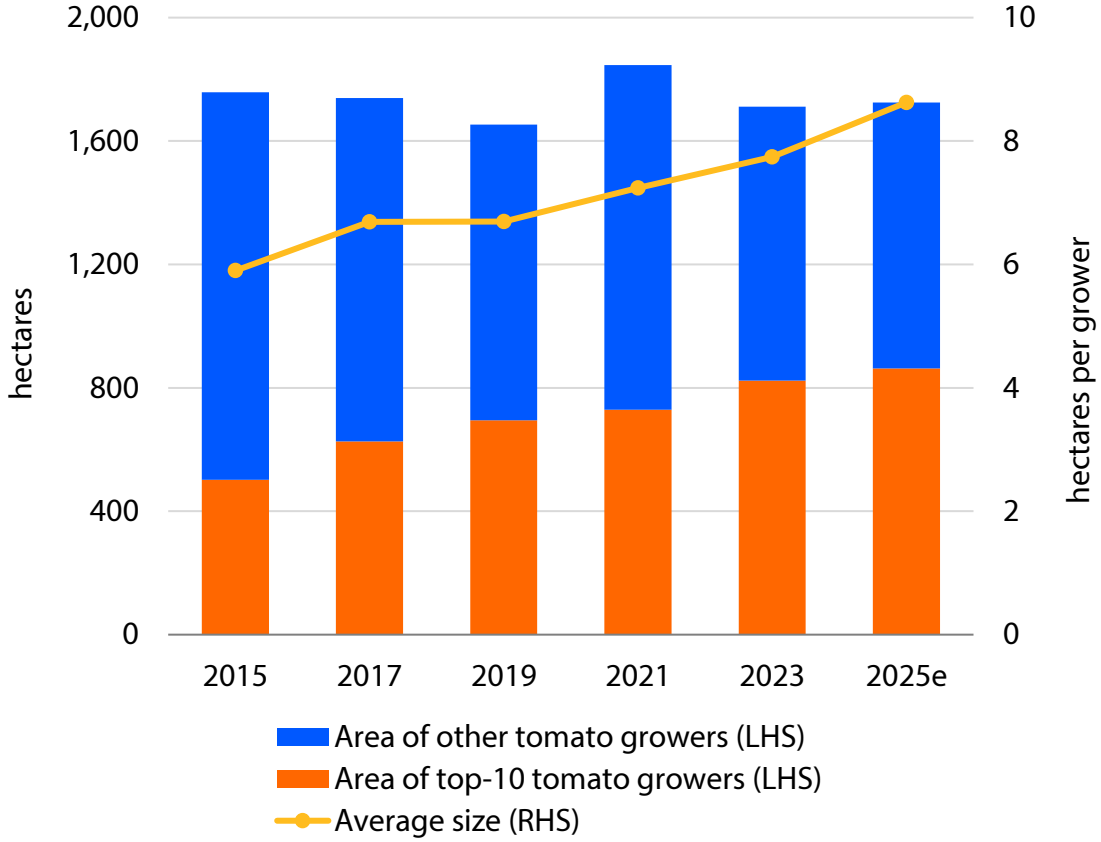
Globally, greenhouse growers are increasing scale through the construction of new greenhouses and via mergers and acquisitions. For example, in the Netherlands the 10 largest tomato growers now account for over half of total tomato cultivation area, up from just 29% a decade ago (see figure 4).

Ownership changes

Another significant and ongoing trend in greenhouse growing is the change of ownership. Some notable examples from the Netherlands in 2024 include:

- *ACRES*: Lans Tomaten, Green2Grow, Prominent I, Prominent II, and Kwekerij G.J. van der Wel merged to form ACRES, encompassing 50 hectares of glasshouses.
- *Agro Care and CombiVliet:* These companies announced their legal merger, creating a new entity that grows tomatoes on nearly 500 hectares of greenhouses in the Netherlands, France, and North Africa.
- *Alvonto*: Van Adrichem Kwekerijen and Van Marrewijk Tomaten merged into a new company, with 62 hectares of greenhouses.
- *Van Gog Kwekerijen*: Van Gog Kwekerijen acquired the Grubbenvorst location from Wijnen Square Crops, resulting in a 110-hectare greenhouse company in the Netherlands and Germany, growing tomatoes, cucumbers, strawberries, and peppers.

Figure 4: Size of Dutch tomato growers, 2015-2025e



Source: CBS StatLine, RaboResearch 2025

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Automation is becoming a dire necessity

Short- and long-term labor shortages

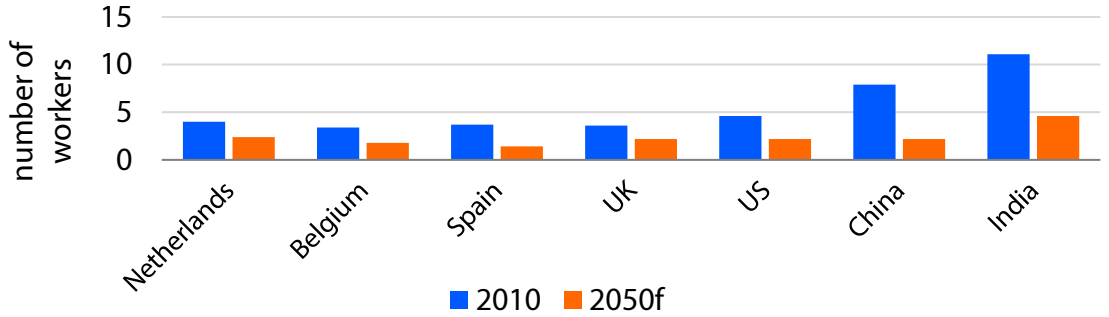
Aging workforce is driving automation

Regulations on the employment of migrant workers are under scrutiny worldwide. However, even without policy changes, automation is becoming essential. The number of available workers is expected to decline sharply in all countries (see figure 5). Other issues include rising labor costs and stagnant labor productivity. In Dutch greenhouses, the number of workers per area has remained stable (see figure 6). Therefore, there is a continued focus on developing robots and mechanization for highly repetitive tasks such as harvesting and leaf picking.

Migrant labor still necessary

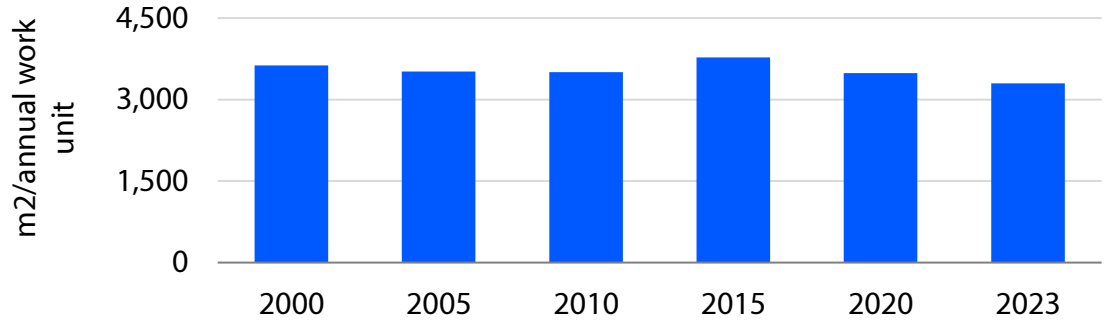
Migrant workers are a key part of the workforce in international greenhouse horticulture. In the Netherlands alone, an estimated 80% of the 67,000 workers are from abroad. These migrants are increasingly coming from more distant countries like Romania and Bulgaria, rather than from closer countries such as Poland. In the US and Canada, migrant workers are more frequently coming from Guatemala and Venezuela instead of Mexico. Canada has had regulations for migrant workers in greenhouse horticulture since the 1960s. In the US, the so-called H-2A visa program facilitates the employment of migrant workers. However, changes to the H-2A program could be introduced by the new administration, potentially leading to the relocation of greenhouse production to Mexico and Canada. On the other hand, high import tariffs are also being discussed, which could encourage near-sourcing.

*Figure 5: Projected ratio of workers to elderly population in selected countries, 2010 vs. 2050f**



***Note:** This is calculated by dividing the population aged 15–64 by the population aged 65 and older.*
***Source:** Washington University 2024*

Figure 6: Labor productivity in Dutch greenhouses, 2000-2023



***Source:** Agrimatie, Wageningen University & Research (WUR) 2024*

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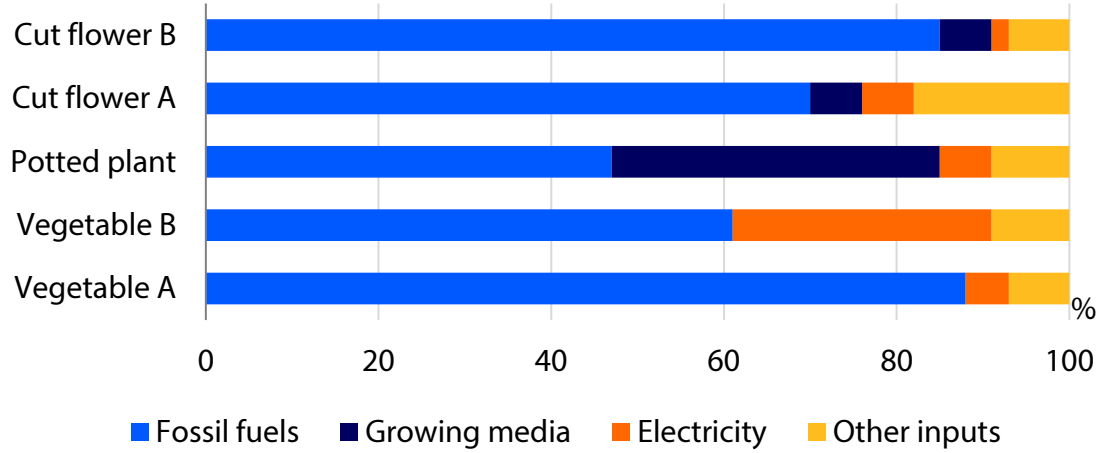
Footprint comes more into focus

Driven by CSRD, retailers are demanding insight into scope 3 emissions

Footprint calculations show need to reduce fossil fuel use

In Dutch greenhouses, fossil fuels account for the largest share of the sector's total environmental footprint, as most greenhouses are heated with fossil fuels. However, factors such as the type of greenhouse, its heating system, and the crop being grown contribute to significant variations in individual companies' footprints. This variation was demonstrated by a Rabobank Sector Management pilot project that calculated growers' footprints (see figure 7).

Figure 7: Share of environmental impact categories in Dutch greenhouse cultivation, 2022



Source: *RaboResearch 2025*

Important steps toward a harmonized approach to environmental footprint calculation and reporting

Various companies, including marketing and distribution companies and growers' cooperatives, have started calculating environmental footprints. This is driven by retailer requirements, voluntary commitments to environmental targets, and regulations. Additionally, in the EU, the Corporate Sustainability Reporting Directive (CSRD) mandates more precise reporting on environmental performance.

Comparing different footprints and building trust with consumers and other stakeholders on the quality and reliability of the footprint is challenging due to varying calculation methods. To standardize life cycle-assessment (LCA) methodologies for calculating environmental footprints, the European Commission launched the Product Environmental Footprint (PEF) over 10 years ago. Category Rules (CRs) were developed for specific calculations. In greenhouse horticulture, the main category rules are HortiPEFCR (for vegetables and fruits) and FloriPEFCR (for cut flowers and potted plants). Inputs like growing media or packaging also have their own category rules. The PEF method covers 16 environmental impacts. The main impact category for greenhouses is fossil fuel use; therefore, CO_2 reduction is considered an essential requirement to meet environmental standards.

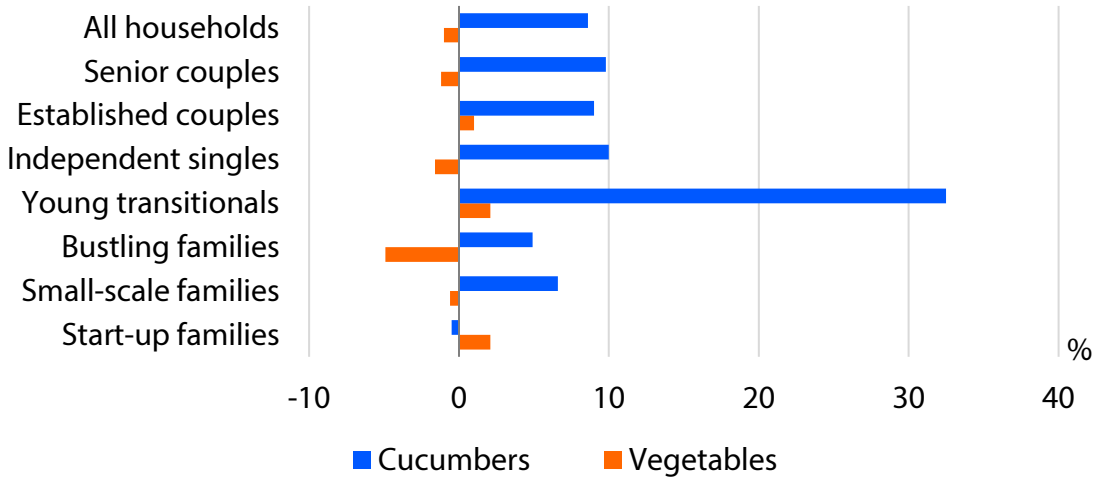
Social media's power in promoting veggies

TikTok hype boosts cucumber consumption worldwide

The influence of social media on consumer behavior has become increasingly evident, particularly in cucumber consumption. Logan Moffitt's series of TikTok videos featuring cucumber recipes gained popularity in 2024, resulting in a rise in cucumber sales in several countries, including Australia (see figure 8). Notably, households in Australia, particularly those with members aged 17 to 35, have significantly increased their cucumber consumption compared to other age groups.

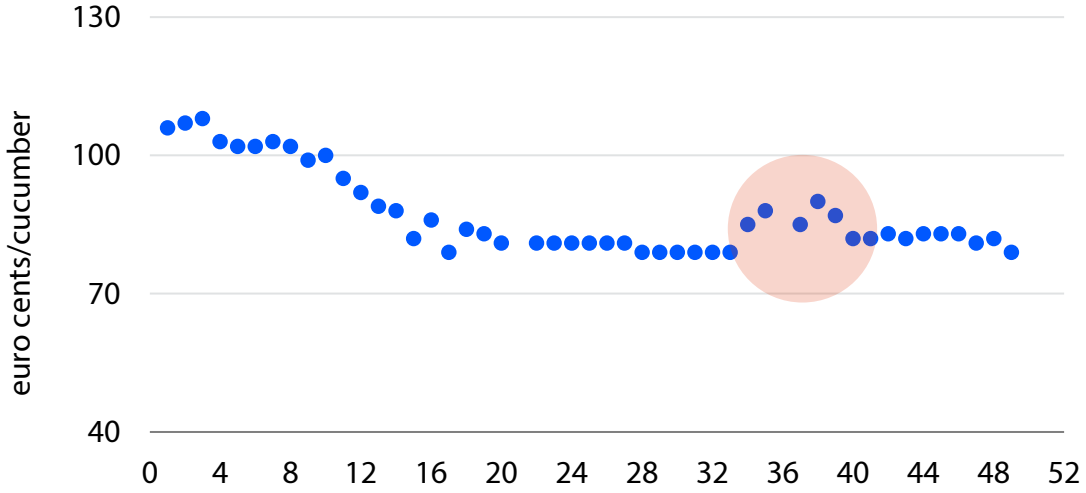
Various media outlets reported that the TikTok videos led to a shortage of cucumbers in Iceland, resulting in price increases. In the Netherlands, cucumber prices also climbed during the peak of the hype (weeks 32 to 40), (see figure 9). It is unclear how much of this increase can be attributed to the TikTok recipe videos, as supply factors may also have played a role.

*Figure 8: Yearly increase in kilogram sales of cucumbers vs. other vegetables in Australian supermarkets, 2024**



***Note:** Data are for the 52 weeks ending September 8, 2024 compared to a similar period in the previous year.*
***Source:** NielsenIQ, RaboResearch 2025*

Figure 9: Average weekly price of cucumbers in Dutch supermarkets, 2024



***Source:** RaboResearch 2025*

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Responding to climate change

Increasingly extreme weather will impact the greenhouse sector

Climate adaptation will become increasingly important for "protected" horticulture

While greenhouses protect crops from extreme weather, they are also vulnerable to conditions such as drought, hailstorms, cold spells, and flooding. These weather extremes can impact both crop yields and quality. Recently, various examples have shown how extreme weather affects greenhouse production. To manage these risks, growers and other stakeholders need to take additional measures, such as spreading production locations, improving water management, using different types of covers, and cultivating different varieties.

Hailstorms in El Ejido, Balanegra, and Vícar (Spain)

In 2024, Almería experienced an isolated high-level depression (a so-called "DANA"), which led to severe weather conditions. The region faced hailstorms and over 300mm of precipitation within a few hours. This extreme weather caused significant damage: plastic coverings were damaged, some greenhouses collapsed, and the quality of crops was affected. While the overall impact on the European vegetable market was manageable, the damage was catastrophic for some individual companies.

Floods hitting greenhouses in Sicily (Italy)

On October 19, 2024, heavy rainfall struck Sicily, causing the Salso River to flood extensively. The areas adjacent to the river, which are partly used for greenhouses, were severely affected. At least 200 hectares of greenhouse area were submerged in mud, damaging crops in tunnels and under glass. This flood was anticipated, as a structural solution for effective water management has yet to be found.

High temperatures and drought (Morocco)

In 2023, temperatures in Morocco reached 50.4 degrees Celsius. This extreme heat, combined with the tomato brown rugose fruit virus (ToBRFV) outbreak, led to substantial crop losses and, subsequently, trade tensions between Morocco and key European partners.

El Niño and La Niña (Ecuador/Colombia)

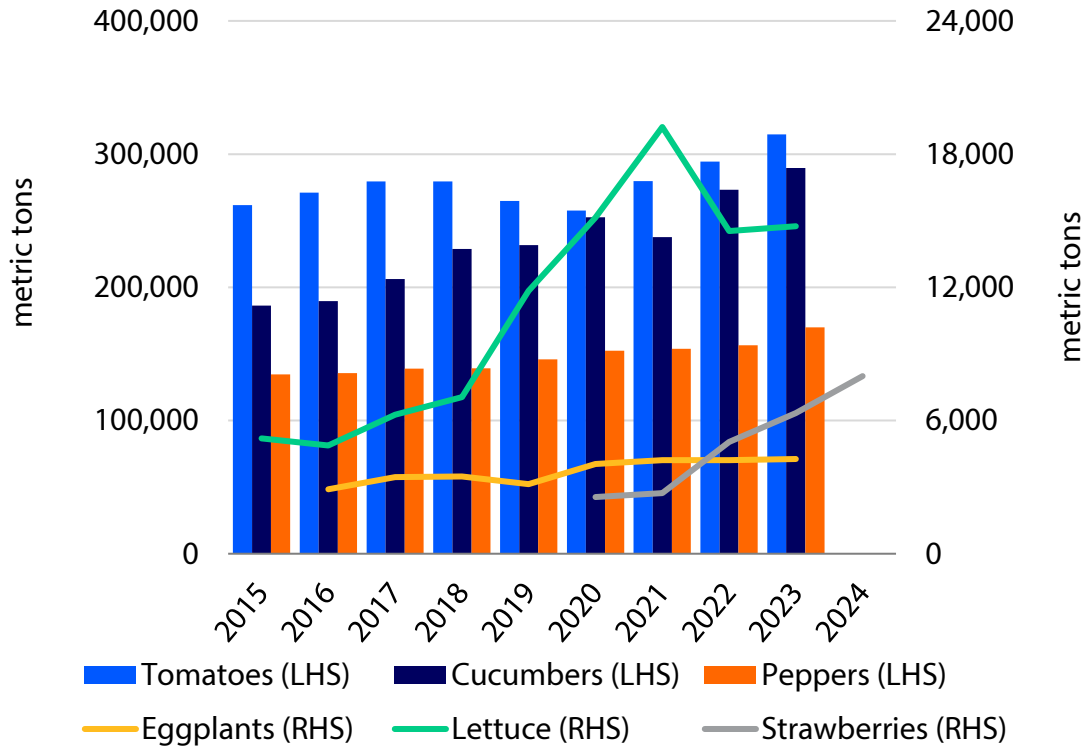
El Niño and La Niña are natural climate phenomena in the Pacific region that significantly impact weather patterns, especially in Latin America and Oceania. Their effects can be intensified by climate change. Possible consequences include lower production, reduced flower quality, flower bud drop, increased disease pressure due to higher humidity, decreased fertilizer uptake due to wetter soil, and damage to greenhouses (Source: Banco Pichincha, 2023).

Source: *Various media sources, Pichincha Bank, RaboResearch 2025*

Canada

Strawberries are the new kid on the block

Figure 10: Canadian greenhouse vegetable production, 2015-2024



Source: *Statistics Canada, RaboResearch 2025*

Canada: A hotspot for high-tech greenhouses

Canada is the second-most important country in the world for high-tech greenhouse cultivation, following the Netherlands. Over the last decade, the area dedicated to greenhouse cultivation has steadily increased (see figure 10). This growth is largely driven by vegetable cultivation under glass, with both the area and production value of greenhouse vegetables roughly doubling in the past ten years (see figures 11 and 12). A notable development is the sharp increase in glasshouse strawberry cultivation. Although strawberries currently occupy a small part of the total greenhouse area and production volume, we see further opportunities for growth. Glasshouse strawberries have the potential to become a new pillar of Canadian greenhouse horticulture.

Concentration in Ontario

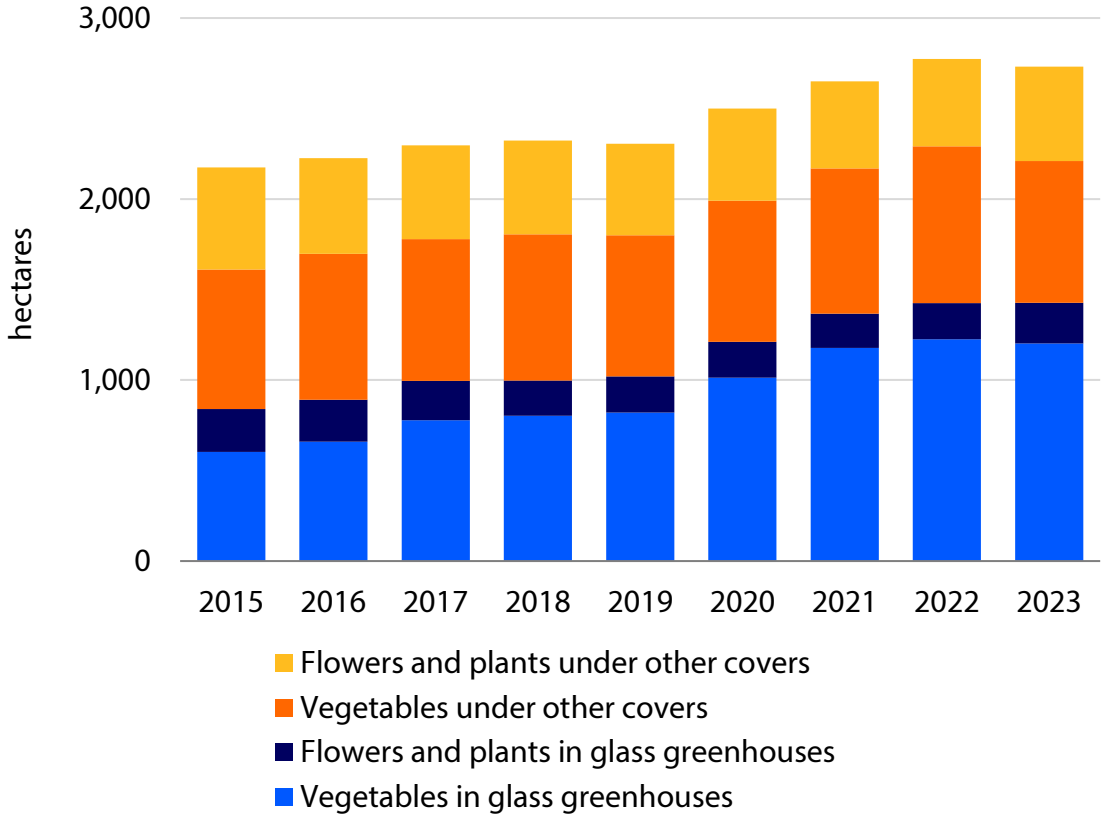
While most Canadian greenhouse production is concentrated in Ontario, other provinces are also seeing development. In this respect, Quebec and British Columbia are worth mentioning, as their governments actively encourage greenhouse investments. The government in Quebec has implemented a strategy to support local food production and increase the province's food self-sufficiency. Currently, greenhouse production in Quebec reaches 189 hectares.

Source: *Market Scan Quebec, Zone Agtech/Dutch Ministry of LVVN (Agriculture) 2024*

Canada

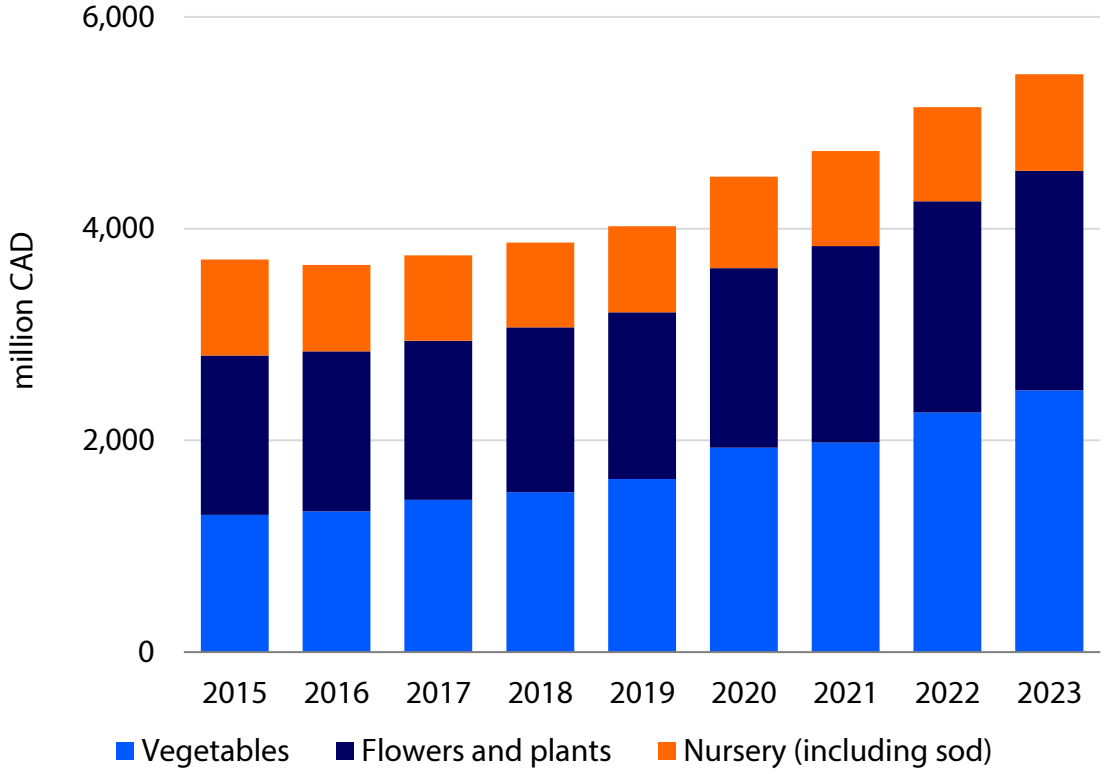
Greenhouse vegetables, acreage and sales: 2015-2023 CAGR 2.9% and 5.0%, respectively

Figure 11: Greenhouse area in Canada by cover type, 2015-2023



Source: Statistics Canada, RaboResearch 2025

Figure 12: Greenhouse production value in Canada by segment, 2015-2023



Source: Statistics Canada, RaboResearch 2025

United States

Expansion in the Midwest and branded greenhouse vegetables

Steady growth of greenhouse acreage and consolidation under brand names

In the US, greenhouses and vertical farms are often grouped together as controlled environment agriculture (CEA), but they have developed differently. From 2017 to 2021, an influx of private equity resulted in significant growth in vertical farming. However, since 2021, several vertical farms have ceased operations due to a lack of profitability. In contrast, vegetable cultivation under glass has grown much more steadily over the past 15 years (see figure 13). Companies that ceased operations have been acquired by existing players, allowing production to continue.

Another notable development is the branding of greenhouse vegetables. Smaller companies often join larger ones through a franchise model to gain market access, while large companies acquire smaller ones to expand faster and offer a complete product range. This trend is particularly evident in the Midwest region of the US and in Canada, leading to an increase in greenhouse vegetable area in these regions (see figure 14).

Figure 13: US greenhouse vegetable area, 2007-2022

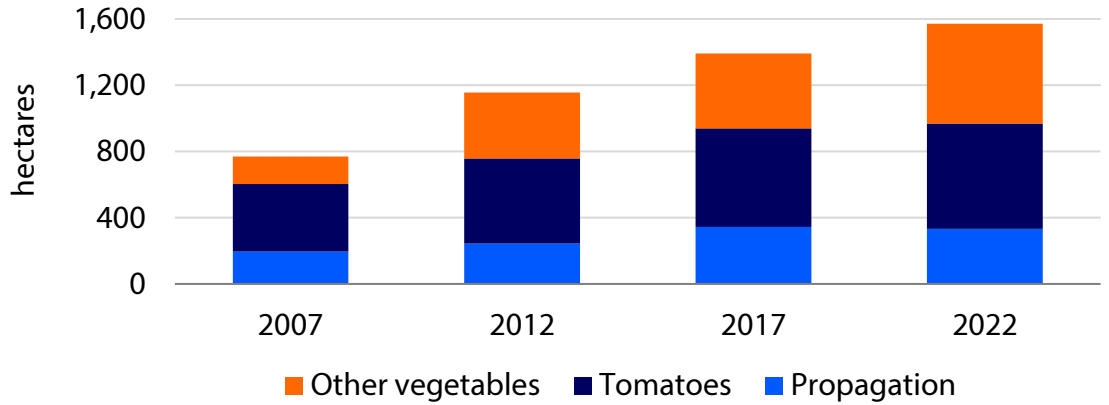
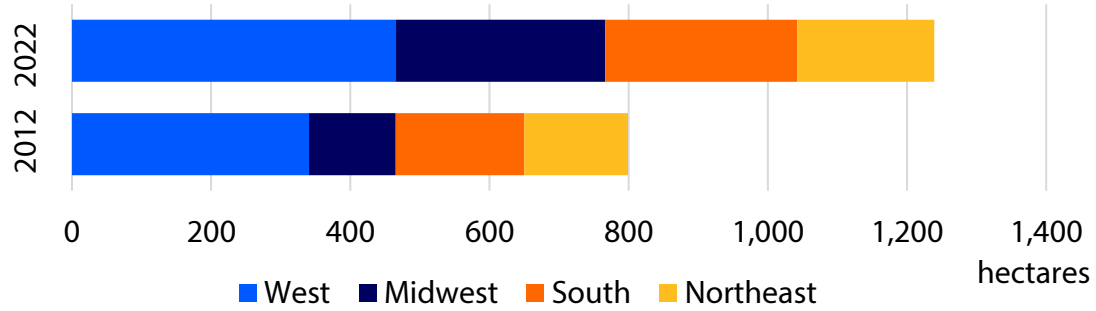


Figure 14: US greenhouse vegetable area by region, 2012 vs. 2022



Source: USDA, RaboResearch 2025

Mexico

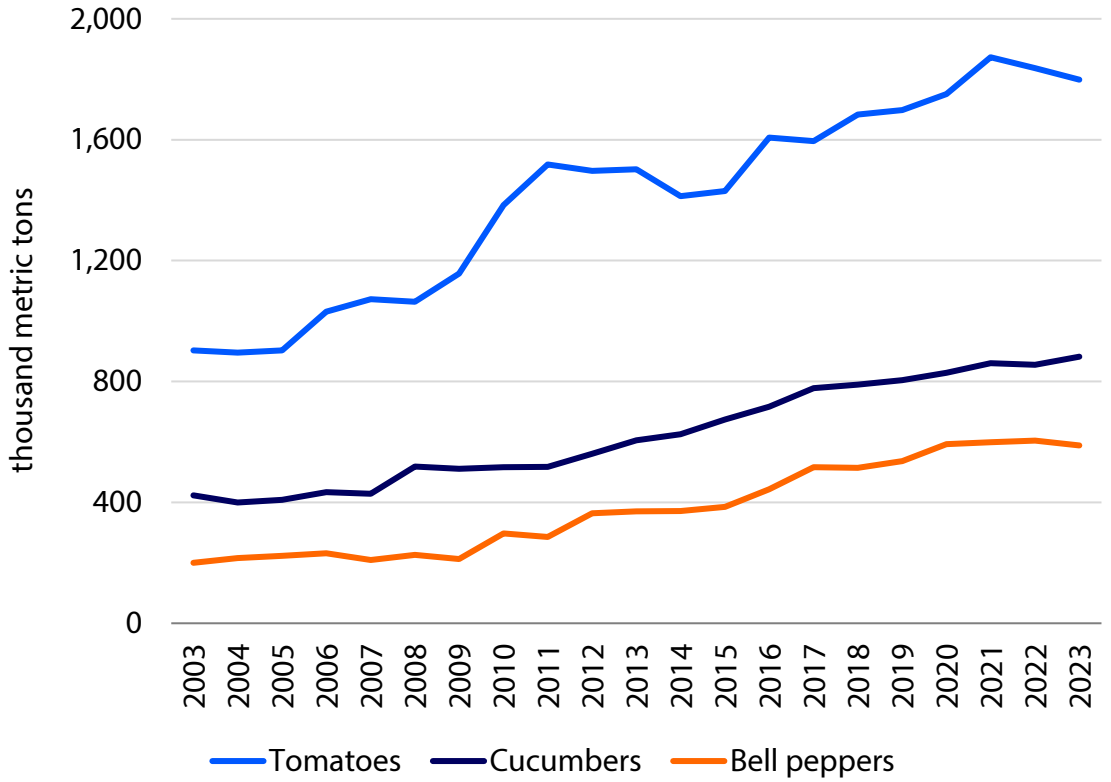
Winds of change

Mexican exports of fresh tomatoes, cucumbers, and bell peppers have more than doubled over the past two decades, increasing from a combined 1.5m metric tons in 2003 to over 3.3m metric tons in 2023 (see figure 15). However, the pace of growth is leveling off.

The protected cultivation area in Mexico varies significantly by cover type (see figure 16). The share of vine vegetable production has increased substantially. In 2010, about 32% of tomatoes, 28% of cucumbers, and 7% of peppers produced in Mexico were grown under some kind of cover. By 2023, these proportions had increased to 64%, 50%, and 20%, respectively. Although the area of protected cultivated berries has also increased significantly, vine vegetables still account for the majority of Mexico's protected horticulture (see figure 17).

Several factors have contributed to the growth of Mexican greenhouse vine vegetable production, including climate suitability, relatively low local wages for farm labor, export-oriented production, and duty-free access to the US market. However, in recent years, the industry has faced sanitary challenges, rapidly increasing labor costs, the elimination of government support programs, unfavorable exchange rates, and increasing input costs, leading to margin pressures. We expect these challenges to trigger innovation and consolidation in the Mexican greenhouse sector. For a more detailed discussion, see *Trends in Mexico's Greenhouse Vegetable Industry*.

*Figure 15: Exports of fresh tomatoes, cucumbers, and bell peppers from Mexico, 2003-2023**



***Note:** Includes greenhouse and open-field production.*
***Source:** INEGI, Secretaría de Economía, Banxico, FIRA, RaboResearch 2025*

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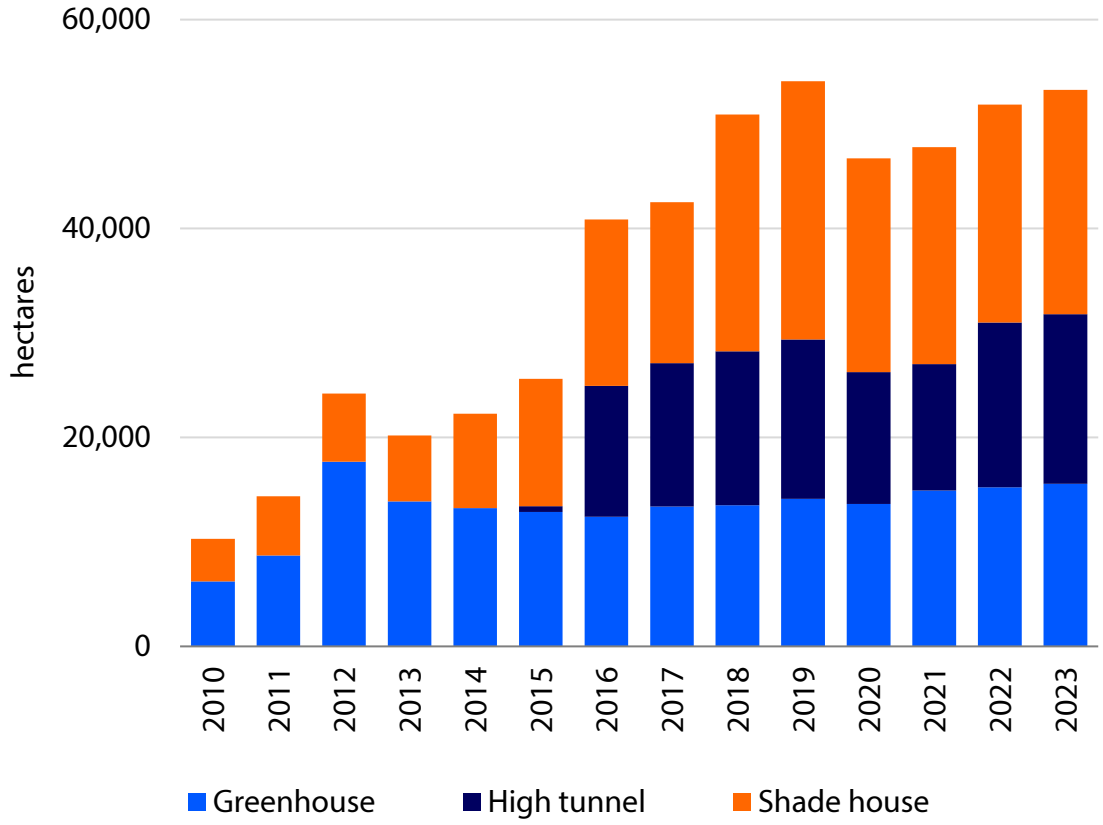
Mexico

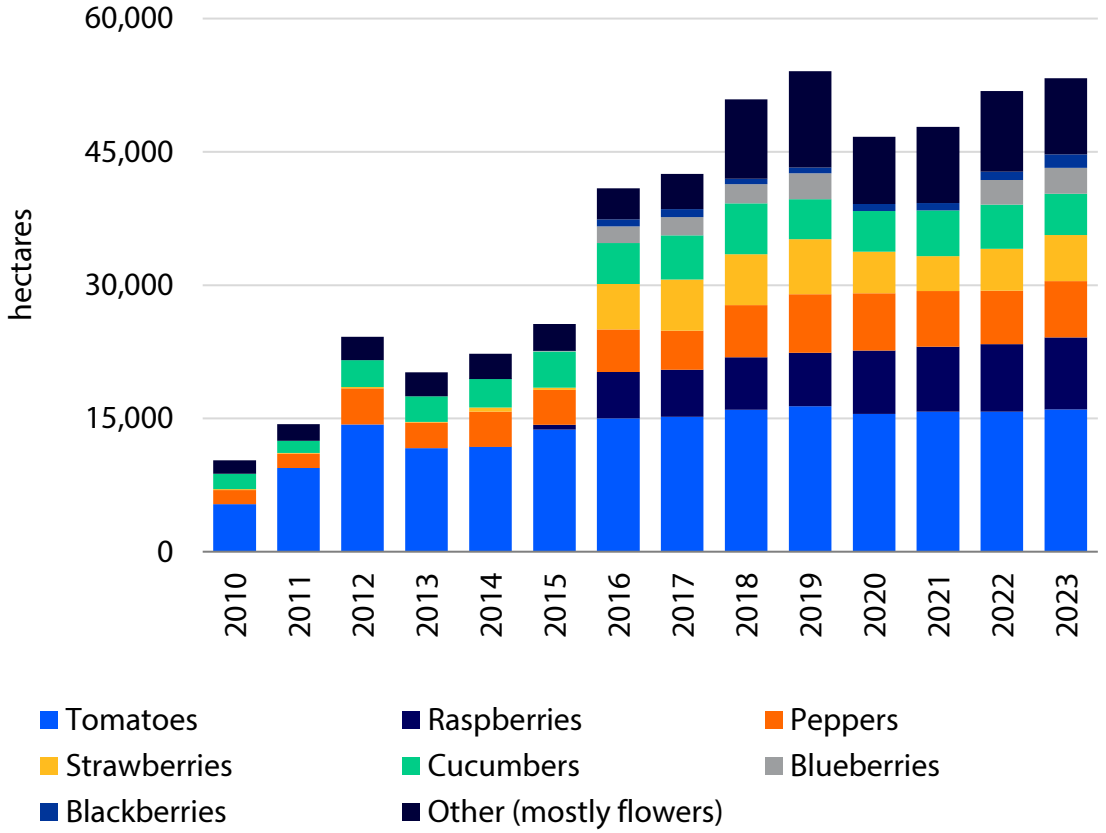
Covered vegetable production area is stabilizing

Figure 16: Greenhouse area in Mexico by cover type, 2010-2023



Source: SADER, FIRA, RaboResearch 2025

Figure 17: Greenhouse area in Mexico by crop, 2010-2023



Source: SADER, FIRA, RaboResearch 2025

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Spain

Greenhouse production will change rather than grow

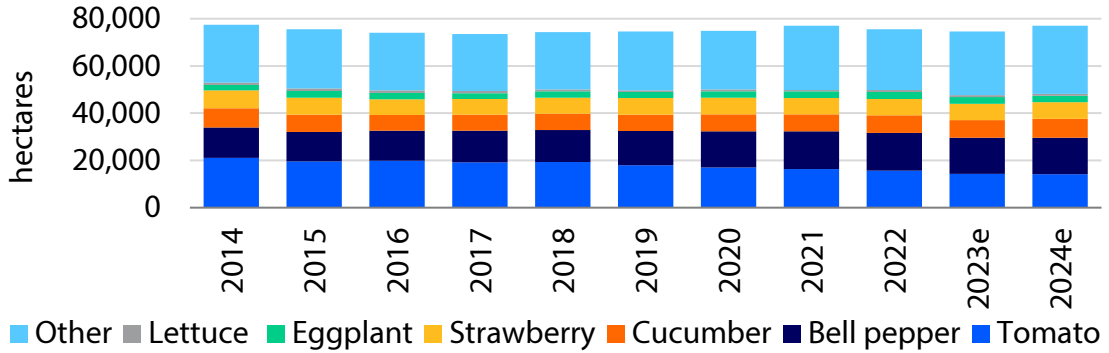
Challenges in Spain's greenhouse vegetable production

Spain, Europe's largest producer and exporter of greenhouse vegetables, is expected to change rather than expand its greenhouse vegetable production.

Since 2015, the greenhouse area dedicated to peppers has increased at the expense of tomato production (see figure 18). Tomato production has faced challenges such as competition (mainly from Morocco), rising production costs, and ToBRFV, among other issues. More structurally, Spanish growers are dealing with rapidly increasing labor costs and climate change, which results in more extreme weather events. For example, the DANA storm in October 2024, followed by extreme high temperatures in November, showcased some of these extremes. However, the impact on production volumes was relatively limited, according to industry sources.

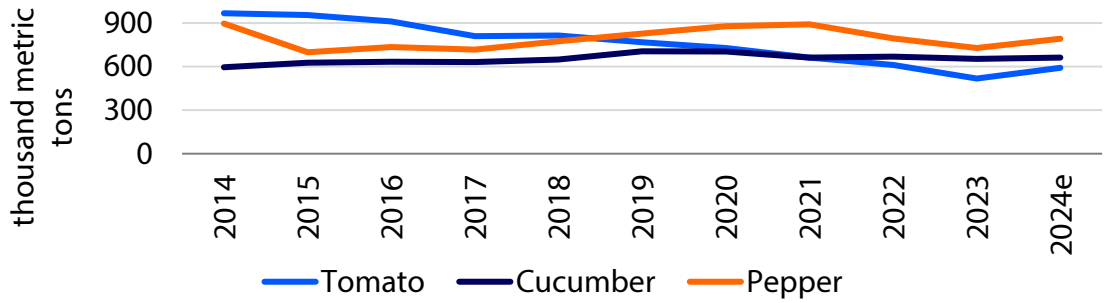
Although Spain will remain the EU's largest supplier in the medium term, competition is likely to increase. Companies in Morocco and Turkey, as well as northern European producers using heated greenhouses, will take advantage of retailers' desire to diversify risks and secure supply. Spanish producers can adapt by focusing on quality, efficient water use, and biological crop protection, for example.

Figure 18: Greenhouse area in Spain by crop, 2014-2024e



Source: MAPA, UN Comtrade, RaboResearch 2025

Figure 19: Exports of greenhouse vegetables from Spain, 2014-2024e



Source: MAPA, UN Comtrade, RaboResearch 2025

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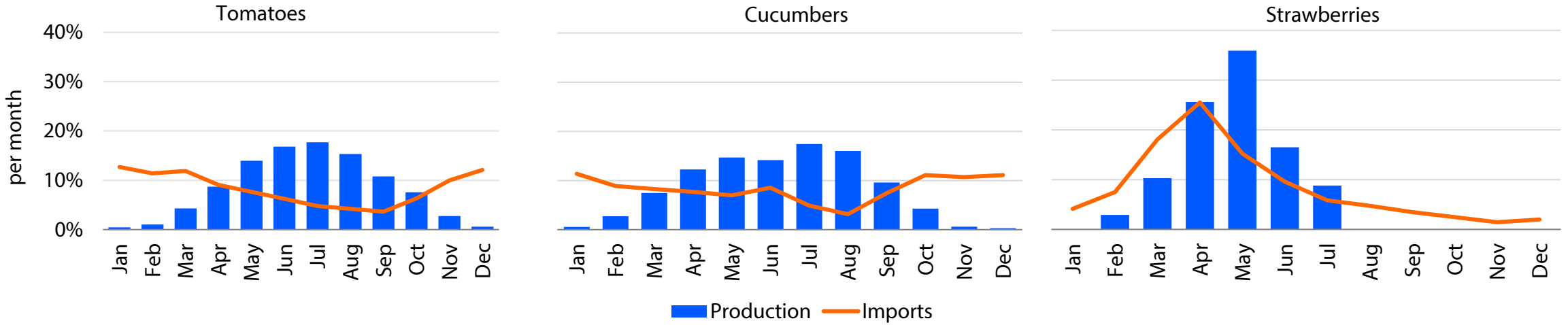
France

Seasonality in French greenhouse production provides opportunities for exports to France

France is a key market for greenhouse vegetables within the EU. In 2023, domestic production of greenhouse tomatoes covered 2,026 hectares, much of it in Brittany. In addition, a significant area of tomatoes is grown under plastic or in open fields in southern France. Greenhouse tomato production in France is highly seasonal, as 6% of domestic production is marketed in Q1, 36% in Q2, 46% in Q3, and 7% in Q4 (see figure 20).

The same seasonal trends apply to cucumbers and strawberries in France. The total area dedicated to greenhouse cucumbers, mainly in the southwest, is 696 hectares, with most of the production marketed during the summer season. In 2024, the area of strawberries grown in greenhouses and tunnels covered 2,213 hectares, mainly in southern France. Like tomatoes, domestic strawberry production is highly concentrated in a few months, as shown in figure 20. Due to the seasonality of domestic production, France needs to import a significant share of vegetables during the offseason.

*Figure 20: Monthly French greenhouse production and imports of tomatoes, cucumbers, and strawberries**



***Note:** The production data represents a five-year average, while the import data is specific to the year 2023.*
***Source:** Agreste, RaboResearch 2025*

Belgium

Grower confidence in Belgium took a hit in 2022 but recovered in 2023 and 2024

Impact of energy cost increases

The war between Russia and Ukraine dealt a serious blow to the confidence of greenhouse growers in Belgium. High energy prices brought a lot of uncertainty about the future. However, during 2023 and 2024, confidence among greenhouse growers recovered, though it has not returned to pre-2022 levels (see figure 21).

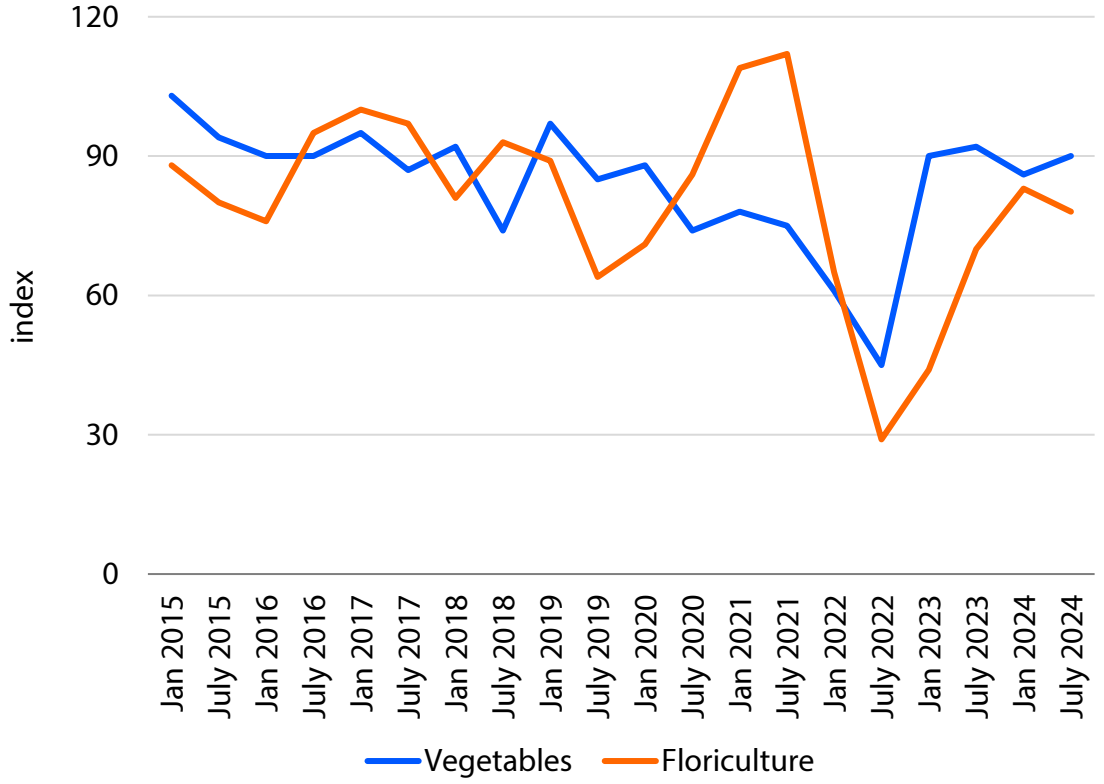
Concentration in Flanders

In Belgium, greenhouse horticulture area is 2,676 hectares (vegetables: 1,272; fruits: 890; floriculture: 514) and is highly concentrated in the provinces of Antwerp and West Flanders. The main crops are strawberries (757 hectares), tomatoes (583 hectares), peppers (114 hectares), and cucumbers (60 hectares).

Growers' cooperative on a European scale?

In Belgium, 95% of production is marketed via one of the three cooperatives (Hoogstraten, BelOrta, REO Veiling). These organizations also provide services like warehousing, sorting, and more. BelOrta has signed a letter of intent to explore cooperation with Dutch cooperative The Greenery through a union of producer organizations. The aim is to join forces and strengthen their position in the European market.

Figure 21: Evolution of the Flemish business cycle index for greenhouse growers, 2015-2024

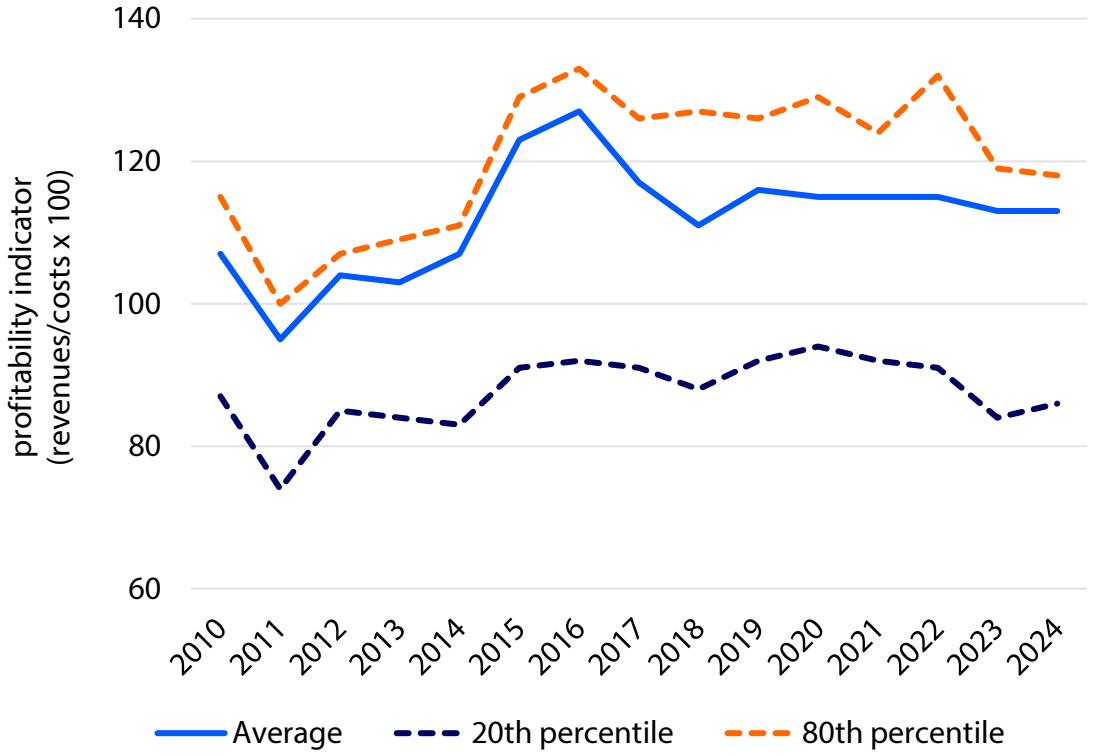


Source: *Statbel Vlaamse landbouwconjunctuurindex, RaboResearch 2025*

The Netherlands

Stable outlook with equal area and good profitability amid energy challenges

*Figure 22: Profitability trends and spread of Dutch greenhouse vegetable growers, 2010-2024**



Profitability in Dutch greenhouse vegetables on track

On average, Dutch greenhouse vegetable producers have shown positive economic results in recent years, recording a profitability indicator of >100 (see figure 22). However, there are significant differences between growers, which depend on the crop, the technology used, and the marketing strategy. Growers with older farms that do not use cogeneration have generally been more exposed to increased energy prices.

Strawberries and peppers gain share in Dutch acreage

In the Dutch greenhouse vegetable sector, peppers and strawberries have gained acreage (see figure 23). However, we expect the acreage to stabilize in the coming years.

More emphasis on taste, slower increase in yields

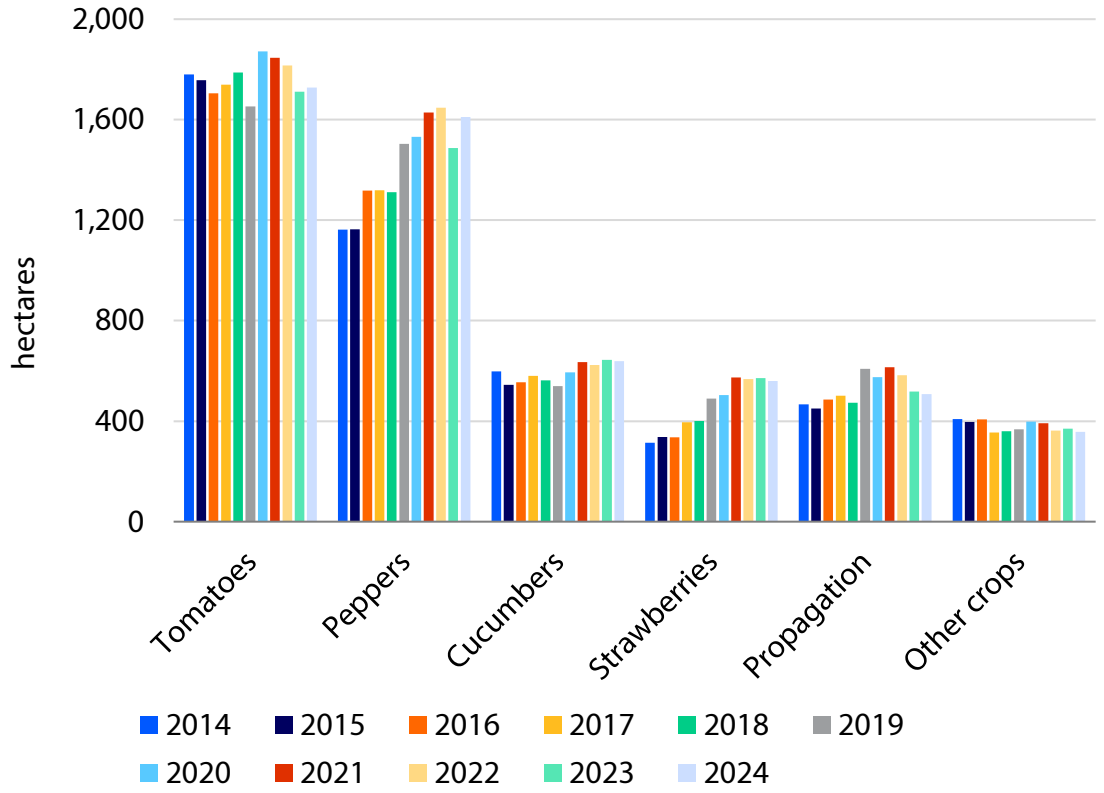
The average yields of the main greenhouse vegetables in the Netherlands have barely risen over the past 25 years (see figure 24). This is due to several factors. Firstly, new small-sized varieties (e.g., cherry and cocktail tomatoes) with much more flavor and better resistance characteristics but lower yields in terms of weight have been included in the cultivation plan. Secondly, production has been moved to winter with the help of assimilation lighting. Eggplants and strawberries still show an increase in productivity. It is likely there will be a stabilization in the coming years if these crops follow a trend similar to that of tomatoes.

***Note:** Profitability spread is illustrated using the 20th and 80th percentile values. Within the sample, 60% of growers achieve results within the dashed lines, with 20% falling below the blue dashed line and 20% above the orange dashed line..*
***Source:** Agrimatie, Wageningen University & Research 2024*

The Netherlands

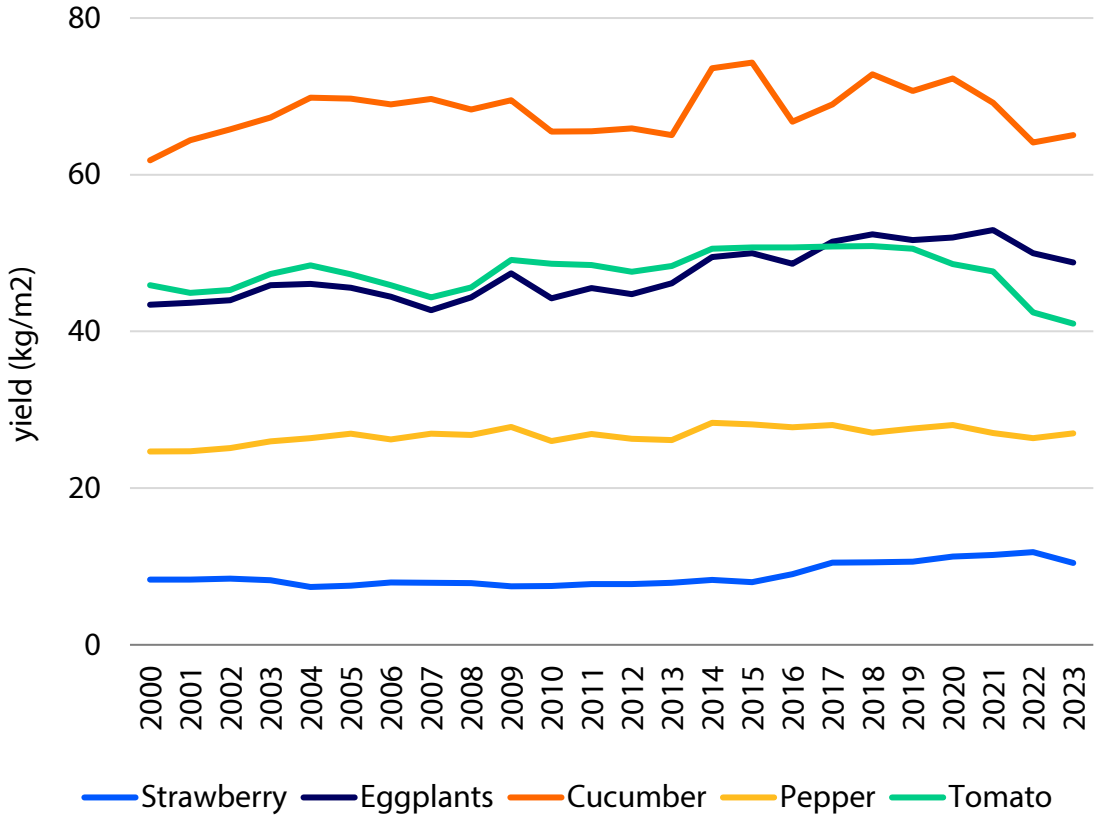
Greenhouse vegetable production area increased over the past decade, yields did not

Figure 23: Greenhouse vegetable acreage in the Netherlands, 2014-2024



Source: CBS, RaboResearch 2025

Figure 24: Average yield in Dutch greenhouses, 2000-2023



Source: CBS, RaboResearch 2025

Rabobank

Germany

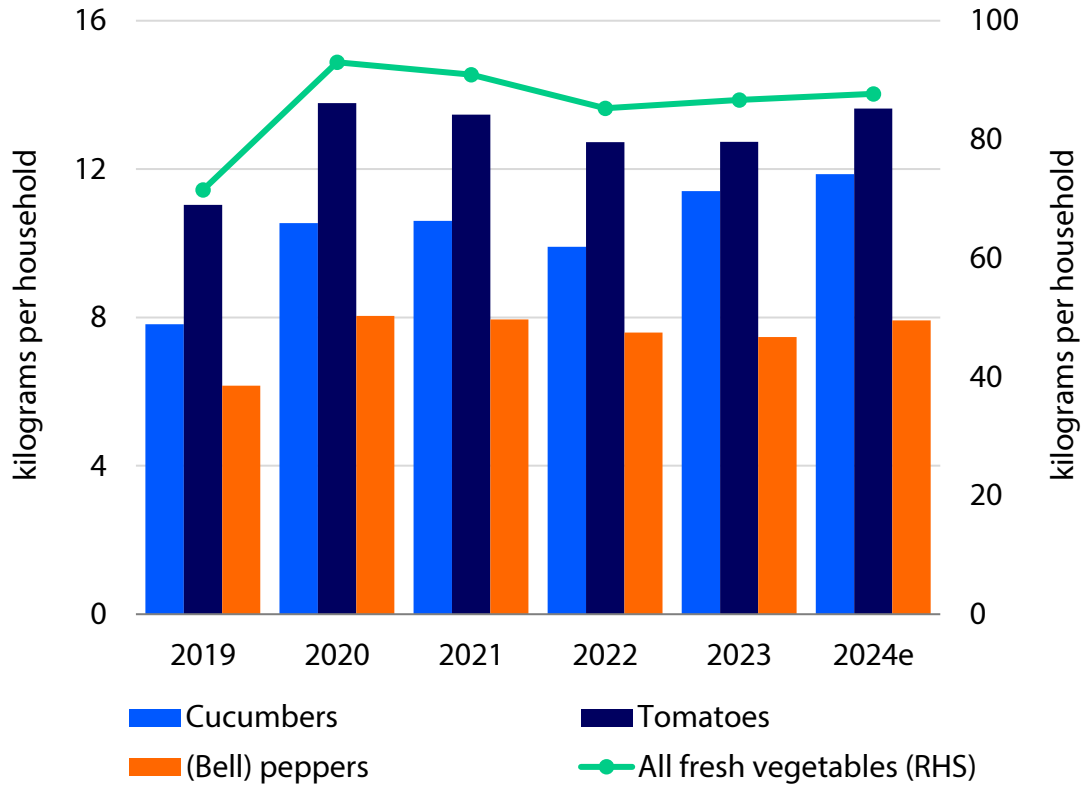
Robust consumer purchases of greenhouse vegetables, low self-sufficiency rate

Germany remains highly dependent on imports

As the EU's main import market for greenhouse vegetables, Germany has strong household purchases of fresh vegetables (see figure 25). Like in many other countries, the Covid-19 pandemic triggered high consumer retail purchases. However, while this "Covid-effect" has faded in many markets, it has hardly diminished in Germany. Consumer purchases of fresh vegetables, including greenhouse vegetables, remain much higher compared to 2019, despite significant price increases. According to Eurostat, average German consumer prices for vegetables were 34% higher in November 2024 compared to the same month in 2019.

Most greenhouse vegetables consumed in Germany are imported. Despite significant efforts to encourage consumption of locally, regionally, and domestically grown greenhouse produce, Germany's reliance on imported greenhouse vegetables has remained largely the same. According to AMI, Germany's self-sufficiency rate for tomatoes, cucumbers, and bell peppers in 2023 was 12.5%, 10.4%, and 3.9%, respectively. As reported by Germany's Federal Statistical Office (Destatis), German greenhouse acreage for tomatoes decreased from 398 hectares to 374 hectares between 2018 to 2023. In the same period, greenhouse cucumber acreage increased from 228 hectares to 244 hectares, and bell pepper acreage grew from 108 hectares to 139 hectares. Less modernized companies are leaving the sector, and modern growers are hesitant to expand rapidly due to high capital costs, increasing energy and labor costs, competitive pressure, regulatory pressure, and a lack of suitable locations.

Figure 25: Household purchases of fresh vegetables in Germany, 2019-2024e



Source: AMI, GFK, RaboResearch 2025

Poland

Imports of vegetables have increased, domestic production is consolidating

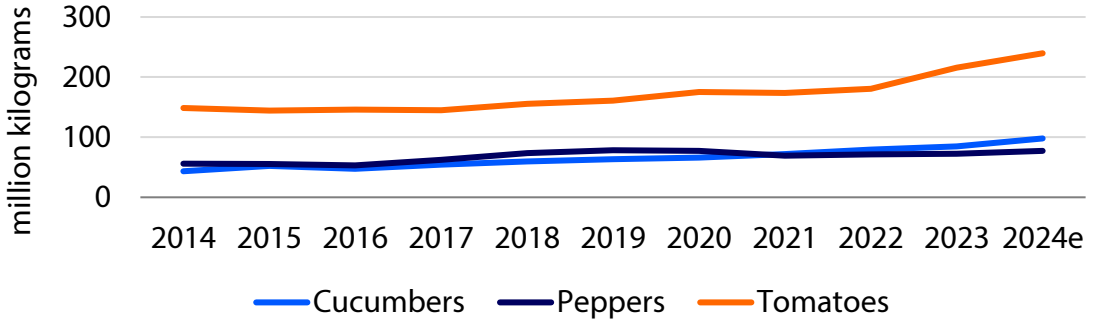
Further growth of domestic production in question

Fueled by economic growth and re-export opportunities to Ukraine and other neighboring countries, Poland has rapidly grown its imports of greenhouse vegetables (see figure 26). These imports are mainly concentrated in the offseason (winter), but when comparing the 2018/19 and 2023/24 seasons, we see the highest growth was from March to June (see figure 27). The Netherlands has become the main supplier of imported tomatoes to Poland. For cucumbers and peppers, there is a wide range of suppliers, including Greece, Germany, Ukraine, Romania, and Turkey.

Poland's domestic production has benefited from the country's low labor costs, experienced greenhouse operations management, and economic growth. However, increasing and volatile energy costs, disease pressure, and fiercer competition may hamper further growth of the industry.

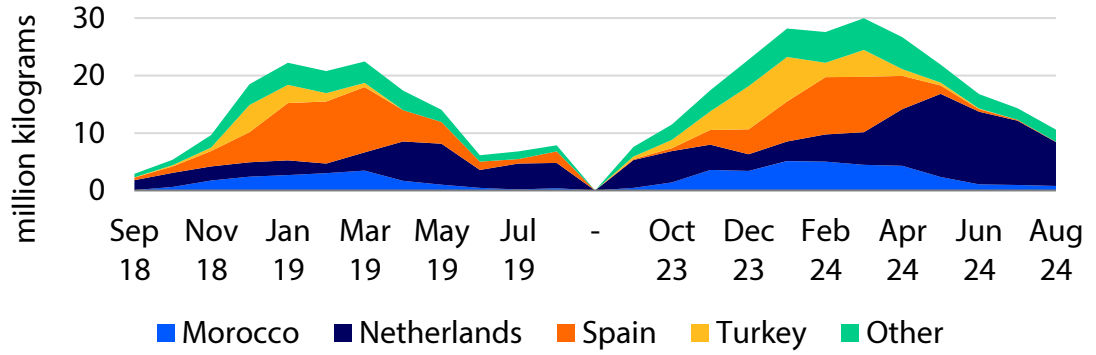
Poland has 5,220 hectares of greenhouses, including 1,750 hectares of tomatoes, 970 hectares of cucumbers, and 2,500 hectares of other crops. The 1,400 hectares of heated greenhouses are mainly used for tomato production (source: RVO, 2023). There is a noticeable trend of consolidation in Polish greenhouse production, with an estimated 20 companies accounting for half of the production acreage.

Figure 26: Trends in Poland's vine vegetable imports, 2014-2024e



Source: *UN Comtrade, RaboResearch 2025*

Figure 27: Seasonal trends of tomato imports in Poland by origin, Sep 2018-Aug 2024



Source: *UN Comtrade, RaboResearch 2025*

Rabobank

Bulgaria

Greenhouse horticulture still in its infancy and in need of larger-scale operations and modernization

Need for modernization

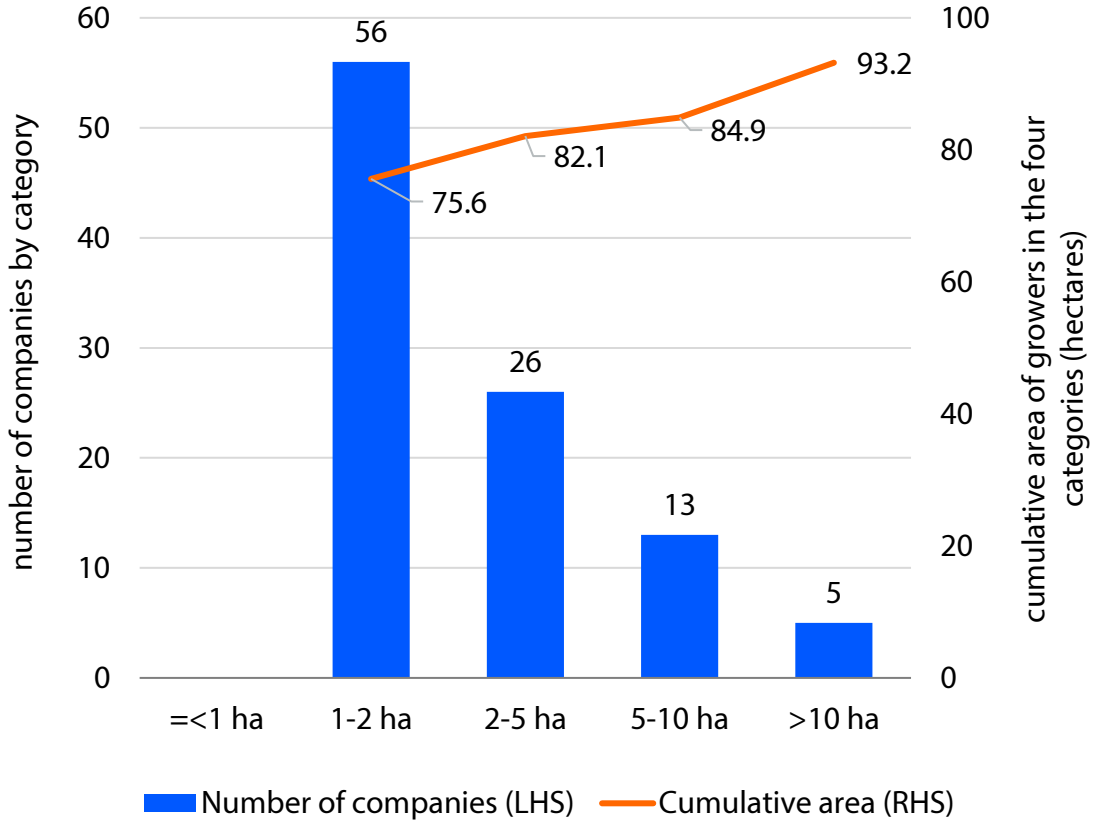
Similar to greenhouse horticulture in Hungary, Slovakia, Romania, and Serbia, the development of greenhouse horticulture in Bulgaria is in its infancy. The total acreage of Bulgarian greenhouses is approximately 1,265 hectares. Most greenhouses (74%) are covered with polyethylene, while glass-covered greenhouses, mainly built in the 1970s, are outdated and in need of refurbishment. Only five farms have more than 5 hectares of covered area, collectively totaling 93 hectares (see figure 28).

A recent survey by the Netherlands Enterprise Agency (RVO) revealed that 21% of Bulgarian greenhouse growers are interested in investing in automatic irrigation and fertilization systems. Climate automation is also a popular investment choice. Additionally, one-third of the respondents plan to expand their production.

Energy uncertainty is a roadblock for growers

According to the survey, there are promising opportunities for expanding greenhouse horticulture in Bulgaria. High import volumes of tomatoes and cucumbers indicate a strong potential for increased local production. Government policies also support the development of greenhouse horticulture. The main concern for developing covered cultivation is to reduce energy costs. Investing in sustainable energy sources is essential for healthy business operations, especially for the long term. This also requires a certain scale of greenhouse businesses or the formation of greenhouse clusters.

Figure 28: Size of Bulgarian greenhouses, 2023



Source: *Valkanov N., RVO, RaboResearch 2025*

Turkey

Challenges to overcome for continued greenhouse growth

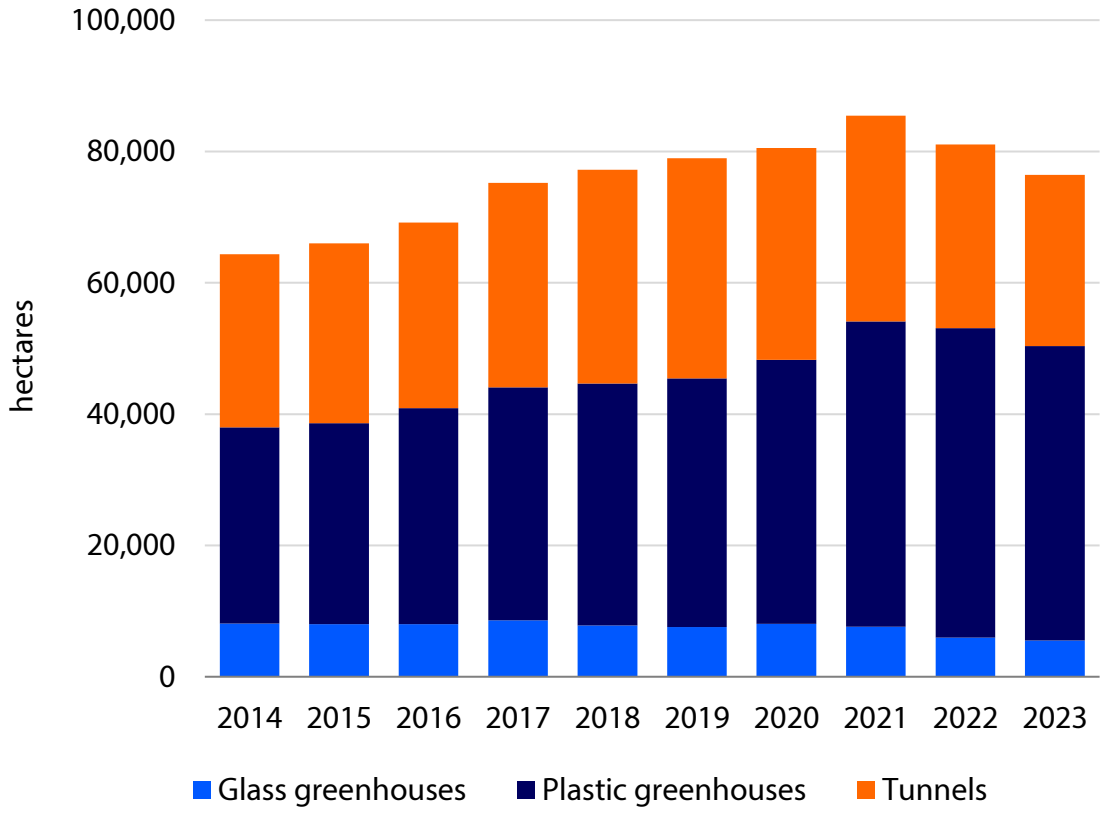
Over the last decade, Turkey gained market share in the EU

Turkey is strategically located between Asia and Europe. As a major player in greenhouse vegetables, with 70,000 hectares dedicated to greenhouse vegetable production, the country has a long-standing tradition in horticulture production and exports. Turkey's greenhouse vegetable exports reach a wide range of destinations, including key EU markets such as Romania, Bulgaria, Germany, the Netherlands, and Poland, as well as other major destinations like Syria, Russia, and Israel. In the competitive EU market, Turkey has successfully increased its share of produce exported to the EU. A comparison of the average imports from 2014 to 2016 with those from 2022 to 2024 reveals that Turkey's share of EU tomato imports rose from 12% to 27%. Similarly, the share for cucumbers grew from 26% to 36% and for peppers from 25% to 34%.

Challenges hindering greenhouse growth in Turkey

In the short to medium term, Turkey's greenhouse production and exports are likely to stagnate or decline. Recent years have seen a decrease in both greenhouse acreage and greenhouse vegetable production volume, partly due to high interest rates and hyperinflation (see figure 29). Other challenges include the small scale of operations and a lack of investment in higher productivity and more sustainable production methods, such as water recirculation and biological pest control. According to industry sources, only about 3% of production currently employs mid- to high-tech methods in heated greenhouses, including substrates and more advanced irrigation.

*Figure 29: Greenhouse acreage in Turkey, 2014-2023**



***Note:** Including approximately 5,900 hectares of ornamentals.*
***Source:** TUIK 2025*

Morocco

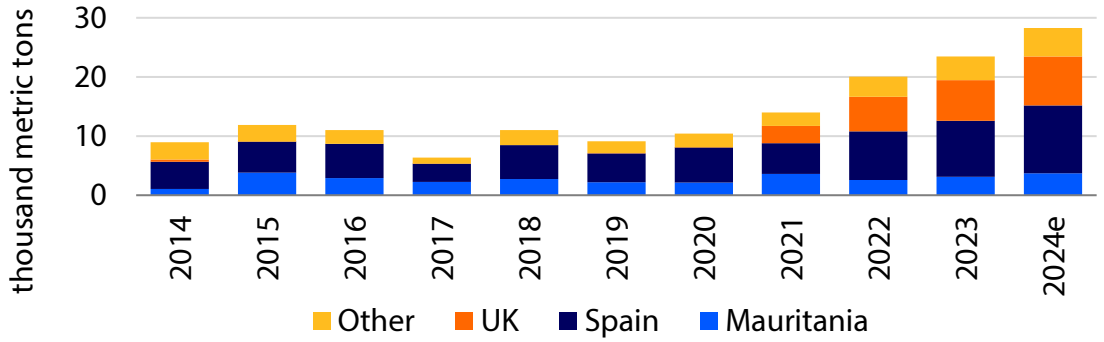
Increasingly competitive for other greenhouse crops besides tomatoes

Set for further, more sustainable growth

North Africa is one of the most positively viewed regions for greenhouse opportunities, according to our survey respondents. This is reflected in Morocco's export performance. While tomato exports have grown steadily over the last decade, cucumber exports have seen a significant increase in the last five years (see figure 30). This growth is driven by demand from the Spanish and UK markets. Moroccan cucumbers have become more competitive compared to Spanish cucumbers. In 2018, the UK's average cost, insurance, and freight (CIF) import price for cucumbers was USD 1.17/kg for Morocco and USD 1.14/kg for Spain. By 2023, these prices had risen to USD 1.45 and USD 1.79, respectively. Morocco has also become more competitive in pepper exports, which have grown by an average of 6% annually over the last decade, with Spain being the main destination. For tomatoes, France remains Morocco's primary market, although the UK has also gained importance (see figure 31).

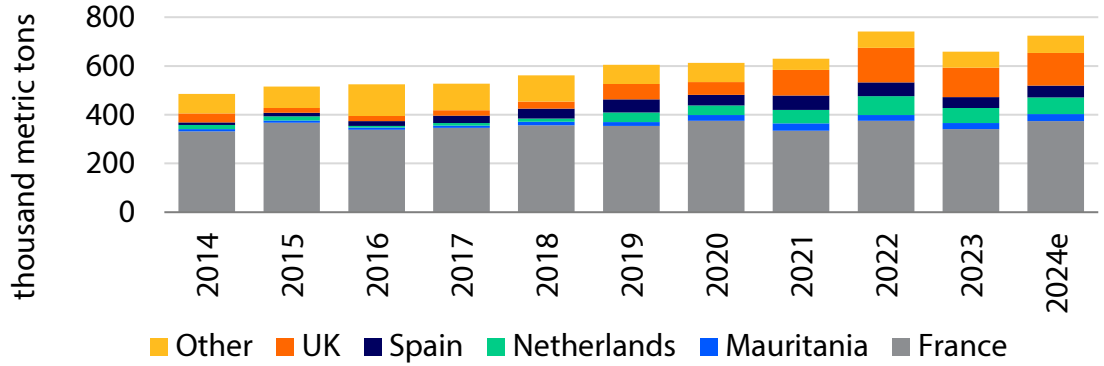
Morocco's greenhouse production is set for further growth due to its low-cost operations, large experienced companies, and government support. However, challenges such as disease pressure, water availability, and extreme weather events like the 2023 heatwave, which significantly affected tomato exports, will continue to pose challenges for Morocco's greenhouse sector. Hence, focusing on environmental and social sustainability, as well as risk management (climate, pests, and diseases), is considered essential to maintain this success story.

Figure 30: Morocco's cucumber exports, 2014-2024e



Source: UN Comtrade, RaboResearch 2025

Figure 31: Morocco's tomato exports, 2014-2024e



Source: UN Comtrade, RaboResearch 2025

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Australia

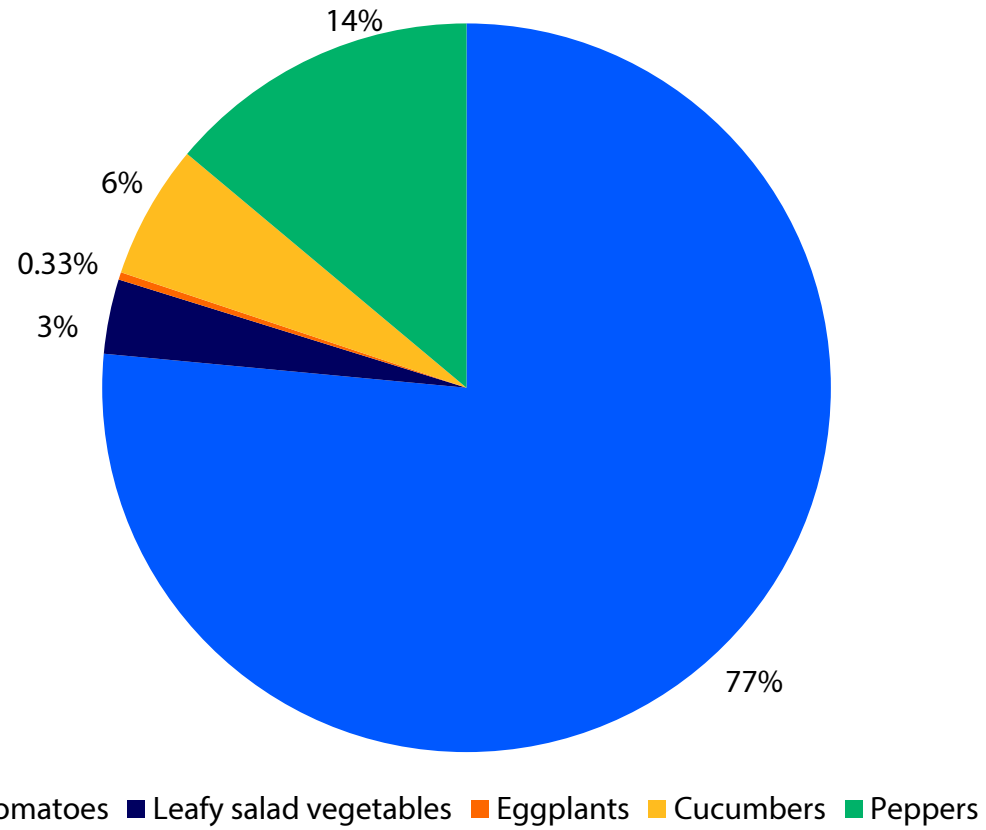
Economies of scale and high-value varieties are key for greenhouse production returns

Focus on high-value greenhouse production

Australia has over 13,900 hectares of protected cropping, which is largely made up of net houses, polytunnels, and polyhouses, making up 65%, 16%, and 14% of acreage, respectively. High-tech greenhouses make up a much smaller portion of protected cropping area, with 302 hectares used for vegetable production in 2022/23. Most greenhouses are located in South Australia, Victoria, and New South Wales, comprising 40%, 31%, and 15% of the area, respectively. Although we expect continued expansion of protected cropping in Australia, the growth of high-tech greenhouses faces challenges such as high startup capital, energy costs, biosecurity-management requirements, and off-taker risk. The importance of biosecurity was highlighted by the detection of ToBRFV in Australia for the first time in August 2024.

For greenhouse vegetable production, which is currently dominated by tomatoes (see figure 32), economies of scale and proprietary/high-value varieties are important for maximizing yields and production value. Scale allows producers to offer customers significant volumes of high-value varieties year-round, attracting a premium. In 2022/23, greenhouse farmgate value of production was valued at AUD 477.5m, averaging AUD 1.58m per hectare.

Figure 32: Greenhouse production in Australia by crop, 2023



Source: *Hort Innovation, RaboResearch 2025.*

Greenhouse types and shapes explained

Basic structures to provide protection

There is a wide range of protected cultivation methods, allowing growers to adapt technology for specific crops. Key structures include:

Windbreaks: Used to reduce wind turbulence, helping to produce quality crops by limiting damage and promoting early crop maturity through a slight increase in average air temperature.

Plastic mulching: Used to control weeds, keep plants off the ground to address phytosanitary concerns, and improve microclimatic conditions near the ground.

Semi-forcing tunnels: Used for shorter periods to accelerate crop growth when temperatures are low.

Protected cultivation structures fall into two main categories:

Net or shade houses (nets): Commonly used in tropical regions, these structures reduce excessive radiation, wind speed, and the impact of heavy rain and hail.

Greenhouses: These have protective covers that shield against water and allow high natural light transmittance.

Greenhouses

There are various definitions for greenhouses. We define them as a walk-in structure (over 2 meters high) designed for cultivating plants under glass, plastic, or similar protection to shield against extreme environmental conditions and/or pests. Within this definition, there is a vast diversity in the construction, coverings, and technologies used.

Three types of greenhouses

Typically, we identify three classes of greenhouses (next slide, table A1).

1. **Low-tech greenhouses:** These are basic walk-in structures designed primarily to protect crops from heavy rains, hail, wind, and sunscald. They have waterproof roofs and often insect-proof netting. There are two main types of roofs: gable roofs and arched roofs (next slide, figure A1). Most operations in these greenhouses are manual, and temperature fluctuations are managed by adjusting the cover. These greenhouses do not have computer-regulated climate control.
2. **Mid-tech greenhouses:** These are walk-in structures wherein climate control is achieved to some extent with semiautomated operations. The main goal is to protect crops from adverse weather conditions, pests, and diseases. Climate control is mainly passive, but sometimes there is active ventilation. Multispan greenhouses are often described as mid-tech, but this depends on the level of technology.
3. **High-tech greenhouses:** These structures achieve climate control through automated operations. They are mainly constructed to extend off-season production by controlling various climate factors such as temperature, humidity, light, CO2, and root-climate (using mulches, substrates, or hydroponics).

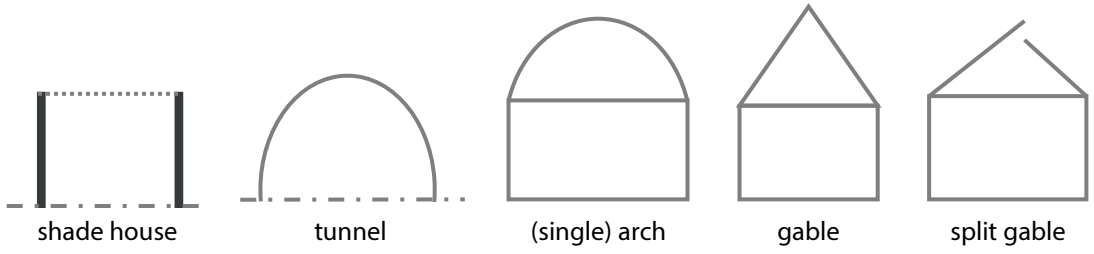
1: Technology levels in greenhouses explained

Table A1: Classification of greenhouses

Category	Description
Low-tech (passive technology)	Structures that often have low production and are not used year-round. There is no automation, and the structures are sensitive to their environment and climate. Most of these structures are covered with plastic mesh.
Mid-tech (semiactive technology)	Structures that have semiautomated systems, such as heating, ventilation, irrigation, cooling, etc. The growth of crops inside these structures can be done in soil or growing media (substrates). Most of these structures are tunnels made from plastic and have dividers for different crops.
High-tech (active technology)	Structures that have a fully automated and controlled environment. They possess the capacity to control irrigation, nutrients, temperature, humidity, and even solar radiation. The crops can be planted either in soil, growing media, or hydroponic systems. The structures can be made from glass or double-paneled plastic and are mostly tall structures.

Source: AMPHAC, Transfer LBC, Opportunities for Dutch Businesses in the Mexican Protected Horticulture Sector April 2020

Figure A1: Distinctive low-tech greenhouse systems



Source: Eerenstein J.H.W., Production of greenhouse vegetable crops; Principles for humid tropical areas, 2015

Table A2: Estimated investments for three greenhouse types

Investment	Low-tech	Mid-tech	High-tech
EUR/m^2	< 30	30 to 60	> 60

There is a wide variety of technologies used in greenhouse cultivation, and their application varies by greenhouse type (next slide, table A3). The choice of technology depends on the crop grown, the cultivation method, and the climate zone. This means that the technology used for the same crop can differ significantly. Additionally, switching crops may require further investments.

As a result, the investment level for different greenhouse systems varies greatly. The most expensive greenhouses can require investments of up to EUR 500/m^2. To indicate the technology level of a greenhouse, the investment level is also used as a classification criterion (see table A2). Using the investment amount as a criterion has the advantage that the classification is relatively unambiguous. However, the investment amount can vary over time and by location (due to factors like currency, quality, and margin).

2: Technology levels in greenhouses explained

Table A2: Technology applied in different greenhouse types

Application	Low-tech	Mid-tech	High-tech
Concrete path	Possible	Yes	Yes
Climate control	No	Limited	Yes
Glass greenhouse	No	Possible	Very likely
Heating system	Limited use	Limited capacity	High capacity
Automatic fertigation	No	Limited	High
Level of mechanization	Low	Medium	High
Level of automation	No	Medium	High
Multispan greenhouse	Limited	Mostly	Possible
Use of substrate	Possible	Possible	Possible
Artificial steering light	Limited	Possible	Possible
High-wire cultivation system	Limited	Possible	Possible
Pipe rail system	No	Possible	Possible
Cogeneration	No	Limited	Possible
CO2 supply	No	Limited	Possible
Energy screen	No	Limited	Possible
Artificial assimilation light	No	Limited	Possible
Use of robots	No	Limited	Possible
Substrate on gutters	No	No	Possible
LED light	No	No	Possible
Blackout screen	No	Limited	Limited
Internal transport systems	No	Limited	Different - varied
Crop in the soil (except organic)	Mostly	Possible	Not very likely
Substrate on the ground	Possible	Possible	No
Low-plastic greenhouse	Possible/likely	No	No
Separate tunnels	Possible/likely	No	No

Source: *RaboResearch 2025*

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