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Market Special: Greenhouse Farming in Germany

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Colophon

Contact Tolgan Raben
T +31 088 602 14 86
T +31 088 602 90 26
tolgan.raben@agentschapnl.nl
NL EVD Internationaal
Juliana van Stolberglaan 148 | 2595 CL Den Haag
P.O. Box 20105 | 2500 EC Den Haag

Author Dr. Julian Voss
T +49 551 79 77 45 15
F +49 551 79 77 45 11
jvo@agrifood-consulting.de
Agrifood Consulting GmbH | Spiller, Zühlsdorf + Voss
Weender Lanstraße 6 | 37073 Göttingen
Germany

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1 Introduction to the market special

The market special is prepared on behalf of the NL EVD International, the Agency for International Business and Cooperation, which aim to promote the international presence of Dutch companies in foreign markets. The target group of this report are the small- and medium-sized companies in the Netherlands (trade and industry), which think about starting their business in a promising German market. This report aims to improve their information base to enter the market.

It is known that Germany is the largest economy the European Union (EU) and the fourth largest in the world. Regarding its purchasing power parity (PPP), Germany has the fifth-largest economy worldwide. Being focused on exports, the key industries in Germany are machinery, vehicles, chemicals and household equipment. German companies have an excellent international reputation and the sign "Made in Germany" stands for quality, innovation and advanced technology. Altogether, the economy benefits from a highly skilled labour force.

These impressive figures clearly indicate that the Germany market is for special interest for foreign companies as it offers the biggest population (82.5 million) in Europe and a favourable GDP (Gross domestic product) – even for fruit and vegetables producers and their supply industries.

An expandable consumption level, quick changing consumer behaviours, a limited domestic production and imports on a high level distinguishes the German market for fruit and vegetables. Germany is the leading EU importer of fruits and vegetables and imports mainly for its own consumption. In 2009, following Spain (17.6%), Germany accounts for 16.2% of the European fruit and vegetables market value (Source: Datamonitor). Bearing in mind that the self sufficiency ratios for fruit and vegetables in Germany are low (22.4% respectively 38.4%), market opportunities for the foreign producing countries are obvious.

Sustainability, know-how and innovations are the main pillars of the Dutch greenhouse farming sector. Germany is by far the most important export market for Dutch horticultural crops and applications, such as greenhouses and installations for greenhouse horticulture. In the last ten years the total exports of Dutch fresh fruits and vegetables have increased from 2,500 million kilos to 3,000 million kilos.

But: Several statistic shows that the relative export share of Dutch vegetables and fresh fruits to Germany decreased in the last years. Between 1996 and 2006 the share of vegetable exports to Germany fell from 43% to 34%. The share of fresh fruits exports fell even further, from 42% to 22% (Source: Productschap Tuinbouw, Dutch commodity board for horticulture).

What are the reasons for this development? First of all, German consumer behaviour changed during the last years. Germany consumers more often buy regional, healthy and varied products. At the same time, German consumers seek for food safety and transparency.

Summing up the background of this market special the overall aim of this report is to strengthen the position of Dutch companies in the German greenhouse farming sector by improving the information base for development of the sector. The market survey provides a clear overview of the status quo of Greenhouse farming in Germany and shows the Dutch companies the business opportunities on this market.

In this context especially the following five topics will be analysed:

- The German trends "local for local", "health" and "organic": Consequences for the market position of Dutch horticultural products in Germany and structure of the competitive landscape. Deduction of recommendations for positioning on the German market;
- Emergency and development of new cultivation areas: Potential analyse;
- Specific opportunities of these new areas for the Dutch greenhouse farming sector;
- Know-how transfer: Identification of specific greenhouse knowledge which can be market of the Dutch horticultural sector in Germany;
- Business opportunities for Dutch companies as a result of cooperation between Dutch and German research institutes and possible ways to put this into practice.

The report is compiled from the point of view of the Dutch horticultural sector and its specific strength: sustainability, efficiency and innovations. It will be considered to what extent the German market development (especially within the new cultivation areas) opens opportunities for Dutch companies.

This analysis of the German greenhouse farming sector is based on an intensive desktop-researches, media content analysis and expert interviews. Data were collected from official statistics, scientific studies and articles from the specialized press.

The statistic data were mainly published by the Federal Statistical Office of Germany. The most recently available data are from database as of February 2011. At this stage some values were still provisional.

The structure of the paper is as follows: The first chapter includes the introduction to the market special. In the second chapter the current market situation with regard to consumption, production, import and export of fruit and vegetables in Germany is discussed. Other aspects covered in this chapter are the important consumer trends affecting greenhouse farming and probable scenarios 2030 of market development.

In the third chapter greenhouse farming in Germany is described with regard to its status quo and technology development, emerging cultivation areas, legislation threats and key players. The fourth chapter is devoted in depth to the analysis of business opportunities for Dutch horticultural sector in the German greenhouse farming sector and recommendations in light of the analysis. Following conclusions in the fifth chapter extensive tables can be found in the appendix.

2 Data about the German market

2.1 Consumption of vegetables and fruits in Germany

In 2009, the German fruit and vegetable market reached total revenues of \$22.9 billion and decreased by 4.8%. The overall volume was 9.8 million t with an increase of 0.1%. From 2005 to 2009, the compounded annual rate of change of the fresh fruit and fresh vegetable in reference to the total market value was 3.3%.

With an annual growth rate of 3.7%, the German fruit and vegetable market is forecasted to have a value of \$27.4 billion in 2014 (+19.7% since 2009). The market volume is forecasted to 10.6 million t with a CAGR of 1.5% (+7.7% since 2009).

According to Datamonitor, in 2009 vegetables were the largest segment (59%) of the fruit and vegetable market in Germany. The degree of self-sufficiency with vegetables has increased by 5.6 points and reached 38.4%. In general, Germany is an increasing market for vegetables. Also import and export volumes showed increases.

The fruit segment accounts 41% of the market's total value. From 2002 to 2010, the German fruit consumption decreased by 8.7%, while imports of fruits decreased by more than 6%. The provisional supply balance indicates a 22.4% degree of self-sufficiency.

In 2010, the consumption of vegetables in Germany was 7.6 million t. Consumption of fruits amounted to 5.7 million t. Table 6 and 7 provide data on the consumption of fruit and vegetables in Germany. According to the AMI (Agrarmarkt Informations-Gesellschaft mbH means Agricultural Market Information Association), in the past year each household ate 142.9kg of fresh fruit and vegetables. The per capita consumption was 2010 at a level of 82g of vegetables and 108g of fruit daily. These figures include both fresh and processed products; and are preliminary for 2009 and 2010.

Since 2002, the consumption of fresh vegetables has been growing up to 7.9% and reached a per capita consumption of 92.8kg in 2010. Per household, 61.4kg of fresh vegetables (-2% in comparison to the previous year and with that less than ever during the last eight years) were bought for a total of €121.85 (+8 % compared to 2009). In 2010, fresh vegetable consumption per household was in detail at 10kg tomatoes, 7.8kg carrots, 6.3kg cucumbers, 6.2kg onions, 4.8kg peppers, 2.8kg lettuces, 1.9kg cauliflowers, 1.8kg asparagus, 1.4kg leeks and 1.2kg cabbages.

In contrast to vegetables, the German market for fruit is declining in volume. Each household bought 81.5kg of fresh fruit (-1% compared to 2009) in 2010 and paid €127.34 (+2% compared to last year). In 2010, German consumer ate 5.8kg fruits less than in the last seven years (2002-2010). In 2010, the most popular fruits of the Germans were apples with 19.5kg, 14.7kg bananas, 9.2kg oranges, 5.9kg

tangerines, 4.4kg grapes, 4.1kg melons, 3.3kg strawberries, 3.1kg nectarines, 2.9kg pears and 2.6kg pineapples.

2.2 Cultivation, import and export of vegetables and fruits in Germany

In 2009, the German vegetable cultivation reached 3.57 million t (open-air and greenhouse vegetables and mushrooms) as a new record. According to the Federal Statistical Office 2010, a total of approximately 3.15 million t of vegetables were harvested. The production record resulted from higher yields per hectare and does not occur from the expansion of cultivated areas. But: From 2005 to 2009, the cultivated area of outdoor and under glass vegetables grew by 6.9% in Germany (Table 8).

According to the results of the annual vegetable report from the Federal Statistical Office, the cultivation of field vegetables in Germany has fallen by 4% to 110,570 ha in 2010. Due to methodological changes – uplift of minimum detection limit from 2 to 5 ha and the exclusion of herbs in 2010 – the percentage value is not permissible. Assuming that by the methodological changes about 3,500 ha were not covered in the data; the decrease is only 1%.

In 2009 open-space vegetables were grown on 115,229 ha and greenhouse products on 1,476 ha. Compared to 2009, the cultivated areas for field-produced and greenhouse vegetables decreased. Nevertheless, several big projects are planned for the near future. Altogether an increase of the German vegetable production in greenhouses is expected for the next years.

The biggest areas of vegetable cultivation in Germany are North Rhine Westphalia, Rhineland Palatinate and Lower Saxony (Table 9). There are also large areas in Bavaria, Baden-Wurttemberg and Hesse. With 452 ha in 2010 of glasshouse area Baden-Wurttemberg is the region with the highest output of greenhouse vegetables in Germany. The second and the third largest greenhouse cultivation areas for tomatoes, lettuces and cucumbers are Bavaria and North Rhine Westphalia.

The cultivation of glasshouse vegetables in Germany can be divided into three main products: tomatoes, field salad and cucumbers (Table 15). Since 2003 the greenhouse acreage of these vegetables has grown continuously: tomatoes by 23.4%, salads by 4.5% and cucumbers by 17.5%. From 2003 to 2009, in comparison to the other greenhouse vegetables, the pepper's acreage had the main increase in the percentage ratio: 43.3% or 13 ha. In 2009, together they account 866 ha or 58.7% of total glasshouse vegetable cultivation area. The harvest of cucumbers and tomatoes were together 139,600 thousand t or 83.5% of the whole volume of produced greenhouse vegetables in 2009 (Table 16). From 2003 to 2009, the production of cucumbers has grown by 34.4% and of tomatoes by 36.2%. Also the yield of peppers (from 2006 by 16.7%) and lettuces (from 2003 by 3.7%) increased.

On the one hand, tomatoes, cucumbers and salads (field salad and lettuce) account for with the biggest cultivated area in Germany. On the other hand, cucumbers and tomatoes achieve together the highest yields.

Concluding, Germany has a high level of consumption, limited domestic production and therefore depends heavily on imports of fruit and vegetables. German imports of fresh vegetables has increased in 2010 by about 5% and will amount to nearly 3.1 million t, while fresh fruit import levels decreased by 1 to 2% to about 5 million t.

Since 2005, the German import value of fresh vegetables remained stable (Table 10). According to preliminary data in 2009, Germany imported 2,826 million t of fresh vegetables with a value of €2.9 billion. Tomatoes are by far the main vegetable imported to Germany: 695,400 t of tomatoes were imported in 2008 (previously 657,020 t in 2009), and with a value of more than €924 million. Between 2006 and 2009 imports increased by 5.9% in value and decreased by 9.2% in volume. Other major product groups include cucumbers / small cucumbers, peppers, lettuces, onions / shallots and carrots (Table 11). It is interesting to note, that the Netherlands is the leading supplier of all the most important German greenhouse vegetables (tomatoes, cucumber and peppers) followed by Spain (Table 14). The Netherlands has also a strong export position in fresh field-produced carrots and onions / shallots.

The export of fresh vegetables has continued to grow provisional by 22.6% to 384,000 t in 2009. Altogether the German export volume of fresh vegetables is about eight times smaller than the import. It grew by 22.6% from 2005 to 2009. The main export-countries are the Netherlands, Italy, Austria, Sweden and France (Table 12).

Fruit cultivation, esp. strawberries

In 2010, the fruit harvest in Germany was low with a decrease of -20% and 1.14 million t (2009: 1.45 million t). Therefore it was the lowest harvest since 2002. Only strawberries achieved nearly the year-before result. The area devoted to strawberries decreased in the past five years (14.5%, Table 17). In 2005, on 18,945 ha strawberries were planted. In 2010, this area shrank to 16,540 ha.

In the last six years the averaged production of outdoor strawberries remains rather stable and was in 2010 152,000 t (Table 17). With 3,658 ha in 2010, Lower Saxony has the biggest area for field-produced strawberries in Germany (Table 9). Followed from Baden- Wurttemberg (2,983 ha), North Rhine Westphalia (2,949 ha) and Bavaria (2,257 ha). Almost a half of the whole strawberry-greenhouse area is concentrated in North Rhine Westphalia (109 ha). Baden-Wurttemberg, Lower Saxony and Schleswig-Holstein account for 18.1%, 12.2% and 9.3% of under glass acreage. All other federal states represent together 33 ha (14%) of the greenhouse area for the strawberries.

The share of the under glass strawberries compared to the total area is only 1.4%. It is interesting to note, that from 2005 to 2010 the greenhouse for strawberries area has grown by 49.8% and reached 237 ha.

Provisional in 2009, German strawberries imports amounted to 104t with a value of €1,84 million. This represented a growth of 12% in value and 0.2% in volume since 2005. Most imports (95.3% of total import volume) descend from EU countries. The

main strawberries imports to the German market origin from Spain (73%), Italy (7.6%), the Netherlands (4.7%), Poland (4.1%) and Greece (2.2%).

2.3

Consumer trends affecting greenhouse farming

The most important trends in German affecting fruit and vegetables relate to health, sustainable and regional products.

Fresh fruits and vegetables naturally contain vitamins, minerals and antioxidants. Regular consumption is seen as contributing to good health and plays a key role in the health trend. Since 2002 the campaign '5-a-day' is promoted by the German Federal Ministry for Food, Agriculture and Consumer Protection in order to support a healthy diet, to reduce weight problems and to prevent nutrition depending diseases.

Although the social trend in nutrition is clearly moving towards wellness and health, the popularity and consumption of fresh and healthy fruit and vegetables is still very low. Despite increased quality, numerous innovations and lower prices, the per capita consumption of fresh fruit and vegetables (about 200g per day in 2010) in Germany remains considerably lower than in other EU member states.

Sustainability contains three topics - the environmental, the social and the economic fields. German consumers became more pensive in the past couple of years. They do not explicitly demand organic products but they care about traceability and sustainable productions: Where do products origin from? How were they grown and treated? How are they marketed? And: German consumers are getting attentive that organic products are not automatically climate-friendly.

Regionality means spatial and therefore emotional proximity. Customers identify themselves with local products which are harvested by producers they know and trust. Therefore they are often willing to pay reasonable prices for regional products. As the world gets more and more globalized and unmanageable, consumers demand for closeness and clarity increases. Regional products stand against the "anonymous source" and create a new consumer confidence.

Studies and surveys such as the market study 'Organic and Fair-trade – what matters and who pays?' undertaken by the You-GovPsychonomics AG confirm these theories. According to this study, the origin of food is much more important for the purchase decision than the organic label. The company interviewed 1,800 consumers on their attitudes towards organic labels in the end of 2009. The results are clear: The origin of food influences the purchasing behavior of consumers much more than organic certification. Another survey from January 2010 named 'The image of local product', conducted at eleven food retail markets in Saxony, confirms that consumer associate local products with higher quality. Therefore a strong market demand for local products emerges. However, local products are very limited in Germany. In 2010 more than 80% of the consumed fruits and 65% of the consumed vegetables were produced abroad.

Also the German consumer organizations promote the seasonal and regional procurement of fruits and vegetables. These products have special values, they are

climate-friendly and they have advantages in freshness and quality.

The interest of German consumers in organic vegetables remains stable. Another clear trend is towards high-quality convenience products in organic quality. A 'greed is good' mentality is still very common in Germany. Fresh-cut products need much service time, manpower and benefit an increased risk for manufacturers and retailers. The price difference to the standard products is still relatively large. It is not yet fully understood by German customers that cost for convenience products are quite high.

In addition to the above mentioned developments, consumer expectations on manufacturing processes, quality and labeling are also increasing. Overall, consumer behavior regarding fruit and vegetables changed in recent years significantly. Producers must adjust to those changes and develop future-oriented product strategies.

2.4 Development of German food retailing

In the last years, the German food retailing is confronted with similar challenges: Sales are stagnating, the national retail space is increasing and price aggressive retail chains are the winners of the last years.

The annual turnover of the German food retail market (FR) amounts to €130 billion. According to Trade Dimensions, the Edeka Group (€43.64 billion), Rewe Group (€36.27 billion), Metro Group (€30,69 billion), Schwarz Group (€27.38 billion) and Aldi Group (€25.45 billion) were the largest German companies in the retail food trade in 2009. The market share of this top five food retailers is about 70%. The share of foreign companies in the German food retail trade is still very low. Conversely, all of the largest German food retailers are active abroad.

Fierce competition in German retailing strengthens simultaneously the internationalization process as well as the in-country consolidation. The concentration process is at the expense of smaller supermarkets whose amount has nearly halved in the last ten years. Further closures are likely in the coming years. The total number of stores with a sales area of less than 400 m² was at a level of about 33,000 at the end of 2005 – tendency strongly decreasing. In 1993, about 56,000 shops in this size category existed. Since 1993, the average turnover of the small shops under 400 m² has decreased by almost 30%. In the same time, the number of customers decreased by 13%. Only few sites can remain, especially if they adapt their shop to local customers needs and strengthen their convenience portfolio.

The German food retailing, especially fruit and vegetables market, is dominated by large discounters. In particular, German discounters have grown since 1992 and achieved a leading position. Their strong expansion in recent years has paid off regarding the awareness and accessibility of the outlets. Nevertheless, the acquisition of new customers for this format is limited.

As discussed above consumer behaviours change strongly in Germany. New consumer trends pose new challenges to the German food retail market. Current concepts show that sustainability is not a short-term trend, but a complete rethink of the industry. It is important not only to offer sustainable products, but to create transparency throughout the entire supply chain - from the production to distribution to the end customer in the stores and their consumption. Strategic partnerships, long-term prospects and close business links in the supply chain will be discussed more and more in the future to bear the challenges. Topics for food retailing are energy efficiency, the use of innovative air-conditioning technology, emissions and waste reduction, use of environmentally friendly packaging, a clear disclosure and optimization of CO₂ consumption in product manufacturing and delivery, or the consideration of social and environmental aspects of procurement. Therefore, sustainability is not just company limited, but always affecting the entire supply chain.

Also regionality develops simultaneously - especially for fruit and vegetables - to a basic principle in food retailing. But it is still not clear what regional exactly means for consumers. Studies imply for example that 40% of the respondents define their own region by reference to their federal state. 16.4% understand by the term region the city they live and 14.4% their natural geographic unit such as the Ruhr district or Swabian. As a food retailer REWE Dortmund for example defines a regional product as a product from the federal state North Rhine-Westphalia. Whereas the food retailer Edeka Südwest does not limit regionality to a federal state and accumulates the entire catchment area of its company. This includes the federal states of Baden-Wuerttemberg, southern Hesse, Rhineland-Palatinate and Saarland. Even Tegut's definition of regionality is beyond the borders of federal states.

Besides, the regional colour in supermarket shelves makes comparability difficult and creates competitive advantages. By personification of the producers and exact knowledge of culture, retailers and suppliers can score in the competition of regionality. Quality, product safety, traceability and cost challenges are still very high.

The mottos of the major food retailers are as short as possible transport routes and being closer to the customer. Produce from the fields should get as fast as possible in the basket of the consumer. Regional procurement has always priority to ensure freshness by short transport distances. Green logistics will be the defining issue of the future. Regional procurement and distribution helps to ensure freshness and CO₂ reduction.

Therefore, more and more retailers are looking for direct contacts to fruit and vegetables producers. While the direct purchase of regional fruit and vegetables in Germany was the domain of rather small trading company, now also big retailers follow this example. More and more food retailers highlight the regionality, especially small self-employed retailers from e.g. the Edeka group and buy more often directly from producers.

For the domestic producers, the trend to regionality brings many benefits. Even the volition to purchase local products is an important requirement for producers to

engage in increased cultivation and long-term storage. Guaranteed quantities, varieties and packaging are arranged and secured through contract farming. This form of cooperation offers benefits for growers and food retailers. At the same time, the quality requirements for the producers increase, e.g. short narrow time windows for delivery or retailers expects regarding gapless temperature documentation.

The demand of local and sustainable fresh produce by consumers and food retailers is large. For domestic producers this is a promising market development – with heavy requirements from retailing side. As today, most products are imported from foreign countries, foreign producers will continue to use their opportunities and also try to score with high quality and sustainable production. But the regional procurement will be increasingly important.

2.5 Scenarios 2030 of market development

"Predictions are difficult, especially when they concern the future" (Karl Valentin).

For the fruit and vegetable consumption in Germany, this saying applies in particular. Today it is much harder to estimate the consumption than ever before. There are various factors which influence the consumption of fruit and vegetables. The following is an approach to describe the main parameters and their effects to the Germany market:

1. Socio-demographic developments

- **Shrinking Population:** According to current forecasts of the Federal Statistical Office, the German population declines from the current 82 million to about 77 to 80 million in 2030. So the consumption is reduced by 2.5 to 6%.
- **Aging population:** The German population is getting older and older – slowly but surely. In the next 20 years, the proportion of 60 years and older will increase from 26% to 36%. Furthermore, women live slightly longer. It is likely that older people and women eat more fruit and vegetables in terms of healthy eating. The overall effect results in our estimation and predicts an increase of up to 2-3% by the year 2030.

2. Consumer attitudes

- **Health and obesity:** Fruit and vegetables have a very positive health image and with good reasons they are held to be very healthy. Therefore, the desire for health and weight loss is already reason for many consumers, especially women, to eat lots of fruit and vegetables. This trend will continue.
- **Food culture:** What dietary patterns will be popular in the future? A meat-heavy dietary with lots of fun in barbecue (catchword: "winter barbecue") or rather a dietary with lots of vegetables and carbohydrates? This lifestyle factor is difficult to estimate. However, especially high-income consumers will increase their consumption of fruit and vegetables.
- **Vegetarians and low-meat-consumer:** The proportion of vegetarians in the German population is not exactly known. Estimations range from just under 2% up to 7%. The share of consumers who eat no or very little meat

for welfare or environmental concerns (climate!) or because of the increasing alienation from food production tends to increase. This trend has also a positive effect on the fruit and vegetable consumption in Germany.

- **Convenience:** The peoples' lack of time is increasing, which speaks for quick meals. It is undisputed that the preparation of fruit and vegetables is often time-consuming. The aim here is to introduce new food innovations (e.g. cabbage prepared for the microwave) onto the market.
- **Other relevant changes** that may affect the market for fruit and vegetables are for example a growing out-of-house market (tendentially negative for fruit and vegetables and positive for meat), a continued growth of the organic market (positive for the demand of fruit and vegetables), more ethno food (slightly positive) or more fine food (positive, especially for high-priced products).

3. Changes in the environment (policy, technology)

- **Improved food security:** The establishment of quality assurance systems such as QS leads to increased consumer confidence in fruits and vegetables. By these actions, fruit and vegetable scandals should be reduced to a minimum. From this follows a long-term stabilization of the consumption effects.
- **Climate policy:** If the climate researchers are not entirely wrong, drastic measures will be needed to protect the climate as soon as possible. Compared to the production of animal products, the carbon footprint of fruit and vegetables is very beneficial. Prospectively, any ambitious climate policy will limit the beef and cheese production (such as inclusion of agriculture in the emissions trading, taxes on products, etc.). Seen in this context, it is expected that the consumption of fruit and vegetables will increase significantly.
- **Technological progress:** Currently, increasing productivity in the production of fruit and vegetables are studied very intensively. Technological advances can lead to a decrease of fruit and vegetable prices and thereby to a stimulation of the consumption.
- **Shift in relative prices on world agricultural markets:** If food is getting scarced due to bioenergy and the increasing meat consumption in emerging markets, the meat price will rise in consequence of processing losses. Most of the agro-economic models assume a tendentially rising price level in the next decades. If animal products – compared to plant products – get expensive, the consumption will decrease. At the same time fruit and vegetable consumption will increase.

The above remarks show that a total forecast is difficult. While the demographic trends are reliable, the psychological effects cannot be accurately estimated. Therefore, we take three scenarios as a starting point: business as usual, improved health image and climate change.

1. In the scenario "business as usual", the next 20 years will go on as in recent years. The consumption of fruit and vegetables will develop inconstantly. Overall, a decline of consumption will be expected due to the demographic change.

2. In the scenario "Improved health image", we assume that the consumption per person of fruit and vegetables will rise – last but not least because of the massive marketing efforts of the EU (e.g. school fruit scheme). On balance, the total amount of consumption will remain relatively constant because of the demographic changes.
3. In the scenario, "Climate change", environmental, health and welfare reasons will put massive pressure on the meat production. The share of vegetarians will increase significantly, and the consumption of meat will decrease to an amount (also recommended by many nutritionists) of about 40kg per person and year. As the cultivation of fruit and vegetables is much energy and space-intensive these products benefit from this development. The consumption increases on the recommendations of the World Health Organization, 240kg of fruit and vegetables per person and per year.

The considerations show that the consumption trends are positive for the German market. Insofar, investments are quite profitable.

Tab. 1: **Effects on German vegetable consumption**

Effect	Effective direction	Uncertainty of the forecast
Shrinking population	negative	Low
Ageing population	positive	Low
Health awareness	positive	High
Nutrition styles	uncertain	High
Increasing share of vegetarians	positive	medium
Convenience	negative	medium
Improved food security	positive	medium
Climate policy	positive, if from the region for the region	extremely high
Technological progress	positive	medium
Price ratios	negative	medium

3 Greenhouse farming in Germany

3.1 Development and status quo of greenhouse farming

The results of the recent horticultural survey (from 2005), published by the Federal Statistical Office, showed that most greenhouses in the German horticultural are relatively old. 43.1% of the greenhouses (about 1 600 ha) were built before 1982. Although existing installations may have been modernized to the current state of the art, greenhouses in Germany are largely outdated. Between 1982 and 2000, altogether greenhouse areas of 1,700 ha have been built. After 2000 only 390 ha or 10.6% of the total greenhouse facilities were built.

Tab. 2: **Status quo of greenhouse farming**

Dimension	Unit	
Number of the greenhouse plants	Total	11,475
	Production	9,289
Cultivated area	Total	3.698 ha
	Production	3,393 ha
Age of the greenhouses	build year before 1982	1,442 ha
Roof cladding	Glass	ca. 80%
	Foil	ca. 15%
	Stiff Plastics	ca. 5%
Investment costs in greenhouse		100 – 500 €/m ²
Heated greenhouse area (estimated)		ca. 2.500 ha
Cost of heating material (depends on culture)	Heating oil equivalent	10 – 35 l/m ²
Harvested production	e.g. tomato	ca. 60 kg/m ²
Operating income	Vegetables	ca. 40 €/m ²
	Pot plant	ca. 80 €/m ²
	Special crops	ca. 120 €/m ²

Source: www.duh.de/uploads/media/100913_DUH_Berlin_Acrylglas_2003_03.pdf

Most of the production area under glass specialized for vegetable farming is owned by small and medium-sized enterprises. However, the trend towards larger enterprises is increasing. According to the above mentioned horticultural survey, 48.7% of all enterprises (5,600) operate sites from 1,000 m² to less than 5,000 m². More over, 3,800 farmers (33%) had less than 1,000 m². The remaining companies (2,100 or 18.3%) farm greenhouse areas of about 5,000 m² or more.

Compared to the same survey from 1994, the number of farms with up to 0.5 ha of horticultural land decreased. At the same time the number of enterprises with 5,000 m² and more greenhouse areas increased by 9.5%. If only enterprises with a focus on vegetable are considered, about one quarter (27.4%) had less than 1,000 m² of greenhouse space. Greenhouse areas from 1,000 m² to less than 5,000 m² are owned by half of the vegetable growers (47.7%). 24.9% of vegetable farmers manage more than 5,000 m² of greenhouse space.

These figures underline huge structural changes in under glass production in Germany as a result of more mechanized and rationalised production conditions. The large-scale production of uniform and marketable products, thus mass production, focusses on cost leadership. This strategy requires access to efficient distribution channels. A slowing factor for the structural changes in greenhouse horticulture is the high capital intensity and the low access to it for German enterprises in this area.

Regardless, the demand of large quantities of the same quality by food retailers is growing. As a result, market channels shift and the relevance of a few key accounts rises. This development will enhance the concentration process on production level. In the futures larger projects, according to greenhouse-parks, will henpeck the German market.

In total, the German glasshouse horticulture is influenced by numerous factors with varying relevance. It is found that the greenhouse production is faced with increasing demands (political-legal, economic, social, ecological and technological). According to experts investments in technological innovations in greenhouses will be evaluated in the future not only on economic criteria. Due to the rising importance of environmental issues and their increasing influence to glasshouse production new evaluation grids will emerge. This will inevitably change the production conditions.

In order to find answers on those developments, the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) currently develops a future strategy for German horticulture. In this the BMELV is supported by the scientific project "Future of the German horticultural sector", which evaluates future-oriented developments in horticulture. The project started in November 2010 with the aim to identify strengths, risks, potentials and opportunities of the German horticultural sector. Concrete future strategies for the horticulture sector and recommendations will be developed during the project duration. The results will be presented in 2013.

3.2 Research and technology trends in German greenhouse farming

The German greenhouse cultivation is currently exposed to an increase in competition. Because of its energy- and labour-intensive production processes and also in the course of the climate change debate alternative forms of energy and climate-friendly production methods are discussed in greenhouse cultivation.

According to the latest horticulture-survey oil (at 7,400 companies) and natural gas (at 2,500 companies) dominated in the heating of German greenhouses. Besides those energy sources coal, coke and LPG played a certain role. Furthermore, renewable energies and biomass (165 companies), solar systems (33 companies), geothermal energy, wind energy and hydropower (148 companies) were used – but only on a low level.

The strong increase in prices for fossil fuels like oil and gas has led to a considerable burden for glasshouse-horticulture-businesses. Heating costs in greenhouse-horticulture have become, after labour costs, the most important factor. 25% of

production costs for the cultivation of tomatoes account on heating costs. Today's horticulture is increasingly forced to grow its products without the use of fossil resources. This trend is already foreseeable, considering other industries, because they already are subject to strict legal requirements, such as regulating of CO₂-emissions. Concerning horticulture, also consumers increasingly demand – as shown above – environmentally friendly products. In particular, the heating-intensive greenhouse-horticulture is affected by these developments and must adapt to these challenges. But the producers also benefit from those developments. They can produce their products more efficient because a reduction in energy consumption also means cost savings.

In view of these trends further research and technological developments in the area of greenhouse-production will be conducted in Germany. Some current research projects are stated in the following.

ZINEG - The Low Energy Greenhouse

With the aim to keep and promote a competitive greenhouse-horticulture in Germany, the project ZINEG (future initiative low-energy greenhouse - Zukunftsinitiative Niedrigenergiegewächshaus) was initiated. The aim of the ZINEG project is to reduce consumption of fossil energy and hence the (fossil) CO₂-emissions for crop production in greenhouses to zero. The project is sponsored by the Federal Ministry for Environment, Nature Conservation and Nuclear Safety and the Rentenbank and it is managed by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) with assistance of the Federal Agency for Agriculture and Food (BLE). The duration of the project is from May 2009 till April 2014.

The project develops greenhouses, in which it is possible to produce in a preferably energy-saving way. There are three research assignments for the three ZINEG-locations: closed greenhouse with a utilization of overdue solar energy (Berlin), closed greenhouse with maximum thermal insulation, utilization of solar energy and automation for ornamental crops (Hanover) and plastic greenhouse with maximum thermal isolation and heating with neutral carbon dioxides (Schifferstadt).

The other focus of this project is set on developing automated process documentation. The Technical University of Munich develops in the scope of ZINEG a transparent documentation and evaluation of the production process in greenhouses. Due to the increasing pressure in the vegetable production and regulations regarding traceability escalate. The importance of recording the environmental impact of the production process increases as well. To describe this accurately, a documentation of the resource-consumption is necessary and developed within the ZINEG project.

The results of the project are set out to be transferred into horticultural practice and horticultural companies by publications, trade fair presentations, online presence and other materials.

FORETA

With innovative solutions, the research cooperation "energy efficient technologies and applications" (short FORETA) aims to increase energy efficiency in small- and medium-sized enterprises. During the project 11 research institutes and 45 companies develop solutions to improve energy efficiency in small- and medium-sized enterprises. The focus of the research is on availability, efficiency and energy-storing. The project is supported by the Bavarian State Ministry for Science, Research and Arts. The duration of the project is from September 2009 till August 2012.

One of the sub-projects of FORETA, named „Increase of energy efficiency in greenhouse horticulture in Bavaria“, analyses possibilities for horticultural companies under glass (ornamental plants, vegetables) in Bavaria for an improvement of energy efficiency. Besides a wide coverage of the actual status of the energy situation, there will be studies in thirteen producing horticultural enterprises to increase the technical energy efficiency (with individual targets for each company) and an economic evaluation of these actions. In addition to that, the penetration and the barriers of implementation of energy efficient solutions in horticulture will be analyzed on the basis of the survey data.

The realization of the suggestions will supported by relevant horticultural consulting services and networks. Therefore, the requirements and possibilities of the federal program for the increase of energy efficiency in agriculture and horticulture of the Federal Ministry of Food and Agriculture (BMELV) and the Federal Ministry of Environment (BMU) are going to be considered in the catalogue of measures.

Greenhouse in Geisenheim optimized rearing of young plants

"Practical and on the state of the art"- with these two features, the new greenhouse can be characterized, which was inaugurated on June 25, 2010 in Geisenheim (Hesse). The federal state of Hesse supports the innovative and new greenhouse of 343 m² with an investment of €370,000. The greenhouse is used for research on questions relating to the production of potted herbs and seedlings of vegetables such as tomatoes, peppers and eggplants grown in different varieties. The aim is to find aromatic and for cultivation in Hessen suitable varieties.

The new greenhouse is equipped with modern facilities: excellent light transmission, ebb-tide rolling tables, heating pipes under the tables, ventilators in the ridge area and a climate-computer. Researchers expect a positive influence on plant growth, because of the fact that the roofing is permeable to UV radiation. A mobile screen, which donates shade by day, prevents heat loss at night. The greenhouse has, compared to a single-glazed greenhouse with mixed heating system, an energy saving of around 47%. Energy-saving high-power LED lamps for exposure of plants are used in winter and furthermore get analyzed regarding the illumination and the light spectrum.

A future experimental program concerning new greenhouses is devoted to the following questions:

- cultivation of species and varieties with lower temperature requirements
- exposure to energy-efficient LED technology compared to traditional high pressure sodium vapour lamps.
- experiments with different irrigation strategies with the aim of saving the water resources
- organic cultivation of potted herbs, with questions to substrate and fertilization
- new herbs to expand the product range, keyword product diversification.

Another topic will be the cultivation of fruit vegetables and varieties for balcony and terrace.

Greenhouse Park in Grevenbroich at Neurath power plant

This is another current project which sets the goal of both, building a large greenhouse park and the development and optimization of vegetable production. In January 2011, the construction of the huge greenhouse park at the Neurath power plant has begun. In the final 20 ha of greenhouses especially tomatoes will be planted. The first harvest is expected in summer 2011.

The biggest greenhouse park in North Rhine-Westphalia is heated by combined heat and power from the power plant Neurath. With this project, technologies for the use of low-temperature heat from power plants are developed.

The concept: The energy from the 100 degree hot district-heating water is now only partly used in households and returns with 40 degree back to the power plant. On one hectare is tested if greenhouses can be heated with residual heat.

The issue of energy efficiency is not only treated in direct research. Also farmer's efforts to improve energy efficiency are supported by public spendings. Investment undertaken in Germany, which lead to significant energy-savings in production-greenhouses and selling-greenhouses over the current state of the art or the actual condition, are supported by the "**federal program to increase energy efficiency in agriculture and horticulture**" ("Bundesprogramm zur Steigerung der Energieeffizienz in der Landwirtschaft und im Gartenbau"). The aim of the program is to give new inputs to the climate-protection and to decrease carbon dioxide emissions and energy costs. The program was established by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) and the Federal Ministry for the Environment-protection, Nature Conservation and Nuclear Safety (BMU).

Grants for investment costs, which increase the energy efficiency (e.g. investment in modernization construction, replacement of old buildings with energy-efficient buildings and construction of energy efficient greenhouses) are intended. The investments have to lead to the reduction of CO₂ emissions and and energy costs. The eligible investment amount must be at least €10,000 and is limited to max. €2,000,000. The grant may not exceed the amount of €400,000. ZINEG is one of the first projects in this federal program.

Besides, in 2008 the new "**information platform to promote efficient energy use in horticulture**" was founded. The main objective of the energy-portal-hortigate is the exchange of information on the efficient use of energy between science and practice and the presentation of good and sustainable solutions for horticulture. The focus is on reports to energy-saving, energy sources, support programs and measures and laws and regulations on the subject of energy. Also an important element is providing documentations of pilot and flagship projects and the latest news and studies. The project is funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) under the auspices of the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) with the support of the Federal Agency for Agriculture and Food (BLE).

The German researchers also deal with other technical issues such as development of new materials for covering greenhouses. Thus, Scientists at the Research Centre Jülich and the University of Bonn got rewarded with the Environmental Award horticulture for the development of high-tech materials for the covering of greenhouses in NRW in 2006. Thanks to ingenious design, significant increase in crop quality and yield were gained. Compared to conventional glass, the new material must not be cleaned and makes the greenhouse resistant to hail. The combination of most transparent and UV-transparent glass leads to special heat-insulating effect and also ensures that the plants grow faster and provide more flavour. Simultaneously, the shelter material is extremely transparent to light. It allows both 97% of the sunlight and short-wave UVB-radiation to pass.

Another project deals with urban-farming. Given the problem of lack resources and cultivation areas the project '**inFARMING**' aims on planting on flat roofs of non-residential buildings. The project was established at the end of February 2011 by the Fraunhofer Institute for Environmental, Safety and Energy Technology (UMSICHT). The leading project partner has set itself the goal of developing concepts for building integrated agriculture on the roofs of buildings and to improve compliance techniques and cultivation processes. With "inFARMING" ideas and ways are developed to specific advantages like less greenhouse gas emissions, a reduced physical footprint and reduced surface sealing by agriculture. Other aims are concept for minimizing transport costs, for urban green spaces and fresh products that are produced directly from consumers.

The focus is on the integrated energy supply trough using waste-heat, photovoltaic or small wind turbines on roofs. Concerning water supply, the water circuits are closed and waste water is purified by plants and used again.

In addition, supplies and materials for insulation and fire protection and very light material components are developed and increasingly integrated bio-plastics based on renewable raw materials. More emphasis is on concepts for an optimal land usage and optimized harvesting, as well as support for sustainability assessments.

3.3 Potential of old and new cultivation areas

This chapter provides an overview of the current construction projects in greenhouse vegetable production in Germany, represented by federal states. It has to be noted, that no new greenhouse projects are planned or have been created on a large scale recently in Bavaria, Berlin, Bremen, Hamburg, Mecklenburg Pomerania, Rhineland Palatinate, Saarland and Saxony.

The following data refers to the year 2010 and was collected from the Federal Statistical Office. It shows the total greenhouse cultivation area and the cultivation area per type of vegetable.

Baden-Wurtemberg

Total cultivated area of glasshouse vegetables: 452.04 ha.

Vegetables (ha): cucumber – 51.92 kohlrabi – 7.25 pepper – 15.20 radish – 17.22 field salad – 137.98 lettuce – 42.75 other salad – 58.37 tomato – 71.54 other crops – 49.83.

Baden-Wurtemberg is economically strong and contributes a large share to the German GDP. In comparison with the other German federal states it has the largest cultivation area in greenhouse farming with 452.04 ha. A big greenhouse project for the cultivation of pepper with a total cultivation area of 11 ha is currently realized in Singen-Beuren, in the south of Baden-Wurtemberg. The Reichenau Gemüse-Vertriebs eG invested in cooperation with 5 gardening companies more than €15 million in this project. This settlement is to be one of the most modern and innovative greenhouse farming facilities for circa 250 000 pepper plants in southern Germany. The first harvest is planned for March 2012. The large scale demand originates from the German food chain Edeka. Edeka wants to expand its range of local products with the logo "Unsere Heimat" ("Our Homeland"). While the consumer need for local products is increasing, most of the peppers sold in Germany are still produced in the Netherlands or Spain. Therefore the production of German peppers is a market niche.

Bavaria

Total cultivated area of glasshouse vegetables: 250.49 ha.

Vegetables (ha): cucumber – 45.81 kohlrabi – 4.42 pepper – 10.02 radish – 11.37 field salad – 60.78 lettuce – 23.62 other salad – 16.12 tomato – 44.07 other crops – 34.28.

The Free State of Bavaria is Germany's largest state and has the second largest population. Bavaria has long ceased to be agricultural state. Nowadays, only 178,000 people are employed in agricultural and forestry use. Nevertheless, landscape and nature are still important topics in the Bavarian state. Bavaria has the second largest greenhouse cultivation area in Germany. No data and information on current projects in the greenhouse farming sector could be found.

Berlin and Bremen

Total cultivated area of glasshouse vegetables: 1.34 ha.

Vegetables (ha): cucumber – 0.04 tomato – 0.73.

Germany's capital Berlin, with its about 3.4 million inhabitants is the biggest city in Germany and the most densely populated federal state. In comparison with other German federal states, Berlin has an income well below the national average and a high unemployment rate, which has increased since the reunification.

The state of Bremen, which consists of the two cities of Bremen and Bremerhaven, is in economic trouble. Relocation of residents and companies in the hinterland of Lower Saxony, persistent job losses, and a budget crisis describe the economic situation. The unemployment rate is the second highest in Germany. Both Berlin and Bremen do not have a significant agricultural sector and are not suitable for greenhouse farming.

Brandenburg

Total cultivated area of glasshouse vegetables: 43.83 ha.

Vegetables (ha): cucumber – 5.90 kohlrabi – 1.30 pepper – 1.52 radish – 0.60 field salad – 1.34 lettuce – 0.71 other salad – 0.55 tomato – 28.27 other crops – 3.64.

Brandenburg has with 2.5 million inhabitants the second lowest population density in Germany. The three largest sectors are the service industry, trade and repair and manufacturing. In services, the sectors of health and social services, public administration and business services have the largest share of employment.

In early 2010, the largest integrated greenhouse area in Germany with 10.2 ha of land was officially inaugurated near Felgate in Brandenburg. The plant is operated by the vegetable production company Felgate GmbH. The area is composed of several houses complexes which contain more than 160 000 plants per greenhouse.

The five plant species are cultivated in a substrate of coir and perlite granules, both biodegradable substances. The heat for the growth of the cucumber provides a biogas park, which consists out of ten biogas plants. By using the waste heat from the biogas park there is an annual saving of about 7,000 tons of CO₂ emissions compared to conventional heating. For an efficient and adequate use of this waste heat a 3,000 m² buffer was built. It allows saving the heat for colder nights.

The greenhouse is equipped with state of the art greenhouse technology. Each 2,000 m² workspace exhibits a terminal-based system in which the employees enter in addition to their work-time also the yields and other observations regarding the role of technology and the development of plants.

Hamburg

Total cultivated area of glasshouse vegetables: 59.69 ha.

Vegetables (ha): cucumber – 10.63 kohlrabi – 2.38 pepper – 0.42 radish – 2.21 field salad – 8.54 lettuce – 7.47 other salad – 10.16 tomato – 13.73 other crops – 4.17.

Hamburg is the largest trading centre in Germany. In the area of Hamburg are a lot of highly productive farms located, engaged not only in cropping, livestock and dairy farming but also in fruit and vegetable production. The "Alte Land" region is the

largest fruit-growing region in Europe. The "Vierlande" area is the most productive region in vegetables production in Germany. The south-eastern part of the metropolitan region is a major asparagus-growing region. However, greenhouses in Hamburg are not widespread and no new projects are planned for the nearer future.

Hesse

Total cultivated area of glasshouse vegetables: 44.34 ha.

Vegetables (ha): cucumber – 2.61 kohlrabi – 0.99 pepper – 1.11 radish – 4.30 field salad – 10.49 lettuce – 2.33 other salad – 3.10 tomato – 14.98 other crops – 4.43.

Hesse's economy has a strong services sector, which is supported particularly by the credit and insurance business, business services, transport and communications and new media. Frankfurt is the largest financial centre in Germany. The European Central Bank, the German Bundesbank and more than 300 other banks located their headquarters in Frankfurt. The Frankfurt airport, with approximately 50 million passengers per year, is the largest airport in continental Europe. The chemical industry, machinery and automobile industry and electrical engineering are the most profitable industries in Hessen.

The new greenhouse in Geisenheim has already been mentioned in chapter 3.2. The 343-square-foot plexiglas building serves both research and the promotion of the local vegetable production, particularly fruit vegetables such as tomatoes, peppers or cucumbers and special pot herbs. These products are traditionally associated with the classic Hessen greenhouse vegetable production.

Mecklenburg Western Pomerania

Total cultivated area of glasshouse vegetables: 13.18 ha.

Vegetables (ha): cucumber – 1.28 kohlrabi – 0.15 pepper – 0.25 radish – 0.12 field salad – 1.23 lettuce – 0.14 other salad – 0.39 tomato – 8.87 other crops – 0.75.

Mecklenburg Western Pomerania has with nearly 1.7 million residents and 23,000 square kilometers, the lowest population density in Germany. The agricultural sector plays an important role: 4.4% of the inhabitants are employed in the agricultural, forestry and fishery sector. Because of its coastal location, Mecklenburg Pomerania has a strong maritime industry (fishing and fish farming, shipbuilding, maritime and port industries). Another important sector is the food industry. This industry is the second largest employer after the construction sector. Greenhouse cultivation is not widespread in Mecklenburg Pomerania and no new projects are planned for the nearer future.

Lower Saxony

Total cultivated area of glasshouse vegetables: 77.14 ha.

Vegetables (ha): cucumber – 37.02 pepper – 1.85 radish – 0.67 field salad – 9.51 lettuce – 2.10 other salad – 2.34 tomato – 17.63 other crops – 3.35.

With nearly 8 million inhabitants and 47.634,90 km² of area, Lower Saxony is one of the largest states in Germany. More than half of the land area is used for agricultural cultivation and about one fifth of the area is forest. Due to its agricultural character the region has emerged a substantial food industry.

In 2010 the Gerhard Schulz Horticulture KG acquired 11.5 ha of open land in Papenburg to create one of the most modern greenhouses with a total cultivation area of 4 hectares to harvest eight million cucumbers annually.

Since February 2011 56,000 cucumber plants are growing in the state of the art greenhouse; the first harvest is expected in early March. The whole area is controlled by a central computer that regulates the ventilation, heating, heat shield and irrigation including fertilizer. The energy supply for the greenhouse will be achieved through biogas plants combined with cogeneration units and wood-fired plants. Before the complete implementation of the environmentally friendly project, the greenhouse is first heated by a gas-fired boiler plant, which is used afterwards to secure the base load.

A 1,600-square-foot hall with sorting machines (hourly output of 16,000 units) is situated next to the greenhouses. The investment volume for the complex with greenhouse, and logistics and sorting area added up to €4.5 million. The site also offers the opportunity to build a second greenhouse complex with an area up to 4.1 ha. Papenburg is the high-performance centre of horticulture in Germany. In Cooperation with the Gartenbauzentrale, approximately 60 affiliated companies market each year 70 million pot herbs and 35 million cucumbers. The new greenhouse complex adds eight million cucumbers a year.

North Rhine Westphalia

Total cultivated area of glasshouse vegetables: 198.63 ha.

Vegetables (ha): cucumber – 34.85 kohlrabi – 5.45 pepper – 3.82 radish – 2.79 field salad – 29.49 lettuce – 35.51 other salad – 19.57 tomato – 44.40 other crops – 22.75.

North Rhine-Westphalia is the most populous and the economically strongest state of Germany. North Rhine-Westphalia is an important industrial region and a major production region for electricity. About a third of Germany's electricity is generated in North Rhine-Westphalia.

In Horticulture North Rhine-Westphalia is one of the leading federal states: The region has the third largest area cultivated by greenhouse farming and the third most horticulture plants in Germany. The production value of vegetables, flowers and ornamental plants is higher than in all other German states. The share of North

Rhine-Westphalia production value of total German production value is 36.8% of flowers and 18.8% of vegetables.

"Niederrhein" a region close to the border to the Netherlands in the west of North Rhine-Westphalia is one of the most important horticultural regions of Germany. This includes all the downstream businesses of the value chain to food processing as well as all adjacent areas of the training and education, the knowledge and experience on specialization, Technology to logistics. Due to the special development and innovation potential of the "Niederrhein" and also as a necessary response to the ambitious developments in the neighboring Dutch region Venlo (establishment of Greenport) the project "Agro Business Niederrhein" was developed.

Until 2018 the region should become one of the most competitive and most innovative regions along the entire value chain of all horticultural and agribusiness regions in Europe. Since 2007 a network of companies, counties, chambers, associations and economic development organizations from the counties of Kleve, Wesel, and Viersen Rhein-Kreis Neuss is built. This network aims to promote the economic outlook and market potential of the companies in the region. Studies show that spatial concentration of production enables the efficient exchange of new knowledge and provides favorable conditions for the spread of process and product innovations. This ultimately results in a higher competitiveness. The close network of research, consulting and suppliers for the production facilities increases the innovation and adaptability in the sector.

In early January 2011 the construction of a huge greenhouse park on the power plant in Neurath Grevenbroich began. This project has already been outlined in Chapter 3.2. The biggest greenhouse in North Rhine Westphalia covers 33 ha with an expected annual harvest of up to 6,000 tons of tomatoes. So far, this kind of scale greenhouse farms is still rare in Germany. The heart of the plant will be one 8,500 m² long central hall. This is where the vegetables will be sorted, packed and loaded. Around the hall four enormous greenhouses will be located- which cover between 4.6 to 8.3 ha. Mainly tomatoes but also other vegetables such as pepper will be cultivated.

In 2008 another major greenhouse project was planned – but failed due to public resistance. Close to the Lower Rhine at Straelen greenhouses with a total agricultural area of 110 ha were planned. But the project met fierce resistance from conservationists and locals and permission was declined.

Rhineland Palatinate

Total cultivated area of glasshouse vegetables: 64.28 ha.

Vegetables (ha): cucumber – 2.34 kohlrabi – 0.25 pepper – 1.42 radish – 12.59 field salad – 10.37 lettuce – 9.01 other salad – 1.40 tomato – 15.95.

Situated in western Germany, Rhineland-Palatinate borders (from the north and clockwise) North Rhine-Westphalia, Hesse, Baden-Wurttemberg, France, Saarland, Luxembourg and Belgium. Rhineland-Palatinate is Germany's leading producer of wine in terms of grape cultivation and wine export. Its capital, Mainz, may be called the capital of the German wine industry, being the home of the German Wine

Institute, the German Wine Fund in the Haus des Deutschen Weines (House of German Wine), and the Verband Deutscher Prädikats- und Qualitätsweingüter Wine Bourse, which brings together the top winemakers of Germany and the wine merchants of the world. Our research could not identify any big-scaled old or new greenhouse projects.

Saarland

Total cultivated area of glasshouse vegetables: 3.01 ha.

Vegetables (ha): cucumber – 0.24 kohlrabi – 0.21 tomato – 0.57 other crops – 0.38.

The Saarland is based on the populations statistics (about one million inhabitants) a small state. The service sector and industrial sector have a strong economical position, but also the iron and steel industry is still an important industry. The largest industries in this sector are the machinery and transport equipment industry. The total greenhouse cultivated area in this state is very low. Our research could not identify any big-scaled old or new greenhouse projects.

Saxony

Total cultivated area of glasshouse vegetables: 42.63 ha.

Vegetables (ha): cucumber – 15.20 kohlrabi – 1.39 pepper – 1.45 radish – 1.64 field salad – 3.65 lettuce – 1.15 other salad – 1.77 tomato – 10.10 other crops – 6.30.

In 2011, a huge complex of greenhouses with photovoltaic systems and operating buildings will be created on a 9 ha area in Rossau. The investor for this project is New Energy London. The photovoltaic system will take up almost the entire roof area of the greenhouse facility, except for the required ventilation openings. The greenhouse is produced in the Netherlands and has a total size of 51,000 m². The total cost of the project is calculated with €12 million. Interest in the purchase of the fresh fruits has already been shown by the trading companies Norma and Edeka.

Saxony-Anhalt

Total cultivated area of glasshouse vegetables: 5.49 ha.

Vegetables (ha): cucumber – 0.78 kohlrabi – 0.26 pepper – 0.32 radish – 0.26 field salad – 0.12 lettuce – 0.22 other salad – 0.05 tomato – 2.88 other crops – 0.60.

Although the Statistical Federal Office reported for 2010 only 5.49 ha greenhouse area in Saxony Anhalt; a major interest along the farmers points to great potential for this state.

Saxony-Anhalt has strategically and logistically optimal conditions for the establishment of companies in various industries, including agriculture and food industry. Major markets for the products are within reach. Saxony-Anhalt is an ideal location for the food industry. Good soils, short distances to the consumer as well as renewable energies define an optimal location for investment in horticulture.

In the end of 2010, 25 Dutch entrepreneurs, bankers and suppliers visited Saxony-Anhalt. During the trip they were informed about the investment opportunities in greenhouses and on the food, logistics and renewable energy sectors of the country. Particularly interesting for Dutch companies was the concept of local agricultural

products "Made in Germany", which are often preferred by consumers and supermarkets.

Some cities in Saxony Anhalt offer special opportunities for the construction of greenhouses. For example the city Staßfurt offers an attractive location for under glass farming due to the possible of using heat generated by the waste of a soda plant nearby. Also the residual heat of the many biogas plants can be used effectively.

The EsBro Dutch Investment Group already announced further greenhouse cultivation projects in Zorbau near Leipzig. The group is going to build a sustainable greenhouse area of 180 ha. The first harvest is planned for 2012. After the completion of the project this would be the largest single greenhouse area in Germany. Currently the investors negotiate with an adjacent incinerator of the supply with waste heat and CO₂ for the complex. Negotiations also take place with various producers from the Netherlands, Belgium and Germany.

Schleswig-Holstein

Total cultivated area of glasshouse vegetables: 23.12 ha.

Vegetables (ha): cucumber – 2.65 kohlrabi – 0.82 pepper – 0.69 radish – 0.48 field salad – 2.93 lettuce – 0.80 other salad – 0.67 tomato – 12.23 other crops – 1.85.

Schleswig-Holstein is characterized by its natural environment (800km of coastline and very few urban areas) and mainly associated with agriculture and tourism. Large companies are focused in the cities of Kiel and Lubeck and the Hamburg area.

Since 2010 pepper plants and tomatoes are cultivated in a 12 hectare greenhouse plant in Hemmingstedt near Dithmarschen. The plants are grown in so-called culture channels resemble oversized flower boxes; the length is 45 km for the peppers and 34 km for the tomatoes. A computer controls the ventilation, the supply of plants with water and nutrients, the roof flaps and the shading system of the greenhouse. In the past it was nearly impossible to grow bell peppers at competitive prices in Germany, since the pepper production requires a huge amount of energy (1,200 megawatt hours of heat per week).

Currently the heating energy comes from a combined heat and power cycle from the nearby Shell refinery. The so-called thermal energy was only a waste product of the production, which was emitted unused in the air. The heat is now collected in several places and fed into a district heating network. The construction of the waste heat system (total cost: €12 million) will be subsidized by the state with five million.

Thuringia

Total cultivated area of glasshouse vegetables: 46.13 ha.

Vegetables (ha): cucumber – 4.88 kohlrabi – 0.25 pepper – 0.31 radish – 0.36 field salad – 0.31 lettuce – 3.24 other salad – 0.24 tomato – 35.95 other crops – 0.57.









In May 2010, the Biowärme Gemüse GmbH, a subsidiary of the producer's wholesale market Thuringia and Saxony-Spreewald eG, officially opened a greenhouse complex in Schkölen. The 8.8 ha of greenhouse production used for Cherry tomatoes cultivation (155,000 tomato plants) uses the waste heat from the adjacent biomass heating plant.

The greenhouses were constructed by a Dutch company which requested exclusively subcontractors from the region for the ancillary works. The water for the plants is collected from rain water on the huge roof area and partly supplied by the Association. A water treatment facility with special filtering technology ensures that only the amount of fluid is consumed which the tomatoes need to grow.

The plants grow in boxes which are put on top of the culture channels. Droppers are placed in each one of these boxes which are connected to the central supply unit by tubes to ensure the supply of water and nutrients. Since the tomatoes are no longer cultivated on the ground they are less susceptible to diseases and their growth is enhanced by the improved climate control. This year new varieties of tomatoes (Baylee and Briosó) are tested according to their fertility. The tomatoes will grow not only on rock-wollmats but also on perlite granules and coconut straw.

In Alperstedt one of the biggest contiguous greenhouse complexes with a total cultivation area of 20 hectares is operated for the production of cucumbers and tomatoes.

Tab. 3: **Potential for new projects in Germany**

Federal State	Greenhouse area	Major products	Potential for new projects
Baden Wurttemberg	452.04 ha	field salad, tomato, other salad, cucumber, lettuce	
Bavaria	250.49 ha	field salad, cucumber, tomato	
Berlin and Bremen	1.34 ha	tomato	
Brandenburg	43.83 ha	tomato	
Hamburg	59.69 ha	tomato, cucumber, other salad, field salad, lettuce	
Hesse	44.34 ha	tomato, field salad	
Mecklenburg Western Pomerania	13.18 ha	tomato	
Lower Saxony	77.14 ha	cucumber, tomato, field salad	
North Rhine Westphalia	198.63 ha	tomato, cucumber, lettuce, field salad	
Rhineland Palatinate	64.28 ha	tomato, radish, field salad, lettuce	
Saarland	3.01 ha	tomato, cucumber, kohlrabi	
Saxony	42.63 ha	cucumber, tomato	
Saxony Anhalt	5.49 ha	tomato	
Schleswig-Holstein	23.12 ha	tomato	
Thuringia	46.13 ha	tomato	

Based on the results of in this chapter, we see opportunities for the development of new greenhouses in Baden Wurttemberg, Brandenburg, Mecklenburg-West Pomerania, Lower Saxony, North Rhine Westphalia, Saxony, Saxony-Anhalt and Thuringia. In those federal states, new greenhouses will developed with competitive structures. Companies from Holland are able to participate in this progress with the development of own greenhouse-projects or with an intensive know-how export.

3.4 Profiling key player in the German market

The previous discussion has shown that production in greenhouses in Germany is quite small-scaled. Against this background the following shows examples of progressive companies, which operate larger greenhouses in Germany. The profiles are intended to give insight into the strategic orientation of growth-oriented companies on the German market.

Landgard eG is Germany's leading marketing organization in horticulture. Organized as a cooperative, the company incorporates more than 3,000 producers for pot plants, cut flowers, and fruits. With a turnover €1.663 billion, Landgard has over 25,000 customers worldwide, employs 3,000 people and keeps offices in nearly 40 locations. As part of its internationalization strategy, the concept of Landgard aims on a system in which horticultural products are marketed throughout Europe using a broad network. The company focuses always on the local-for-local-trend and combines it with additional export activities. Currently Landgard has subsidiaries in England, France, Italy, Netherlands, Austria, Switzerland and the Czech Republic.

With the objective of an optimal utilization of resources, Landgard started the development of a giant greenhouse park near Neurath (North Rhine-Westphalia). Together with 4 gardeners from the Straelener region and the energy company RWE Power Landgard checks the possibilities of using the heat from a power plant in greenhouses. The project started in early 2011. After the completion of all phases, the greenhouse park will cover at least 20 000 m².

Another project of Landgard is related to a greenhouse facility as large as 17 football fields. The greenhouse facility in Hemmingstedt was built under special conditions. It uses the waste heat of an adjacent refinery. The heat provides optimal and uniform conditions for the plants to season and allows a preventative pest management. After bringing into service peppers in red, yellow and orange and tomatoes in the currently popular forms (vine, bush-cherry and date tomatoes) are being planted. The project was pushed by the Landgard cooperative and afterwards passed to four producers, members of the Landgard. They manage the operations and market all products via the Landgard subsidiary Godeland. For the project, another 12 acres of greenhouse are planned. After the completion of all project steps it would be the largest greenhouse complex in Germany.

The company **Gemüsering GmbH** was established in 1991. Gemüsering organizes the interaction between German regional production, marketing and food retail. The company offers field-fresh products in a consistent quality at reasonable prices. Gemüsering is not only a marketing enterprise, but also active in production. In this respect the company differs from many marketers of fruit and vegetables. Therefore, the company is in a position not only to check the quality, but to also to influence it during its own production. Gemüsering aims to please its customers with exceptionally high quality. In close partnership with its growers and suppliers, Gemüsering aims on reliable relationships with its customers and suppliers.

The following products are produced by Gemüsering and its growers: Basil, cauliflower, broccoli, spring onions, dwarf beans, chicory, Chinese cabbage, cocktail tomatoes, dill, oak leaf lettuce, gherkins, iceberg lettuce, endive, turnip, peas, lamb's lettuce, fenchel, cucumber, carrots, kohlrabi, swede, lettuce, cress, leek, lollo bionda, lollo rossa, mixed herbs, mixed salad, parsley, parsley root, radicchio, radishes, red radish, white radish, rhubarb, Romana, beetroot, red cabbage, rocket, chives, celery, marrow, spinach, pointed cabbage, runner beans, celery, vine tomatoes, herbs and vegetables for soups, tomatoes, white cabbage, (winter) radish, savoy cabbage, courgette, sweet corn and cucurbita pepo.

Gemüsering operates in Thuringia (Alperstedt) one of the largest integrated greenhouse plants in Europe, with a production area of 20 ha. The site was completed in 1998. Today the company plants on an area of 10 ha each cucumbers and tomatoes. The two crops are produced in two separate greenhouses, each with 5 acres of net production area. The marketing of the products is conducted exclusively by Thuringian fruit and vegetable sales center (TOGAZ) which then distributes them to retailers. Gemüsering emphasises on regional production. Behind this background the greenhouse crops are mainly sold in East Germany throughout the retail chains (Edeka, Kaufland, Metro Group).

One of the largest tomato producers in Germany is located in Mecklenburg Western Pomerania. For more over 50 years, tomatoes are grown in Barth. Since then, new greenhouse facilities were built and the old modernized continuously. The last building project was finished in 2006, when a new packaging hall of 3,000 m² and a greenhouse of 2.2 ha were opened. The new greenhouse was set up by "Ammerlaan Construction b.v.", the packaging hall uses a a sorting machine of the Dutch manufacturer "Greefa".

Today, **Hahn Gemüsebau GmbH**, the operator of all production sites in Barth, owns over 11.2 ha of land under glass. As mentioned above the main products of Vegetable Hahn GmbH are tomatoes. Almost 10 different varieties of tomatoes are grown there. At the same time, the company grows cucumbers and peppers. The greenhouse crops are sold throughout whole Germany.

4 Business opportunities Dutch companies

4.1 Matching Dutch strengths with recent developments in Germany

The structure of the Dutch greenhouse sector has changed dramatically in recent decades. The overall market developments and particularly the increasing demand for product differentiation and innovation has led to a major shift from supply-driven to market-oriented production concepts. At the same time, the number of players in the supply chain has greatly reduced - this trend will intensify in the future. Direct contacts between big producers and food retailers are more and more common. In the process the Netherlands have taken a leading role in the field of food quality and food safety. But: This aspect will disappear as a unique selling proposition in the future, as appropriate quality promises are getting more and more market standard across Europe and the world.

A strength of the Dutch greenhouse is its strong position and experience in the export of greenhouse products. Although this position is threatened by increasing competition, Dutch products still score in foreign markets. At the same time, the Netherlands are pioneers in sustainability production concepts. The Dutch government and industry have defined, for example, ambitious goals on energy consumption, environmental protection and use of pest management. Recently, artificial lightening of greenhouse vegetables has appeared on the scene. This leads to increasing light nuisance and environmental pollution. As from 2014, the screening of artificial light must be 100% during the periods of darkness.

On the whole, the Dutch greenhouse sector is in general much more innovative than other agricultural sectors. A study of the LEI defined 10% of companies in the area of greenhouse production as innovators (Source: Breukers / Hietbrink / Ruijs (2008)). These companies are the first in the Netherlands with the introduction of new products and processes. The dynamic market forces producers to adapt continuously technological innovations (e.g. robotics). In addition to product and process innovations, there are many innovative developments in greenhouse management (e.g. quality assurance, tracking and tracing). At the same structures are implemented in order to dispose obsolete greenhouses and to develop modern facilities. Following this strategy five Greenports have been established in the Netherlands. Those regions are clusters for innovative production networks in horticulture and offer production capabilities with a global role model.

The following table summarizes Dutch greenhouse farming knowledge it's sought after in Germany:

Tab. 4: **Matching Dutch strengths with recent developments in Germany**

	Dutch Strengths	German soughts
Production	<ul style="list-style-type: none"> • Development of Greenports • Strong entrepreneurship 	<ul style="list-style-type: none"> • New concepts for innovative and capable Greenhouse-concepts and locations
Logistics	<ul style="list-style-type: none"> • General logistic position of Greenports • Fine logistics around distribution centers 	<ul style="list-style-type: none"> • Connection of new Greenhouse-locations with fine logistics structures
Technology	<ul style="list-style-type: none"> • Fast development and application rate of innovations • Fulfillment of additional functions • High level of knowledge infrastructure 	<ul style="list-style-type: none"> • Modernization of existing greenhouses with modern production and management concepts, development of new and capable greenhouse
Vitality	<ul style="list-style-type: none"> • Strong organizational structure • Leading position in product quality and safety 	<ul style="list-style-type: none"> • Market-orientation to force challenges of future-markets
Space and infrastructure	<ul style="list-style-type: none"> • Designation of Greenports • Provision of space for greenhouse horticulture 	<ul style="list-style-type: none"> • Development of regional greenhouse-clusters in new regions (e. g. East Germany)
Innovation climate	<ul style="list-style-type: none"> • Support of innovation and development of knowledge 	<ul style="list-style-type: none"> • Impetus to accelerate the processes started in Germany in this area
Sustainability	<ul style="list-style-type: none"> • Financial support for increase of sustainability • Participation in sustainability projects • Progressive legislation gives Dutch sector a lead 	<ul style="list-style-type: none"> • Innovative approaches for financial support to develop sustainable greenhouses in Germany

Source: Partly taken from Breukers / Hietbrink / Ruijs (2008)

In recent years the German greenhouses reached a more and more difficult and competitive environment. This shows the above tables and the sought after modern, innovative production structures. Based on high energy-consuming, labor-intensive production processes and also in the course of the climate change debate a discussion about alternative forms of energy and climate-friendly production systems in greenhouses started in Germany. With the aim to develop a competitive environment for greenhouse horticulture in Germany, – as shown – there are different measures of political and scientific level. The overall objective of those measures is to reduce the consumption of fossil energy and thus a reduction of (fossil) CO₂ emissions in German greenhouses. In addition various projects started

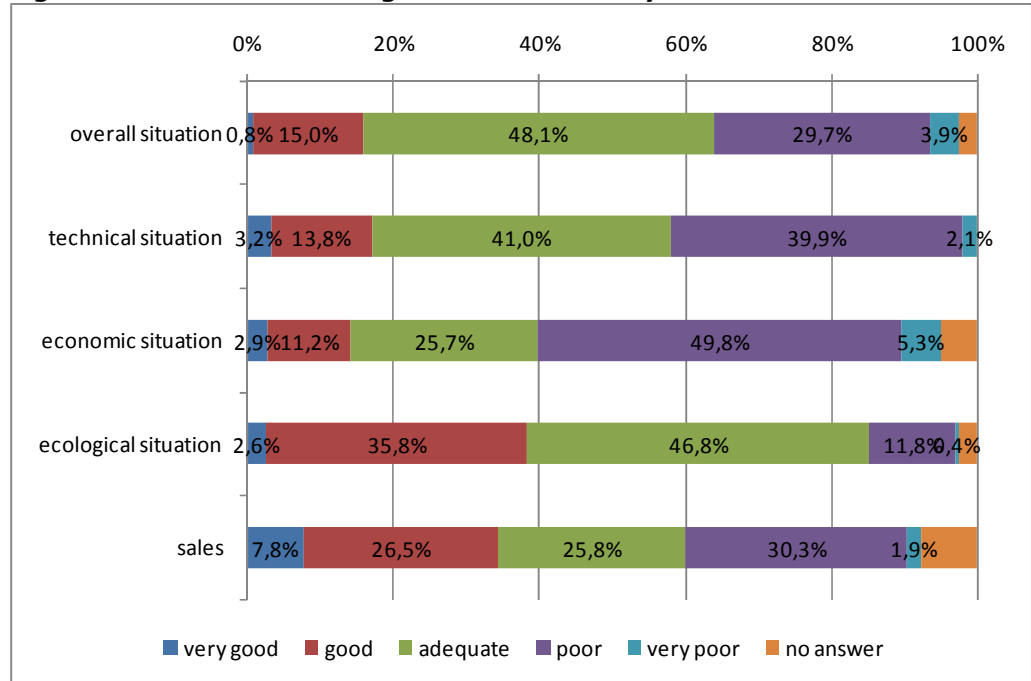
to meet the future requirements for environmental and sustainable production concepts in greenhouses, for example:

- Closed-operation greenhouse with use of solar energy,
- greenhouses with maximum insulation, closed -operation, solar energy use and integration strategies for potted plants,
- plastic Greenhouses with maximum isolation and CO₂ neutral heating with innovative heating concept or
- greenhouses with heat protection glazing.

But: Those measures are a drop in the ocean. An insight on "greenhouse production in Germany" gives a recent survey, conducted among 39 experts from consulting, science and commerce, which was conducted from May to August 2010 (Source: Geidel / Flenker / Bokelmann (2010)). Main topics of the survey were: the evaluation of the actual situation and the existing production facilities, evaluation of important technology adoption criteria, environmental policy issues in German greenhouses, requirements of market partners, assessment of consumer behavior and the evaluation of a potential CO₂ label. The key results of the study can be summarized as follows:

- Based on several problems (technical, economical, ecological and sales situation), the overall situation of the German greenhouse sector is evaluated rather pessimistic. Current greenhouses are old and modern ones arise only occasionally. On the economic side many companies are as well in a poor condition. This situation avoids companies to raise capital for necessary investments. For the same reason, investments in sustainable production system are subject to economic criteria. Over and above the trade situation is considered difficult due to low consumer prices.
- The national greenhouse horticulture assesses the changing environment realistic – but reacts rather slowly to changes. In this aspect great differences between economically successful and less successful companies appear.
- Because of their very conservative information behavior, it is difficult to get in broad contact with German producers.
- The adoption of new technologies depends on economics criteria. Inhibitory effects are especially economic factors (lack of capital), personal terms (managerial behavior) and unclear prospects (succession).

Fig. 1: Situation of German greenhouse industry



Source: Geidel / Flenker / Bokelmann (2010)

4.2 Positioning strategies for Dutch companies on the German market

The German greenhouse sector needs input from successful partners from abroad. Via which strategy can the Dutch horticultural sector market their know-how in Germany? Are business opportunities available for Dutch companies as a result of the knowledge transfer between Dutch and German research institutes? What will be the best possible way to put this cooperation into practice? Following chapter gives answers on those questions and follows the dimensions of table above.

- Production:** Compared to its neighbors in the Netherlands the greenhouse sector in Germany is situated less entrepreneurial. 40% of German greenhouses were built before 1982 and are very small. This shows the lack of broad-based capable production structures, which only can be found in some flagship projects in Germany. In this respect, modern production concepts (e.g. sustainable production of fruit and vegetables) are rarely implemented in practice. At the same time there is a lack of innovative cluster projects. At the level of regional economic development Germany should learn from Dutch Greenports and should also seek the establishment of Greenports in Germany. For this, experiences from the Netherlands are an important starting point in Germany.
- Logistics:** As outlined before, Germany has only a little or no greenhouse regions that are linked with innovative logistics concepts. However, the discussions on consumer behavior have revealed that freshness grows more and more in importance to consumers – and freshness has at tight link to capable logistics. At the same time the development of export markets requires efficient and modern logistics concepts.

- **Technology:** In this report quoted several times that 40% of Germany's greenhouse areas were built before 1982. This figure indicates that Germany greenhouse produces are less progressive with the adoption of new technologies compared to the Netherlands. At the same time great research project for the development of new greenhouse technologies have been launched only recently. In this respect, Germany should learn from existing and modern greenhouse technologies from the Netherlands. Less intensive is research on innovative production and management concepts. This lack of knowledge is a great opportunity for Dutch companies establishing themselves on German market through know-how transfer.
- **Vitality:** Overall, the German greenhouse industry – compared to the Netherlands - is less organized. One example is the low overall assertiveness in the establishment of large greenhouses, which have failed to residents conflicts. In addition, German producers were by no means a pioneer in product quality or safety issues. Overall, the German greenhouse industry needs more creativity and dynamism to meet new market requirements. Alongside, Germany should learn from its Dutch neighbors regarding the adaptation of new technologies.
- **Space and infrastructure:** Recommendations for actions and opportunities for the Dutch greenhouse industry within this dimension are closely linked to the concept of Greenports. Modern and efficient greenhouse structures must be developed in Germany at new locations. Existing strong horticultural regions will benefit less, as they show a lack on spaces for such structures. Due to energy issues, new greenhouse location will occur at the same time at locations with access to waste heat or at locations with favorable climate shifts. Dutch companies are asked to take a leading role on these new sites. We predict similar structures as to the Netherlands which benefit from Dutch technologies and production know-how. At the same time new ownership will occur, because the existing players out of small companies are not able participate in these new projects due to their lack of capital. Developing Greenports similar to in German requires specific know-how, which is available in the Netherlands on corporate, scientific and political level. Using this know-how opens opportunities to strengthen the Dutch market position within the greenhouse sector in Germany.
- **Innovation climate:** The German government has just established support programs to promote innovations the area of greenhouses. Transnational research cooperation between the Netherlands and Germany could accelerate this process and strengthen the position of the Dutch sector in Germany. Research projects should be agreed at the political level and rolled out at the institutional level. This requires an intensive exchange between potential partners.
- **Sustainability:** In order to create incentives for investment in the area of sustainable production systems in Germany, support programs should be established. In this area the German government could gain insights from Dutch programs. Political consulting with Dutch knowledge might help to develop effective incentives in Germany.

The following table provides specific recommendations to deploy the massive market potentials in Germany greenhouse sector in know-how and technology export:

Tab. 5: **Recommendations to deploy market potentials in Germany greenhouse sector**

	Politics	Scientific	Companies
Production	Support to the development of Greenport	Evaluation of the potentials of Greenport on the basis of scientific research	Investments in efficient greenhouse sites
Logistics		Scientific support to the establishment of new logistics concepts for the greenhouse sector in Germany	Establishment of existing Dutch logistics concepts in Germany
Technology		Transnational research projects to develop new technologies for the German market	Adaptation of existing technologies through direct investments
Vitality		Qualification of German experts throughout Dutch scientific education programs	Exchange between German and Dutch industry associations to strengthen organizational structure
Space and infrastructure	Support to the development of Greenports	Scientific support the establishment of Greenports in Germany	Development of Green Ports in Germany
Innovation climate	Support to the development of appropriate support programs	Scientific support to the establishment of support programs	
Sustainability	Support to the development of appropriate support programs	Scientific support to the establishment of support programs	

Concrete starting points are the intensification of the political dialogue on the subject, the organization of business trips into potential areas for greenports in Germany, the link of research projects in both countries and conducting road shows showing latest technologies.

4.3 Final SWOT analysis identifying positioning strategies for Dutch horticulture on the German market

Finally, based on a SWOT analysis, positioning strategies for the Dutch horticulture will be derived and discussed.

The SWOT-analysis is based on the terms strengths, weaknesses, opportunities and threats. The strengths-weaknesses profile reflects the company's internal situation, whereas the opportunities-threats profile mainly covers major external factors on the company. Using the SWOT-analysis, strengths-weaknesses and opportunities-threats profiles can be created in order to derive and give recommendations for further action.

In accordance to the above mentioned result of this analysis, in summary the following strengths, weaknesses, opportunities and threats can put to record:

Strength:

- The Netherlands have effective structures and concepts for fruit and vegetables throughout the entire supply chain, especially in the areas of sustainability, efficiency and innovations.
- With great experience in new concepts, Dutch companies are able to offer German food retailing companies new differentiation potentials.
- Dutch companies have a great expertise in establishing new structures abroad.

Weakness:

- The image of Dutch companies in Germany could be improved. A German saying states 'You do not do business with Dutch people, they do business with you'.

Opportunities:

- Germany delivers as an export market for Dutch companies a high purchasing power. Additionally, the consumption of sustainably produced fruit and vegetables increases in some milieus with a high purchasing power.
- German food retailers perceive differentiation potentials in their fruit and vegetables ranges and search for capable suppliers in an increasing competitive environment.
- More than in any other food categories, the purchase of fruit and vegetables depends on regional production among German consumers. This trend is currently intensifying. Germany needs large-scaled greenhouses to fulfill market demands. Hitherto, the greenhouse production in Germany is small-scaled. However, an economical and sustainable production requires the development of further greenhouse projects.
- Through a high investment backlog of existing greenhouses and state-supported modernization programs, (short term) increasing investments in greenhouses combined with a growing demand of know-how can be expected.

- At b-to-b-level, the performance and capacity of Dutch greenhouse producers and suppliers is appreciated among Germany companies.

Threats:

- Germans consumers have doubts about Dutch fruit and vegetables, as the 'water bomb' perception still persists among many.
- The development of large greenhouse projects causes massive resident protests in Germany. In the past those have led to the downfall of projects.

This study clarifies that the production of fruit and vegetables in Germany is very fragmented. In the near future a continuous concentration process at producer level will progress. In the course of this development many large-scale greenhouse-projects will emerge in Germany. The necessary expertise in the construction and operation opens Dutch company with its recognized competence in the area of the greenhouses varied opportunities for participation (for example joint ventures, development of own projects, etc.).

In order to partake in this favourable development, the performance of the Dutch fruit and vegetable sector and its input industries should be further positioned in Germany by several actions. In particular, the issues of sustainability, efficiency and innovations in greenhouses operations should be demonstrated amongs experts in Germany. Intensive activities – as shwon in chapter 4.2 – could give more attention to Dutch companies in the fruit and vegetables sector in Germany – particular in potential investment regions. In addition, using information and experience exchanges, contacts between the Dutch sector and potential business and scientific partners Germany could be promoted.

This analysis has also shown that there are some resentment among German stakeholders in fruit and vegetable sector when dealing with Dutch business partners. Although, the performance and capacity of Dutch companies is well recognized in Germany. We expect high reactance effects if Dutch companies concentrate more and more on the Germany market. This development is based on the fact that the fruit and vegetable production in Germany – as mentioned aboved – is very fragmented. Small-sized producers will be afraid of the loss of their livelihood. Behind this background contrary wind has to be expected and should be attenuated in advance through intensive communication. Initiated dialogues between business, industry associations and politics are as well a strategy to solve this problem.

In total there is no reason to believe that the mentioned obstacles will hinder the market entry of Dutch companies broad-based. The efficiency and professionalism of the Dutch companies will convince on the long term run. To limber up the German market for requirements of the future and in order to develop capable production structures, strong partners are essential. Nevertheless, the fact should not be ignored and will always keep in mind dealing with Germans.

5 Conclusion

This market study gives an insight into current trends and developments in fruit and vegetables from greenhouse production for the German market. Relevant aspects throughout the value chain were identified and discussed. In summary, the following key findings can be pointed out:

Although consumers in Germany have a high purchasing power, the consumption of fruit and vegetables is far below the WHO recommendation. The German average consumption is lower than in most other European countries - although the prices for fruit and vegetables are comparatively low. In this market report we tried to identify relevant factors affecting the future consumption of fruit and vegetables with a simply forecasting model.

In the recent past, the issues of sustainability and regionalism became more and more a basic principle instead of a fashion trend for the German consumer. However, the aspect of regionalism in the range of fruit and vegetables in Germany is represented only partially, since more than 80% of the fruit consumed must be imported from abroad. For vegetables the import rate is at least 65%. Following the regional programs of the German food retail market the potential for local products (at reasonable prices) is high.

The remarks on the structure of the food retail business have shown that the intense competition moved fruit and vegetable departments closer to the focus. The retailing companies hope for differentiation potentials with sustainability concepts and regional product ranges. Therefore strong partnerships with regional producers are focused. However, food retailers complain about the small number of capable fruit and vegetable producers in Germany.

The total production of fruits and vegetables (in greenhouses) is very fragmented in Germany. The market data show at the same time that there is an investment gap at the small structured greenhouses. Against this background, the greenhouse production in Germany – compared to other European countries with modern and efficient structures – is only partially competitive. State funding to modernize greenhouse does not take desired effects in a short-term run.

The current emergence of several large-scaled greenhouse-projects confirms the assumption that Germany has major backlog in the area of large-scaled glasshouse sites. Overall, it is expected that this consolidation process on producer-level will significantly increase. More and more modern and professional structures at the producer level will occur. This development offers Dutch companies a variety of activities accessing the German market. On the one hand, Dutch companies could provide modern greenhouse technology to Germany. On the other hand, there are many opportunities for direct investments in production facilities – potential sites at the newly-formed German states as well as at the traditional horticultural plants in West Germany are shown in this report.

In modern greenhouses the basis for sustainable horticultural production and marketing systems is given. The efficient use of water resources, low energy consumption and high quality and safety standards require state-of-the-art greenhouses. At the same time modern greenhouses are basis for low production costs: in the context of rising energy spending, which account for a significant share in the fruit and vegetable production, high energy efficiency plays a prominent role.

The development of resource-efficient greenhouses is also in the focus of scientific research in Germany. Especially in the recent past, Germany has established a number of research networks in greenhouse productions system. The networks are working hard on improving the resource use in the greenhouses (in particular energy, water and pesticides). But also topics like process design in fruit and vegetable supply chains are reviewed. Production, harvesting, processing and distribution and thus the entire value chain needs to be redesigned to achieve an overall sustainable fruit and vegetable production.

During the intense debates on quality, food safety and the rising demand for traceability of the products the requirements of transparency and documentation and following the administrative work in the fruit and vegetable production increased drastically. Also these topics are regarded in new research projects in Germany supported by public funds.

In summary, it can be stated that the current developments in German greenhouses are advantageous for foreign companies that can show a high level of competence and performance in this business area. Starting points can be found along the entire value chain – but also in science. As proposed, several actions for linking Dutch and German (research network) capabilities can be useful for a larger technology transfers and closer business relationships.

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In the course of this project, we have held discussions with experts from the following institutions:

- Fakultät Agrarwissenschaften und Landschaftsarchitektur, Hochschule Osnabrück (<http://www.al.hs-osnabrueck.de/>)
- Forschungsanstalt Geisenheim (<http://www.fa-gm.de/>)
- Gartenbaukompetenzzentrum Gülzow (http://www.landwirtschaft-mv.de/cms2/LFA_prod/LFA/content/de/Institute/Gartenbau-Kompetenzzentrum/index.jsp)
- Institut für Gemüse- und Zierpflanzenbau Großbeeren/Erfurt e.V. (<http://www.igzev.de>)
- Johann Heinrich von Thünen-Institut, Bundesforschungsinstitut für Ländliche Räume, Wald und Fischerei (<http://www.vti.bund.de>)
- LWK Niedersachsen, Geschäftsbereich Gartenbau (<http://www.lwk-niedersachsen.de>)
- Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie (<http://www.smul.sachsen.de/lfulg/>)
- Thüringer Landesanstalt für Landwirtschaft (<http://www.thueringen.de/de/tll/>)
- Zentralverband Gartenbau e.V. (<http://www.g-net.de/>)

- Zentrum für Betriebswirtschaft im Gartenbau e. V. (<http://www.zbg.uni-hannover.de/>)

Useful sources

Agencies & organizations

Center for Business Management in Horticulture and Applied Research (ZBG)

www.zbg.uni-hannover.de

Federal Agency for Agriculture and Food (BLE)

www.ble.de

Federal Ministry for Food, Agriculture and Consumer Protection (BMELV)

www.bmelv.de

Federal program to increase energy efficiency in agriculture and horticulture

www.ble.de/nn_1666708/DE/05__Programme/04__BundesprogrammEnergieeffizienz/BundesprogrammEnergieeffizienz.html

Statistics and Reports of the Federal Ministry for Food, Agriculture and Consumer Protection

www.bmelv-statistik.de

The Federal Office of Consumer Protection and Food Safety (BVL)

www.bvl.bund.de

Vegetable Section at the Federal Committee of fruit and vegetables

www.gemuesebau.org

Journals & information Networks

Agricultural Market Information Company (AMI)

www.ami-informiert.de

GABOT - Search for Horticulture

www.gabot.de

hortigate - Horticulture Information System

www.hortigate.de

Information platform to promote efficient energy use in horticulture

<http://energieportal-hortigate.de>

Lebensmittel Zeitung – Food Journal

www.lebensmittelzeitung.net

Top agrar - Agricultural Journal

www.topagrar.com

Greenhouse Projects

FORETA - Research cooperation "energy efficient technologies and applications"

www.foreta.de

inFARMING – The project of Fraunhofer Institute for Environmental, Safety and Energy Technology - Building integrated agriculture on the roofs of buildings

www.umsicht.fraunhofer.de/presse/bericht.php?titel=110223_infarming&druck=1

ZINEG - The Low Energy Greenhouse

www.zineg.de

Producers of greenhouse vegetables

Gemüsering GmbH
www.gemuesering-stuttgart.de
Hahn Gemüsebau GmbH
www.barther-tomaten.de
Landgard eG
www.landgard.de

Contact to Department of States for informations on projects:**Baden Wurttemberg:**

Ministerium für Ländlichen Raum und Verbraucherschutz Baden-Württemberg
Kernerplatz 10
70182 Stuttgart
Phone +49 711 / 1260
Fax +49 711 / 1262255
poststelle@mlr.bwl.de
<http://www.mlr.baden-wuerttemberg.de/>

Bavaria

Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten
Ludwigstraße 2
80539 München
Phone +49 89 / 21820
Fax +49 89 / 21822677
poststelle@stmelf.bayern.de
<http://www.stmelf.bayern.de/>

Brandenburg

Ministerium für Infrastruktur und Landwirtschaft Brandenburg
Henning-von-Tresckow-Straße 2-8
14467 Potsdam
Phone +49 331 / 8668096
Fax +49 331 / 8668357
oeffentlichkeitsarbeit@mil.brandenburg.de
<http://www.mil.brandenburg.de/>

Hesse

Hessisches Ministerium für Umwelt, Energie, Landwirtschaft und Verbraucherschutz
Mainzer Straße 80
65189 Wiesbaden
Phone +49 611 / 8150
Fax +49 611 / 8150
pressestelle@hmuehv.hessen.de
<http://www.hmuehv.hessen.de/>

Mecklenburg Western Pomerania

Ministerium für Landwirtschaft, Umwelt und Verbraucherschutz

Paulshöher Weg 1

19061 Schwerin

Phone +49 385 / 5880

Fax +49 385 / 5886024

poststelle@lu.mv-regierung.de

<http://www.lu.mv-regierung.de/>

Lower Saxony

Niedersächsisches Ministerium für Ernährung, Landwirtschaft, Verbraucherschutz
und Landesentwicklung

Calenberger Straße 2

30169 Hannover

Phone +49 511 / 12021

Fax +49 511 / 1202382

pressestelle@ml.niedersachsen.de

<http://www.ml.niedersachsen.de/>

North Rhine Westphalia

Ministerium für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz
des Landes Nordrhein-Westfalen

Schwannstraße 3

40476 Düsseldorf

Phone +49 211 / 45660

Fax +49 211 / 4566388

poststelle@mkulnv.nrw.de

<http://www.umwelt.nrw.de/>

Rhineland Palatinate

Ministerium für Umwelt, Landwirtschaft, Ernährung, Weinbau und Forsten

Kaiser-Friedrich-Straße 1

55116 Mainz

Phone +49 6131 / 160

Fax +49 6131 / 164646

poststelle@mufv.rlp.de

<http://www.mufv.rlp.de/>

Saarland

Ministerium für Umwelt, Energie und Verkehr Saarland

Keplerstraße 18

66117 Saarbrücken

Phone +49 681 / 5014500

Fax +49 681 / 5014521

http://www.saarland.de/ministerium_umwelt_energie_verkehr.htm

Saxony

Sächsisches Staatsministerium für Umwelt und Landwirtschaft
Archivstraße 1
1097 Dresden
Phone +49 351 / 5640
Fax +49 351 / 5642209
poststelle@smul.sachsen.de
<http://www.smul.sachsen.de/>

Saxony-Anhalt

Ministerium für Landwirtschaft und Umwelt des Landes Sachsen-Anhalt
Olvenstedter Straße 4
39108 Magdeburg
Phone 0391 / 5671949
Fax 0391 / 5671964
pr@mli.sachsen-anhalt.de
<http://www.mli.sachsen-anhalt.de/>

Schleswig-Holstein

Ministerium für Landwirtschaft, Umwelt und ländliche Räume Schleswig-Holstein
Mercatorstraße 3
24106 Kiel
Phone +49 431 / 9880
Fax +49 431 / 9887239
internetredaktion@mlur.landsh.de
<http://www.mlur.landsh.de/>

Thuringia

Thüringer Ministerium für Landwirtschaft, Forsten, Umwelt und Naturschutz
Beethovenstraße 3
99096 Erfurt
Phone +49 361 / 37900
Fax +49 361 / 3799950
poststelle@tmlfun.thueringen.de
<http://www.thueringen.de/de/tmlfun/>

Bundesanstalt für Landwirtschaft und Ernährung (BLE)

Deichmanns Aue 29
53179 Bonn
Phone +49 228 / 9968450
Telefax +49 228 / 68453101
info@ble.de
<http://www.ble.de/>

Tab. 6: Vegetable supply balance¹ (1 000 t)

	02/03	03/04	04/05	05/06	06/07	07/08	08/09 ²	09/10 ²
Usable production	2 540	2 589	2 957	2 856	2 855	3 047	3 124	3 231
Import	6 240	6 200	6 063	6 425	6 507	6 576	6 526	6 369
Export	1 027	1 058	1 105	1 364	1 296	1 366	1 379	1 191
Domestic use	7 753	7 731	7 915	7 917	8 066	8 257	8 270	8 410
Market consumption	7 010	6 980	7 118	7 122	7 267	7 428	7 443	7 568
Per capita consumption (kg)	84,9	84,6	86,3	86,4	88,2	90,4	90,7	92,8
Self-sufficiency (%)	32,8	33,5	37,4	36,1	35,4	36,9	37,8	38,4

¹) including vegetables for direct consumption and for processing

²) preliminary data

Source: BLE, BMELV

Tab. 7: Fruit supply balance¹ (1 000 t)

	02/03	03/04	04/05	05/06	06/07	07/08	08/09 ²	09/10 ²
Usable production	999	1 039	1 236	1 119	1 226	1 331	1 249	1 350
Import	8 117	8 553	7 899	8 751	8 389	8 029	7 669	7 593
Export	2 570	2 757	2 726	3 100	2 930	3 156	2 836	2 905
Domestic use	6 581	6 814	6 366	6 797	6 679	6 203	5 980	6 038
Market consumption	6 270	6 497	6 048	6 478	6 365	5 901	5 748	5 725
Per capita consumption (kg)	76,0	78,7	73,3	78,6	77,3	71,8	70,0	70,2
Self-sufficiency (%)	15,2	15,2	19,4	16,5	18,4	21,5	19,5	22,4

¹) including fruit for direct consumption and for processing

²) preliminary data

Source: BLE, BMELV

Tab. 8: Cultivated area and production of vegetables¹

	2005	2006	2007	2008	2009	2010
Outdoor vegetables (ha)	107 771	111 045	111 274	116 106	115 229	110 570
Under glass vegetables (ha)	1 392	1 386	1 464	1 500	1 476	1 325
Harvested production total ² (1 000 t)	3 167	3 161	3 387	3 477	3 568	
- outdoor	2 959	2 968	3 179	3 264	3 443	3 148
- under glass	146,6	138,7	152,8	156,0	167,2	142,8
- Mushrooms	61	59	55	57	58	

¹) excl. strawberries

²) From 2010 this category does not include Herbage

Source: AMI Agrarmarkt 2010, Federal Statistical Office of Germany, BMELV

Tab. 9: Cultivated area of vegetables and strawberries per States of Germany¹ (ha)

Federal State	Year	Total area	of			
			vegetables		strawberries	
			outdoor	under glass	outdoor	under glass
Germany total	2008	133 466	116 106	1 500	15 663	197
	2009	132 830	115 229	1 476	15 910	216
	2010	128 435	110 570	1 325	16 303	237
Baden Württemberg	2008	13 561	9 995	472	3 045	49
	2009	13 320	9 757	460	3 059	43
	2010	12 942	9 464	452	2 983	43
Bavaria	2008	15 952	13 670	283	1 990	8
	2009	15 620	13 323	284	2 004	9
	2010	15 326	12 809	250	2 257	9
Berlin and Bremen	2008	141	130	1	.	.
	2009	141	130	1	.	.
	2010	124	113	1	.	.
Brandenburg	2008	6 730	6 356	49	322	3
	2009	6 524	6 156	52	314	2
	2010	6 735	6 321	44	366	4
Hamburg	2008	553	476	69	.	.
	2009	502	430	63	9	-
	2010	531	462	60	.	.
Hesse	2008	8 305	7 397	72	824	12
	2009	8 042	7 104	57	870	11
	2010	7 888	6 908	44	922	13
Mecklenburg Western Pomerania	2008	2 394	1 961	19	415	0
	2009	2 623	2 145	20	458	1
	2010	2 450	1 898	13	539	0

Lower Saxony	2008	22 896	19 475	116	3 280	24
	2009	22 819	19 267	116	3 402	34
	2010	21 781	18 017	77	3 658	29
North Rhine Westphalia	2008	24 060	20 780	227	2 967	86
	2009	24 213	20 752	242	3 125	(95)
	2010	23 521	20 265	199	2 949	109
Rhineland Palatinate	2008	18 340	17 659	57	620	4
	2009	18 719	18 175	56	485	(4)
	2010	18 771	18 145	64	559	3
Saarland	2008	156	137	4	.	.
	2009	154	136	4	.	.
	2010	151	136	3	.	.
Saxony	2008	5 276	4 523	56	695	1
	2009	5 584	4 803	52	728	1
	2010	4 762	4 105	43	613	1
Saxony Anhalt	2008	5 747	5 547	7	192	1
	2009	5 904	5 744	6	153	2
	2010	4 539	4 395	5	136	3
Schleswig- Holstein	2008	7 421	6 257	26	1 130	9
	2009	7 062	5 898	23	.	.
	2010	7 390	6 238	23	1 107	22
Thuringia	2008	1 935	1 743	42	150	-
	2009	1 603	1 408	40	.	.
	2010	1 523	1 295	46	.	.

¹⁾ From 2010 this category does not include Herbage

Source: Federal Statistical Office of Germany

Tab. 10: Import and export of fresh vegetables (1 000 t)

	2005	2006	2007	2008	2009 ¹
Import	2 799	3 027	2 999	3 035	2 827
Export	313	326	379		384

¹) preliminary data

Source: EUROSTAT, BMELV

Tab. 11: Top 5 countries. Import of fresh vegetables to Germany (1 000 t)

	2005	2006	2007	2008	2009 ¹
Netherlands	1 029,5	1 117,6	1 133,2	1 146,1	1 057,8
Spain	822,4	858,8	784,3	864,6	842,1
Italy	289,5	341,7	342,9	322,4	258,6
France	163,7	164,8	169,3	168,2	147,3
Belgium	148,9	146,8	138,3	126,3	113,0

¹) preliminary data

Source: Federal Statistical Office of Germany, BMELV

Tab. 12: Top 5 countries. Export of fresh vegetables from Germany (1 000 t)

	2005	2006	2007	2008	2009 ¹
Netherlands	97,9	87,6	106,9	103,2	63,3
Italy	49,4	48,4	47,3	50,5	55,1
Austria	53,7	51,9	47,9	62,1	51,4
Sweden	41,4	41,9	50,6	36,7	35,9
France	30,8	38,7	38,2	39,9	29,3

¹) preliminary data

Source: Federal Statistical Office of Germany, BMELV

Tab. 13: German Imports of fresh vegetables per product (1 000 t)

Products	2006	2007	2008	2009 ¹
White, red cabbage	18,5	21,9	18,4	13,3
Brussels sprouts	26,5	35,1	40,9	39,5
Cauliflower	75,7	88,3	77,1	66,1
Other cabbage	117,3	112,5	111,4	97,7
Salad	288,8	265,4	266,6	263,6
Chicory	50,7	48,7	49,0	37,0
Asparagus	28,8	27,5	30,2	22,6
Carrot	237,4	233,2	242,8	193,2
Celeriac	15,5	13,0	11,3	12,2
Pea	3,7	5,0	4,6	5,2
Bean	20,9	25,0	24,1	20,6
Other legumes	0,6	0,7	0,7	0,8
Cucumber, gherkin	477,1	478,2	484,3	476,5
Tomato	717,7	704,8	695,4	657,0
Onion, shallot	271,9	271,2	257,6	227,8
Garlic	17,6	18,8	16,8	18,0
Leek	47,6	44,2	42,2	45,5
Horseradish	53,8	53,9	64,0	51,5
Artichoke	2,1	2,2	1,7	2,2
Aubergine, celery	38,7	40,3	44,3	42,9
Mushroom, Truffle	64,8	64,3	74,0	68,7
Pepper	308,5	294,0	319,1	326,4
Courgette	54,2	54,2	59,6	57,3
Other vegetables	88,2	96,5	98,9	81,4
Total	3 026,6	2 998,7	3 035,2	2 826,9

¹) preliminary data

Source: Federal Statistical Office of Germany, BMELV

Tab. 14: German Imports of the main fresh vegetables per country of origin

Products/ States	2007	2008	2009 ¹	2007	2008	2009 ¹
	t			thousand €		
Tomato						
total	704,8	695,4	657,0	951,8	924,7	852,9
EU	671,8	655,5	611,9	909,5	878,6	791,5
- Netherlands	347,3	336,2	336,4	466,4	458,9	420,6
- Spain	185,6	192,2	169,4	242,3	234,5	214,2
- Belgium	55,9	47,4	41,8	62,8	53,5	42,9
third countries	33,0	39,8	45,1	42,2	46,1	61,4
Cucumber, gherkin						
total	478,2	955,6	938,3	387,3	727,0	710,7
EU	468,5	471,2	461,9	379,6	358,7	349,9
- Netherlands	241,6	240,2	231,7	186,4	174,3	162,8
- Spain	159,7	181,7	179,5	138,8	145,9	144,0
- Greece	23,2	15,5	17,1	22,8	14,0	17,2
third countries	9,7	484,3	476,5	7,8	368,3	360,8
Pepper						
total	315,6	286,5	311,2	553,9	525,0	454,2
EU	237,0	266,1	269,3	436,6	451,4	385,3
-Netherlands	121,8	126,8	132,6	253,2	239,1	201,4
-Spain	88,5	117,1	114,7	147,2	179,5	157,1
third countries	49,516	45,1	46,3	117,3	73,6	68,9
-Israel	34,4	27,9	32,0	94,5	50,6	50,6
Lettuce						
total	111,1	112,6	107,4	105,3	100,5	99,6
EU	110,5	111,9	107,0	104,7	99,8	99,0
- Netherlands	10,5	11,0	11,6	12,5	11,6	13,4
- Spain	60,8	61,2	61,9	54,6	49,9	47,5
- Belgium	23,5	24,8	19,2	23,8	24,1	21,7
third countries	617	677	411	607	757	585
Onion, shallot						
total	271,2	257,6	227,8	141,5	103,6	84,8
EU	185,5	188,1	166,1	93,2	71,5	57,5
- Netherlands	67,8	69,1	56,2	31,5	24,8	17,7
- Spain	71,7	81,3	80,2	30,7	20,1	20,4
third countries	85,7	69,5	61,7	48,3	32,1	27,3
- New Zealand	27,9	31,0	24,4	14,4	13,5	8,9
Carrot, turnips						
total	233,2	242,8	193,2	84,4	93,4	93,4
EU	225,2	233,7	176,9	79,6	87,1	77,0
- Netherlands	124,4	136,6	98,4	33,1	39,9	31,5
- Italy	53,9	52,5	39,8	26,4	28,1	26,7
third countries	8,1	9,1	16,4	4,8	6,3	9,3
- Israel	4,0	7,9	14,7	2,1	4,7	7,7

¹⁾ preliminary data

Source: Federal Statistical Office of Germany, BMELV

Tab. 15: Cultivated area of glasshouse vegetables in Germany (ha)

	2003	2004	2005	2006	2007	2008	2009	2010 ¹
Kohlrabi	44	37	36	38	39	37	32	28
Lettuce	133	134	160	162	163	176	138	129
Field salad	269	262	262	258	266	281	281	278
Cucumber	229	265	249	257	259	266	269	216
Tomato	256	292	284	279	293	308	316	322
Radish (Rettich)	44	38	35	35	34	27		
Radish (Radies)	49	54	56	54	63	50	54	55
Pepper	30			37	35	41	43	39
Other crops ¹	264	290	309	266	311	316	343	259
Total	1 319	1 371	1 392	1 386	1 464	1 500	1 476	1 325

¹⁾ From 2010 this category does not include Herbage

Source: Federal Statistical Office of Germany, BMELV

Tab. 16: Harvested production of glasshouse vegetables in Germany¹ (1 000 t)

	2003	2004	2005	2006	2007	2008	2009	2010 ²
Kohlrabi	1,9	1,6	1,5	1,6	1,8	1,6	1,3	1,1
Lettuce	6,2	6,6	7,9	7,6	8,0	7,9	6,5	5,7
Field salad	2,7	2,7	2,7	2,4	2,6	2,8	2,8	2,7
Cucumber	54,3	56,3	64,0	61,4	61,1	63,9	73,0	48,4
Tomato	48,9	58,1	56,1	53,2	62,6	65,1	66,6	73,2
Radish (Rettich)	2,0	1,6	1,5	1,6	1,4	1,2		
Radish (Radies)	1,1	1,5	1,4	1,3	1,5	1,6	1,2	1,1
Pepper				1,8	2,1	1,9	2,1	2,2
Other crops ²	10,1	9,7	11,5	7,8	11,7	9,9	13,7	8,3
Total	127,2	138,1	146,6	138,7	152,8	156,0	167,2	142,8

¹⁾ Including walkways under fixed or flexible plastic protected areas

²⁾ From 2010 this category does not include Herbage

Source: Federal Statistical Office of Germany, BMELV

Tab. 17: Cultivated area, yield and import of strawberries

	2005	2006	2007	2008	2009	2010
Cultivated area total (ha)	18 945	17 570	16 626	15 830	16 126	16 540
- outdoor	18 827	17 450	16 483	15 633	15 910	16 303
- under glass	118	120	143	197	216	237
Production outdoor (1 000 t)	146,5	169,7	153,4	144,9	152,8	150,5
Import (1 000 t)	103,5	97,4	87,3	91,4	103,7	

Source: Federal Statistical Office of Germany, BMLEV