



The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement n° 311778

Case studies on asparagus value chains from Belgium and Peru (Task 3.5)

Jana Schwarz, Bernd Annaert and Erik Mathijs

—

Division of Bioeconomics, KU Leuven

To be cited as:

Schwarz, J, Annaert, B & Mathijs, E (2015) GLAMUR WP3 - Case studies on asparagus value chains from Belgium and Peru. KU Leuven, Belgium.

Summary

This case study report, which constitutes deliverable D3.2, presents data relating to the performance of a local and a global asparagus supply chain. It is one of the food commodity supply chains studied within the GLAMUR project as part of work package 3. The main objective of this report is to determine a set of attributes and related indicators regarding the performance and critical issues of the asparagus supply chains.

The two fresh asparagus supply chains have been chosen for the case study. First, a chain of fresh white asparagus produced in the region of Limburg in Flanders (Belgium) and sold by a large supermarket chain in the same region (local chain). The study focuses on the region of Flanders due to the political organization of agriculture in Belgium: Each of the three regions of Belgium – Flanders, Wallonia and Brussels-Capital – has authority over socio-economic matters including economy, environment and agriculture. Thus, the context of agricultural production is region-specific. The same farmers involved in the Flemish supermarket chain also use another marketing channel and sell their produce directly to consumers through farm shops. Second, we analyze a supply chain of mainly fresh green asparagus grown in Peru, exported to Europe and sold in a Flemish supermarket store (global chain).

Data have been gathered through semi-structured qualitative interviews with stakeholders involved in the two chains, by surveying farm workers and producers, by using secondary data and by a literature and document review.

The context of the local and the global chain is very different: In Flanders, 137 farmers have cultivated asparagus on 380 ha in 2014. This is less than 1% of the total agricultural land in Flanders. However, there is a continuous trend of increasing the land devoted to asparagus cultivation but at the same time the number of asparagus growing holdings is decreasing. In contrast, Peru is the world's leading exporter of asparagus and the sector is very important for the local and national economy. In 2012, asparagus has been grown on more than 33,000 ha which earned Peru more than 400 million USD FOB. Producers are very diverse, varying from small scale producers with less than 1 ha of asparagus land to some large agro-export companies growing asparagus on more than 1,000 ha. Practically the whole asparagus production is exported, either fresh, frozen or chilled, mainly to the US and to European countries.

We first describe the supply chains in detail and identified the main critical issues. These are mainly debated with regard to the Peruvian chain which due to its size and the production area - which is situated along the Pacific coast in a desert area – has a much larger impact on the society and the ecosystem than the Flemish chain. First, water issues are highly debated. Water resources are scarce in the production region and water is a limiting factor for further expansion of horticultural production. There is a discussion on the use of scarce water resources for the production of export crops. Second, labour issues are debated. The Peruvian agro-export sector provides a large number of jobs (we estimate more than 50,000 field workers) in the Coastal region. However, there are

discussions on the working conditions of the people employed in the sector. Also in Flanders, nearly all asparagus workers are migrants from outside the production region and the country. Third, standards and certifications play a prominent role in both asparagus chains. In the Flemish supermarket chain, adherence to Flandria and GLOBALG.A.P. is a de facto requirement and also in Peru, compliance with standards is important to sell to overseas markets.

Based on these critical issues, we have identified five food chain performance attributes: Resource use, labour relations, contribution to economic development, creation and distribution of added value, and governance. In a next step we have developed a set of indicators that can be used to assess these performance attributes. The choice of indicators was mainly done based on data availability and by adapting indicators from the SAFA guidelines on the sustainability assessment of food and agriculture systems.

Regarding the five attributes our main findings are:

Resource use: The Flemish chain performs better when considering economic land and labour productivity whereas the Peruvian chain performs better when assessing physical productivity of land and labour. Due to differences in climate, asparagus production requires much more water in Peru than in Flanders. The water footprint of asparagus is 1,137 m³ in Peru and 889 m³ in Flanders.

Labour relations: For most indicators related to labour relations with field and processing workers (e.g. payment of the minimum wage, providing legal work contracts, compliance of working hours with national standards) the Flemish chain performs better than the Peruvian chain. However, data quality for the Peruvian supply chain is much better than data quality for the Flemish local case which is mainly based on assumptions.

Contribution to economic development: The contribution of the local and the global chain to economic development differs significantly. Whereas the Peruvian chain contributes largely to job creation, the number of workers in the Flemish asparagus chain is relatively low. Moreover, nearly all seasonal workers in Flanders are migrants whereas in Peru, around half of the labour force comes from outside the production region.

Creation and distribution of added value: We focus on the percentage share of the price the farmer receives compared to the price the consumer pays. This is much lower for Peruvian farmers. They only receive on average 6% of the price whereas the farmers involved in the Flemish supermarket chain receives an estimated 24% of the consumer price.

Governance: In the Flemish supermarket chain, all farmers need to comply with the GLOBALG.A.P. and Flandria standard. In Peru, nearly 40% of agro-export companies comply with at least one certification scheme.

Contents

Summary	3
1 Introduction	7
1.1 General introduction.....	7
1.2 Sectoral regional context: Flanders.....	8
1.3 Sectoral national context: Peru.....	9
2 Case study Belgium/ Flanders	10
2.1 Description of the supply chain steps and the main actors.....	10
2.2 Reason for selecting the Flemish local asparagus chain	13
2.3 Context of the case study and critical issues.....	14
2.3.1 Global-local issues and the role of the territory	14
2.3.2 Role of standards and certifications	15
3 Case study Peru	16
3.1 Description of the supply chain steps and the main actors.....	16
3.2 Reasons for selecting the Peruvian global chain.....	19
3.3 Context of the case study and critical issues.....	21
3.3.1 Global-local issues in the chain and the role of the territory	21
3.3.2 Water issues	22
3.3.3 Social issues – Labour relations.....	23
3.3.4 Role of standards and certifications	23
3.3.5 Role of public policies and institutions.....	24
4 Research design	25
4.1 Research questions	25
4.2 Selection of attributes and their relation with the research questions	26



4.2.1	Resource use.....	26
4.2.2	Labour relations	27
4.2.3	Contribution to economic development.....	27
4.2.4	Creation and distribution of added value	27
4.2.5	Governance	27
4.3	Selection and description of performance indicators.....	28
4.4	Data quality check	29
5	Methods of data collection.....	30
6	Results	33
6.1	Performance indicators for the local and global chain	33
6.2	Resource use.....	40
6.3	Labour relations.....	41
6.4	Contribution to economic development	42
6.5	Creation and distribution of added value	42
6.6	Governance.....	42
7	Discussion and conclusion	43
7.1	Preliminary discussion of the local-global comparison.....	43
7.2	Discussion of the methodology.....	44
	References	46
	Annexes	49

1 Introduction

1.1 General introduction

In this case study report we present the results of our research on two supply chains of fresh asparagus. The research forms part of work package (WP) 3 of the GLAMUR project which includes the collection, analysis and organization of data on the performance of local and global food supply chains. The research has been carried out by a team of the Division of Bioeconomics at KU Leuven, Belgium. In a later stage of GLAMUR the data collected for the above mentioned case studies will be compared.

The following two chains have been analyzed: First, a chain of fresh white asparagus produced in the region of Limburg in Flanders (Belgium) and sold by a large supermarket chain in the same region (local chain). The Belgian study focuses on Flanders due to the political organization of agriculture in Belgium: Each of the three regions of Belgium – Flanders, Wallonia and Brussels-Capital – has authority over socio-economic matters including economy, environment and agriculture. Thus, the context of agricultural production is region-specific. As Flanders is the main asparagus producing region in Belgium it has been selected for the present case study. The same farmers involved in the Flemish supermarket chain also use another marketing channel and sell their produce directly to consumers through farm shops. Second, we analyze a supply chain of mainly fresh green asparagus grown in Peru, exported to Europe and sold in a Flemish supermarket store (global chain). The calculation and comparison of performance indicators is carried out for the Flemish supermarket chain and the global Peruvian chain.

The food supply chain of Peruvian asparagus has been chosen as one of three GLAMUR case studies addressing food imports from non-EU countries to the EU since it provides a particularly interesting case for analysing the tensions and complementariness between global and local aspects of a food supply chain. Especially the trade-offs between economic development, social and environmental impacts related to asparagus production in Peru are very interesting for studying the sustainability performance of this global food chain. Thus, the research focuses mainly on analyzing the context of asparagus production in Flanders (Belgium) and Peru and on elaborating performance indicators that can be used to compare the sustainability of asparagus production in the two countries. The comparison of supply chains will be performed for the Flemish supermarket chain and the Peruvian export chain. Both chains have a Flemish retail store as the endpoint of analysis.

The report is structured as follows: In the following subsections we describe the national context of asparagus production in Flanders and in Peru, respectively. Chapter 2 describes the configuration and context of the Flemish asparagus supply chain including the critical issues we have identified regarding the sustainability and performance of the chain. This is followed by a presentation of the Peruvian asparagus chain in chapter 3. In chapter 4 we explain the research design including our research questions and the selection of attributes and indicators for analyzing the supply chain performance. Research methods are presented in chapter 5. This is followed by the results in chapter 6 and discussion and conclusion in chapter 7.

1.2 Sectoral regional context: Flanders¹

As mentioned above we focus our analysis on the region of Flanders due to the political organization of the agricultural sector in Belgium. Each of the three Belgian regions has authority over its agricultural sector and in 2013, 86% of the area dedicated to asparagus production in Belgium has been situated in Flanders (Annex A).

The Flemish agricultural sector is relatively small, representing less than 1% of total GDP and employment. In 2011, Flemish agriculture realized a turnover of 5.1 billion EUR. The products with the greatest contribution to turnover were pork (27%), dairy (14%), beef (13%) and vegetables (11%). The total area used by the Flemish agricultural sector amounted to 625,700 ha in 2013 of which 279 ha have been used for asparagus production (Statistics Belgium, 2015). Thus, asparagus production does not play a significant role in Flemish agriculture. However, the area devoted to asparagus has increased significantly since 2009. Whereas in 2009 asparagus has been cultivated on 166 ha, in 2013 279 ha have been used for asparagus production. At the same time, the number of holdings has decreased from 162 to 137 (Annex A). Thus, asparagus production is following a general trend of consolidation which is taking place in the agricultural sector, i.e. less farmers own larger areas of land. Asparagus growers usually only dedicate part of their agricultural land to asparagus production and also cultivate other vegetables such as leek.

Asparagus yields have increased from around 6 tonnes/ha at the beginning of the 2000's to around 9 tonnes/ha in 2011 and 2012 (Annex C). The predominant variety grown by Belgian farmers is white asparagus. The main production regions in Belgium are situated in the Flemish region of Limburg, in the north eastern part of the country.

Regarding food marketing channels in Belgium, most food is sold through the retail sector which is highly concentrated: Three retailers – Delhaize, Carrefour and Colruyt – capture more than 70% of the market share. Small shops have virtually disappeared and local markets and direct farm sales generate only a very small share of the turnover related to food sales: In 2012, Belgian farmers markets generated a total turnover of 15.3 million EUR and on-farm sales generated a turnover of 76.2 million EUR. This equals only 0.49% of the turnover related to all food sales. However, 21% of the Flemish population reports to have purchased products directly from a farm. Products purchased on-farm are fruits (23.4% of all products bought on-farm), potatoes (19.4%), vegetables (18.4%), meat (16.7%), dairy (8.8%), poultry (5.5%) and eggs (3%) (VLAM, 2013). However, on-farm sales are very common in the asparagus sector and are of increasing importance for the growers (pers. comm. Boerenbond, 2014). The farmers interviewed within the scope of the current research estimate that they sell around 40% of their asparagus directly to consumers.

¹ For more information on the Flemish agricultural sector see the GLAMUR WP2 report on Flanders.

1.3 Sectoral national context: Peru

In Peru, the agricultural sector accounted for 6.2% of total GDP in 2013 and employed 25.8% of the labour force (CIA, 2014). Especially exports of high-value horticultural products have increased tremendously during the past decades with asparagus being the most prominent crop. However, the importance of other horticultural products such as grapes, avocados and artichokes is steadily increasing. Peru is the world's leading asparagus exporter and the sector is very important for the economy and the labour market in the production regions. Only considering exports of fresh and chilled asparagus, exports more than tripled between 2000 and 2013, amounting to nearly 125,000 tonnes in 2013. This earned Peru more than 400 million USD FOB (Annex F). Practically the whole production is exported, either as fresh produce or as frozen or preserved products. The main destination markets of fresh and chilled asparagus in 2013 were European countries (26 percent) and the US (70 percent) (see Annex E). Amongst the most popular destination countries in the EU are France, Germany, the UK, Spain, Italy, the Netherlands and Belgium.

Peruvian asparagus is grown along the Pacific coast and mainly in two regions - La Libertad and Ica. Both, green and white asparagus is produced but the production of green varieties outnumbers the production of white asparagus (85% green vs. 17% white, Benson, 2009). The reason for this is that the cultivation of white varieties is more difficult: the white spears need to be covered from the sun in order to keep their white colour and moreover, they easily get brown spots due to the heat. Due to the favourable climatic conditions in the production regions, asparagus yields currently on average 11.4 tonnes per hectare per year (Annex C), being among the highest yields in the world (OSITRAN, 2009). Depending on the region two to three harvests are possible per year (O'Brien and Díaz Rodríguez, 2004). However, the competitiveness of the sector is highly dependent on cheap labour and water inputs as will be shown in chapter 3.

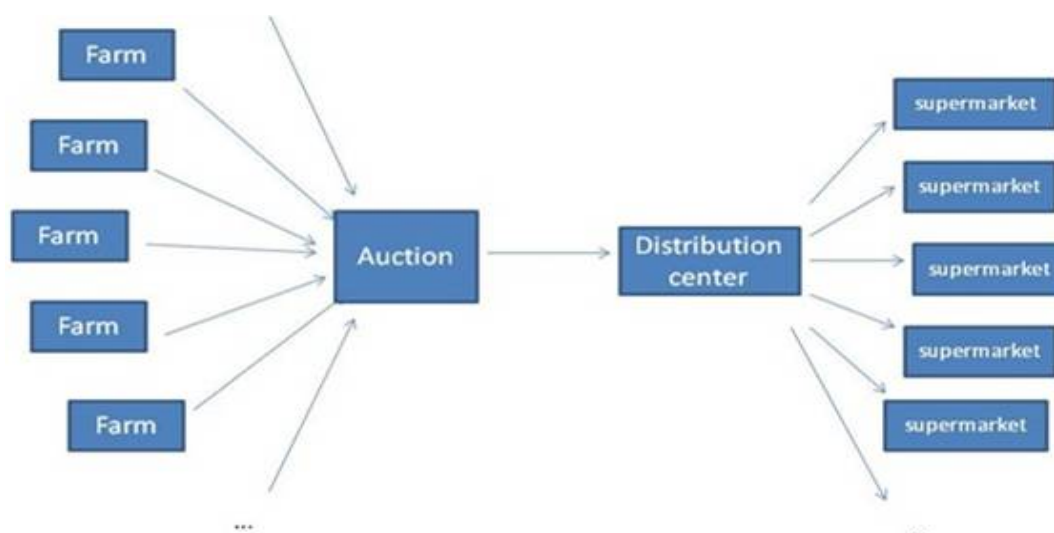
2 Case study Belgium/ Flanders

2.1 Description of the supply chain steps and the main actors

In this section we describe two variations of the Flemish asparagus chain: First, a long local chain where the product is sold in a supermarket and second, a short local chain where the same farmers sell their produce directly to consumers through a farm shop. We first present briefly the basic supply chain configuration and then describe the different steps and stakeholders in more detail below.

The supply chain analysis starts at the farm stage. In the case where asparagus is sold through a supermarket, the farmers deliver their produce to a cooperative auction where it is sorted, cooled and packaged. After being bought from the auction by a supermarket chain, the asparagus is brought to a regional distribution centre from where it is redistributed to the supermarket stores. Figure 1 depicts the configuration of the local supermarket chain.

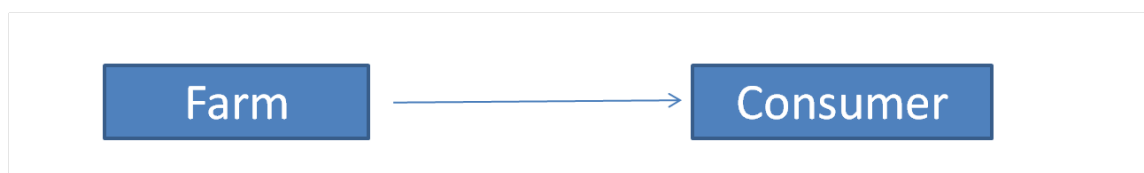
Figure 1: Flow chart of the local Flemish supermarket supply chain



(Own figure)

A variation of this chain is a very short chain where asparagus is directly sold to the consumer through a farm shop. The farmers of this short farm shop chain are the same ones as those supplying the supermarket but they keep a part of their produce for direct selling. The production process and the growers involved do not differ between the two supply chain configurations. The only actors in the farm shop chain are asparagus producers and consumers as shown in Figure 2.

Figure 2: Flow chart of the Belgian farm shop supply chain



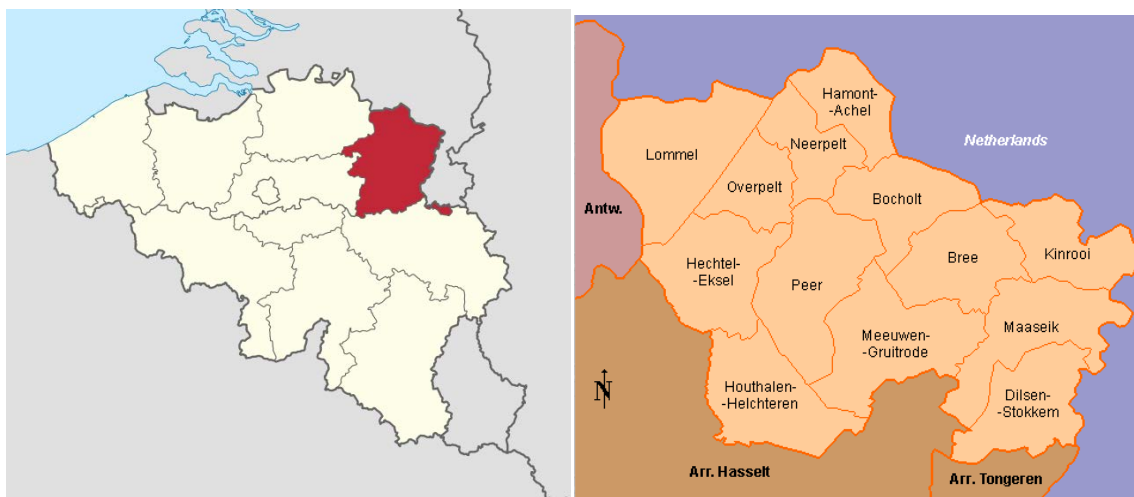
(Own figure)

In the following paragraphs we describe in more detail the different stages and stakeholders involved in the Belgian asparagus supply chain.

Production and processing

The main asparagus production regions in Belgium are situated in the Flemish region of Limburg, in the north eastern part of the country (Figure 3). The farmers interviewed for this case study come from the municipalities of Hamont-Achel, Bocholt and Kinrooi. In 2013, asparagus has been produced in Belgium on a total of 326 ha by 157 farmers (Statistics Belgium, 2014). 137 of these farms are located in Flanders, cultivating 279 ha of asparagus land. Over the past years the area under asparagus production in Belgium has continually increased. Compared to today's area, asparagus has only been grown on 174 ha in 2009 (Annex A). Yields have also increased from around 6 tonnes/ha at the beginning of the 2000's to around 9 tonnes/ha in 2011 and 2012 (Annex C). The predominant variety grown by Belgian farmers is white asparagus; only one farmer has grown green asparagus in 2014, occupying 17 ha (pers. comm., 2014). Regarding production techniques, only 9 ha of asparagus have been grown in a greenhouse in 2014, the remaining production takes place outdoors (pers. comm., 2014). For creating a microclimate on the fields, the rows are covered with plastic and irrigated with sprinkler irrigation if necessary. Harvest takes generally place from the beginning of April until mid-June. After harvest the asparagus is bathed and sorted based on 5 classes of thickness and 4 classes of form. The best quality asparagus (with the form 'straight and white' and thickness category A (16-22mm) or AA (22-28mm)) receives the Flandria quality label. After sorting the asparagus is either packed in dishes à 500 gram or in boxes of 5 kg.

Figure 3: Asparagus production regions in Belgium



(Source: wikipedia.com and crwflags.com)

Farm shop

The three farmers interviewed sold on average 40 % of their asparagus directly to the consumers through a small shop on the farm. Asparagus sold through this channel has generally a lower visual quality than the asparagus sold to the auction, but can still be sold for a good price. Around half of the asparagus sold via the farm shops is being peeled with a peeling machine. Furthermore, two of the farms interviewed sold the lowest quality asparagus in form of a 'soup package', where it is already peeled and cut. Prices in the farm shops have varied between 4.20 EUR/kg and 6 EUR/kg in 2014 depending on the quality class. The soup packages have been sold for around 3 EUR/kg.

Cooperative auction

The higher quality asparagus is delivered to a cooperative auction where the product is inspected for quality, weight, size and packaging. Then the asparagus is grouped according to quality codes and stored until it is sold. The leading auction for asparagus is the BelOrta auction situated near the city of Mechelen in the province of Antwerp. More than 75% of the Flemish asparagus production is sold through BelOrta. On average, the auction sells 2 million kg of asparagus per year (Pers. comm., 2014).

In the sales hall of the auction fruits and vegetables are offered to the buyers, many of which are retailers. The auction starts with a high price which then descends until the first buyer concludes the transaction. Nearly immediately after the sale has been concluded the product is ready to be collected by the buyer.

In 2013, the average price received by farmers for Flandria asparagus at the auction was 3.75 EUR/kg. For code B asparagus (12-16mm) farmers received 1.60 EUR/kg. This

is much lower than 5 EUR/kg that can be received in the farm shop for the same quality. (Pers. comm., 2014)

Distribution and retail

After the asparagus has been bought at the auction by the retailer, it is transported to local distribution centres from where it is distributed to the retail stores all over the country. We focus our analysis on a big Flemish retailer who has a distribution centre in Halle, around 50 km away from the auction in Mechelen.

2.2 Reason for selecting the Flemish local asparagus chain

In this section we explain the reasons for selecting the Flemish local supermarket asparagus chain according to the Food Supply Chain framework presented below and the local-global distinction criteria identified in earlier research stages. We focus on the supermarket chain because it has the same endpoint as the global Peruvian asparagus chain and thus, a more holistic comparison of the two chains can be carried out.

In the Flemish supermarket asparagus chain all main production and marketing steps take place within the region of Flanders. This is shown in the food supply chain framework in Table 1. It shows the supply chain steps from the production of inputs until the retailer horizontally. Vertically, the spatial scale where the respective step takes place is indicated. Land and water inputs are regional as production takes place in Flanders. However, some production inputs come from outside the country such as seasonal labour (mainly from Eastern Europe), rhizomes (mainly from the Netherlands), machinery and the transplanting services provided by Dutch companies. All the steps following agricultural production happen in Flanders and thus we consider this supply chain a local one.

Table 1: Food Supply Chain framework of the Belgian local asparagus supply chain

Spatial Scale	Production inputs	Agricultural Production	Transport	Processing Collection	Distribution	Retailing
Local (Flanders)	Land Water	137 producers	Transport from farms to the auction	Packed and marketed at the cooperative auction	By truck to a local distribution center and then to the supermarket	Flemish supermarket
Global (Europe)	Labor Rhizomes Machinery Transplanting					

(Own table)

Regarding the four local/global dimensions identified in the GLAMUR project – (i) physical/geographical distance, (ii) governance and organizational issues, (iii) the kind of

resources, knowledge and technologies employed in the production process, (iv) the role of territory in defining the identity of the product - the Flemish asparagus supply chain is also considered local, although it includes some global features. First, the physical/geographical distance between production and consumption is relatively short, as most supply chain steps take place within the region of Flanders. Second, governance and organizational issues are considered rather global. Compared to directly selling to the consumers through a farm shop, there is no personal connection between producers and consumers in the supermarket chain and communication happens mainly through the use of labels. Most of the governance in the chain happens through the cooperative auction and the use of certifications and standards (see section 2.3.2). Third, the kind of resources, knowledge and technologies employed in the production process show some global features and some major inputs and services are imported from outside the region as has been discussed above. Nonetheless, land and water resources are local. Fourth, the role of the territory is a rather local aspect of Flemish asparagus production. Asparagus is still considered a very local and seasonal product by many Belgian consumers and due to soil quality it is only produced in specific regions in Belgium. Altogether we consider the Belgian asparagus supply chain a local chain, especially in comparison to the Peruvian asparagus chain.

2.3 Context of the case study and critical issues

In this section we summarize the most important global-local issues related to Flemish asparagus production and the role of standards and certifications which is important in governing the supply chain.

2.3.1 Global-local issues and the role of the territory

Flemish asparagus is a very seasonal product due to a very short harvesting season from the end of April to June. Moreover, it is only grown in specific regions in Belgium due to soil quality and sold mainly within the country. This is especially the case for asparagus sold at the farm shop to consumers who generally live in the vicinity. Thus, the consumers know where the product has been grown and during the past years, the amount of asparagus sold directly on the farm has increased a lot (Boerenbond, pers. comm., 2014). According to the farmers interviewed for this study, they sell between 30 and 50% of their produce directly to the consumers. The 'localness' of the product is also used as a sales argument in marketing, stressing the Flemish origin of the asparagus and nicknaming it "white gold" (e.g. www.visitflanders.us).

However, there are also some global aspects in asparagus production: The rhizomes are imported from nurseries in the Netherlands and often the transplanting is also done by external Dutch companies. Moreover, the largest share of seasonal workers for harvesting and packing comes from Poland and Eastern Europe. Thus, the local product depends on input supplies from other countries.

2.3.2 Role of standards and certifications

In order to sell their product to the auction, all asparagus farmers need to comply with the Flandria quality label. This label includes requirements on (i) cultivation practices such as planting material and fertilizers used, (ii) quality standards such as the shape of the product and the absence of foreign products, and (iii) traceability and control in order to be able to trace each product chain from the soil to the consumer. Compliance with the Flandria quality standard is checked by inspectors at BelOrta (belorta, 2014). However, producers who receive the Flandria label do not necessarily have to be located in the region of Flanders. Some of the producers are located in Germany, the Netherlands or other Belgian regions and sell through a Flemish auction. Almost 90 % of the vegetables from Flanders are put on the market under the Flandria label (Van Bellgem, 2013).

Another important standard in the supermarket supply chain is GLOBALG.A.P.. In the case of BelOrta, the auction holds a group certificate including a producer group of 86 farms (GLOBALG.A.P., 2014). This means that all producers have to comply with the standard, but external certification costs are lower than in the case of an individual certification. The GLOBALG.A.P. standard includes compliance criteria for all stages of production, from pre-harvest activities such as soil management and fertilizer use to post-harvest activities like packing and storing.

Compliance with Flandria and GLOBALG.A.P. is thus crucial for selling asparagus through the auction to supermarkets. But whereas compliance with GLOPBALG.A.P. is not used as a label for marketing reasons, products that comply with the Flandria quality standards receive a product label. According to Van Bellgem (2013) the Flandria label has a very good reputation being associated with positive characteristics such as home-grown, sustainable, requiring very little transportation and healthy.

3 Case study Peru

3.1 Description of the supply chain steps and the main actors

Peruvian asparagus production and exports have increased tremendously during the past three decades, making Peru the world's leading asparagus exporter. Only considering exports of fresh and chilled asparagus, exports more than tripled between 2000 and 2013, amounting to nearly 125,000 tonnes in 2013. This earned Peru more than 400 million USD FOB (Annex F). Practically the whole production is exported, either as fresh produce or as frozen or preserved products. The main destination markets of fresh and chilled asparagus in 2013 were European countries (26 percent) and the US (70 percent) (see Annex E). Amongst the most popular destination countries in the EU are France, Germany, the UK, Spain, Italy, the Netherlands and Belgium.

As shown in Figure 4 Peruvian asparagus is mainly grown in coastal areas in two regions, namely La Libertad and Ica. Both, green and white asparagus is produced but the production of green varieties outnumbers the production of white asparagus (85 percent green vs. 17 percent white (Benson, 2009)). Due to the favourable climate in the production regions, asparagus yields currently on average 11.4 tonnes per hectare per year (Annex C), being among the highest yields in the world (OSITRAN, 2009). Depending on the region two to three harvests are possible per year (O'Brien and Díaz Rodríguez, 2004).

Figure 4: Major asparagus production areas in Peru in 2012

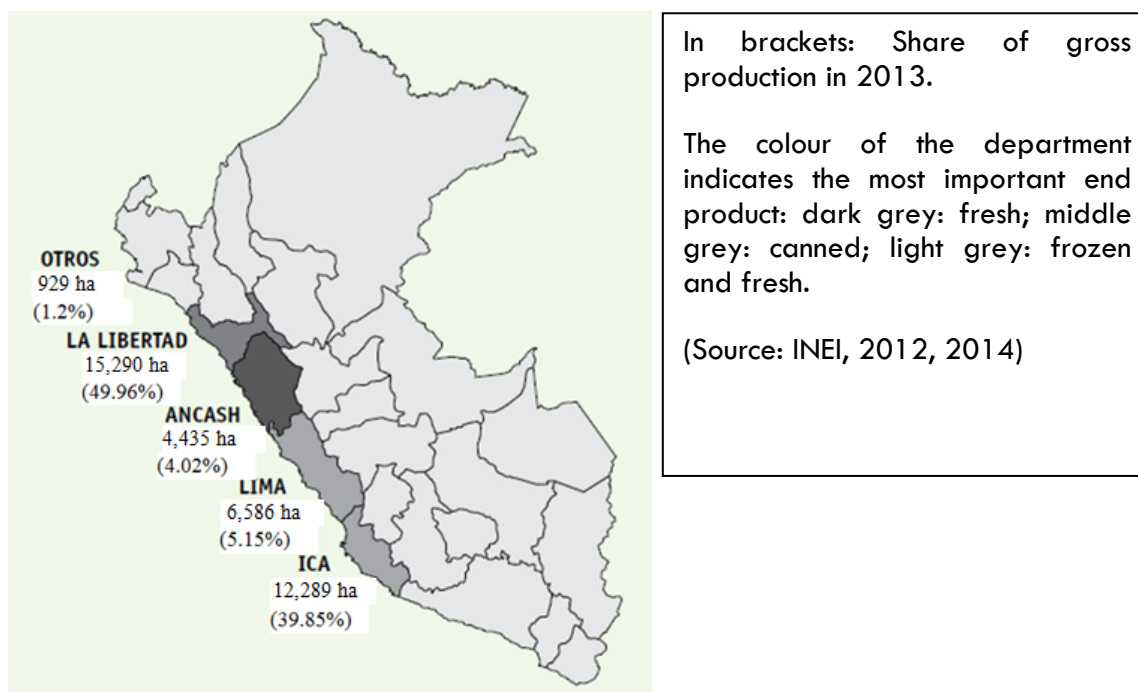
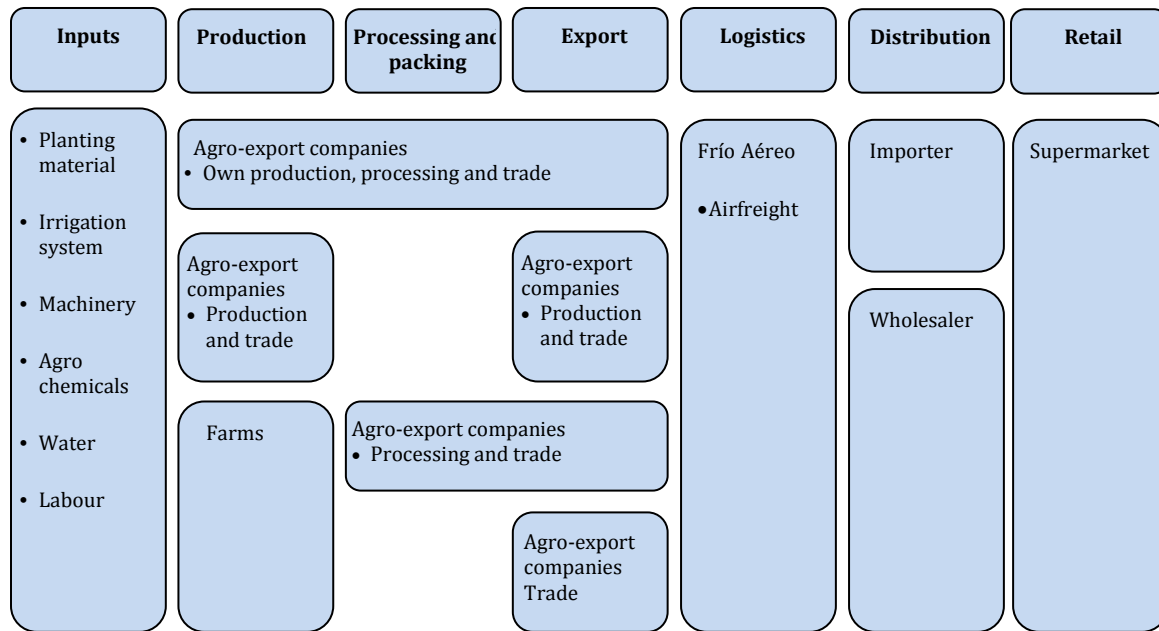




Figure 5 presents an overview on the Peruvian fresh asparagus supply chain. Production, processing and exports take place in Peru. Then, the produce is transported to its destination market. Despite the long distance between production and consumption of the product, the chain of Peruvian asparagus is highly integrated.

Figure 5: Chart of fresh asparagus chain originating in Peru and exported to Europe



(Own figure)

Production and export

According to the latest agricultural census of 2012 (INEI, 2012) there are nearly 3250 asparagus growing entities. The size of these production units varies between 1 and 1600 hectares. However, the largest share of producers grows asparagus on up to 50 hectares: Around 80 percent of the producers have up to 5 hectares of asparagus land, 10 percent cultivate between 6 and 10 hectares, around 6 percent between 11 and 50 hectares and 3 percent more than 50 hectares. There are four companies growing asparagus on more than 1000 hectares of land.

Producers can be divided regarding their role in the value chain: First, producers who sell their produce to an export company and second, agro-export companies who sell the asparagus to the overseas market. In Peru there are around 100 agro-export companies that can be further divided into four categories (as shown in Figure 4): 1) Export companies with own production and processing, 2) Export companies without own production but processing, 3) Export companies with production but without processing capacities, 4) Pure trading companies. These companies generally buy in additional volumes from external producers and rent in capacities for processing. (Schuster and Maertens, 2012)

Processing and packing

For fresh asparagus the processing stage involves cutting, washing, sorting and packing. After the harvest it is important that no more than 30 minutes pass until the arrival in the pack house in order to maintain a high quality of the produce. In the pack house the fresh asparagus is loaded, weighted, cut, washed and then sorted, graded and bunched à 0.5 kg. The bunches are then packed in cartons of 5-12 kg, palletized and loaded onto refrigerated trucks. These bring the produce either to the Jorge Chavez International Airport in Lima for airfreight (more than 80 percent of the produce) or to the harbour of Callao in the case of conveyance via ships (Días Rios, 2007).

Logistics: Transport and cooling

Practically all fresh asparagus is transported by plane to Europe as the product is easily perishable and needs to reach the overseas market in due time. 99 percent of the airfreight of green fresh asparagus is handled by an association called Frío Aéreo (OSITRAN, 2009) which is owned by 33 agro-export companies representing 80-90% of the industry (INDECOPI, 2011). Around 100 companies use the services of Frío Aéreo and per year, the logistics operator handles around 100,000 tonnes (Frío Aéreo, pers. comm., 2014). The company activities include quality inspection of the produce upon arrival, cold storage, containerizing, loading and dispatch of the produce. According to INDECOPI (2011), Frío Aéreo has substantially helped to increase the efficiency of the logistics chain of perishable products, reducing loading times from 4 hours in 1998 to 1.5 hours in 2005. For shipping the asparagus to its overseas destination, Frío Aéreo needs to work with a ramp operator such as Talma, Swissport or Globeground. In total there are around 17 airlines that transport the product to Europe and the US (Frío Aéreo, pers. comm., 2014). After arriving at its destination, the containers are stored in the airline warehouse for further transfer to the trader.

Distribution and retail

In 2008, Peruvian asparagus has been imported by 45 countries. Around 95% of the Peruvian exports are going to the US and the EU. In Belgium, three companies have imported fresh asparagus from Peru. Together, these companies imported nearly 42,000 boxes à 5kg. (Frío Aéreo, pers. comm., 2014)

In the supermarket chain considered in this analysis, the asparagus is flown to the Amsterdam Schiphol airport. An import company then bring the vegetables by truck to the village of Hoogstraten in Flanders, around 130 km away from Amsterdam. From there, the asparagus is transported by truck to the supermarkets central distribution centre in Halle, at around 100 road distance from Hoogstraten. The last supply chain step is the final distribution of the produce to the retailer stores across the country. (Pers. comm., 2014)

There are basically three different packaging options of fresh imported asparagus in the supermarket (Figure 6). First, asparagus can be packed in plastic trays and shrink wrapped (left picture). Second, the bunches can be put together with plastic strips (picture on the right). Sometimes, they are additionally wrapped into plastic or paper.



The fact that the asparagus has been produced in Peru is not used as a sales argument in marketing. However, on the label the origin of the product is indicated. But generally there are no further label specifications for differentiating Peruvian asparagus from asparagus originating in other countries.

Figure 6: Packaging and labels of fresh green asparagus



(Sources, from left to right: www.collectandgo.be; www.fruitlabel.de; www.portalfruticola.com)

3.2 Reasons for selecting the Peruvian global chain

The Peruvian asparagus supply chain has been selected as a GLAMUR case study for different reasons:

First, it represents an extremely global case regarding geographical distance: Production takes place in Peru, the endpoint of our analysis is a Flemish supermarket. Furthermore, production inputs such as fertilizers, certified seeds or irrigation systems and are mostly imported (OECD, 2007) and half of the workers on asparagus fields and processing plants are migrants from Peruvian regions other than the production region. Furthermore, virtually the whole production is exported to the US and the EU, making it a particularly interesting case study for GLAMUR.

Second, the chain provides a very interesting study of tensions and complementarities between local and global: The “global” product has led to a strong growth of the horticultural export sector in the production regions and provides a huge number of jobs. However, there are also many controversies around negative “local” impacts of asparagus production, especially regarding labour relations and water issues (see sections 3.3.2 and 3.3.3).

Third, asparagus as opposed to tropical fruits for instance, can also be produced in Europe. Thus it is possible to make comparisons of production methods and certain impacts of the Belgian and the Peruvian asparagus sector.

Regarding the four criteria for local/global distinction identified in earlier stages of GLAMUR, the Peruvian asparagus chain can be ranked as a very global case: First, the physical/geographical distance between input production, agricultural production and consumption is large as has been pointed out above. Only considering the linear distance between Lima and Brussels it amounts to nearly 10,000 km. Second, governance and

organizational issues are also quite global, as most of the governance is executed through the use of certifications and standards which are mainly imposed by European retailers (see section 3.3.4). Third, the kind of resources, knowledge and technologies employed in the production process are mostly global. As shown in the table below, most inputs are imported from outside the production region. Asparagus production takes place in the Peruvian coastal region only since the 80's and thus, the cultivation is not an inherent local practice. This also relates to the fourth criterion, the role of the territory in defining the identity of the product. The fact that the asparagus is being produced in Peru does not add any additional value or identity to the product.

The issues discussed above are shown graphically in Figure 7. Horizontally it shows the main steps of the global asparagus supply chain and vertically, the spatial scale of the activities and/or inputs used in this step are depicted. We start from the point of view of the production region which is considered being "local".

Figure 7: Food Supply Chain framework of the global asparagus supply chain

Spatial Scale	Production inputs	Agricultural Production	Transport	Processing Collection	Transport	Collection	Distribution	Retailing
Local (Production region)	Land Water	Around 3200 producers	From farms to agri-export companies Fuels	Packed in around 100 agri-export companies				
Regional (Peru)					Labour	To the airport	Airport	
Global (World)	Seeds (US) Machinery						Airfreight Energy, fuels, to a regional Belgian distribution centre	super-markets

(Own figure)

Local production inputs defined as inputs that come from the production region are land and water. The labour force needed on the fields often comes from other Peruvian regions and is thus considered a regional input. Global inputs are seeds and machinery coming from outside Peru, e.g. most seeds are of the variety UC157 coming from the US. Agricultural production takes place in different regions in Peru – mainly La Libertad, Lima and Ica - but is considered to be local in each location. After harvest, the asparagus is transported to agri-export companies located in the same regions. There it is processed and packed. Production, processing and collection all takes place in the Coastal Regions within Peru as explained above. The packed produce is then transported to the harbour of Callão close to Lima or to the airport from where it is send to the overseas market. The maximum distance between place of production and Callão/Lima is below 600 km and fresh asparagus is usually transported by airfreight to its destination country. From Callão/Lima, the fresh asparagus is exported to destination markets worldwide and thus, distribution is categorized as being global. After being imported to Belgium, the

asparagus is distributed to a distribution centre and then to the retail stores in different regions of the country.

3.3 Context of the case study and critical issues

3.3.1 Global-local issues in the chain and the role of the territory

As the whole supply chain is totally dependent on external demand, even local impacts can be linked to the 'globalness' of the chain. A review on the local-global debate and the perceived performance of the Peruvian food sector in general can be found in the WP2 National Report (Del Pozo-Vergnes, 2014). The global-local issues associated with Peruvian asparagus can be divided into discussions concerning the environmental, social and economic sustainability dimension of the supply chain; either having local impacts in the production region in Peru or global impacts such as CO₂ emissions due to transportation.

First, there are discussions around negative environmental impacts of asparagus production and exports. These debates can be further subdivided into those pointing out local and global impacts. Regarding local impacts, the overexploitation of scarce water resources in order to produce export crops under desert conditions has received much attention from NGO's (especially Hepworth et al., 2010) and the media (e.g. The guardian, 2010; PRI, 2012). This debate will be explained in more detail in section 3.3.2. Regarding global environmental impacts, there are debates around food miles, the carbon footprint and long distances that the product travels between the place of production and the final consumer, advocating more local consumption (e.g. Mail online, 2010). This general debate is not directly linked to the product but to the geographical spread of the supply chain. Around 85 percent of the asparagus is transported by airfreight to the overseas markets which leads to carbon emissions and thus, negatively effects the environment.

Second, debates around social issues are mainly linked to working conditions in the production and processing stages (e.g. Ferm, 2008, Fernández-Maldonado, 2010). On the one hand, the asparagus boom has generated huge employment opportunities in the coastal production areas. On the other hand, there are many accusations of labour right discriminations such as extremely low wages, long working hours and sudden dismissal of workers during 'seasonal recessions'; the latter two legally protected under the controversial Law 27360 (Promotion of the Agrarian Sector) which decreased labour rights protections in the agroindustry. This debate is described in section 3.3.3.

Third, there are issues related to the economic dimension of the asparagus supply chain. The absolute dependence of the whole chain on external demand makes it extremely vulnerable to external shocks. This is reinforced through the perishability of the fresh produce. Moreover, the role of private standards being imposed on upstream actors by stakeholders in the destination countries is an important issue regarding the global-local interactions of the asparagus supply chain. This is further discussed in section 3.3.4.

Related to the debate around food miles, the territory does not play a significant role in defining the product and as a marketing strategy as consumers might make rather negative associations with Peruvian asparagus. This is reinforced by the fact that in Belgium fresh asparagus is still considered a very 'local' and seasonal product and many consumers are not used to purchasing fresh asparagus all year round. Thus, the origin of Peruvian asparagus is displayed on the label but does not serve as a sales argument.

3.3.2 Water issues

A critical issue associated with the global asparagus supply chain is the discussion around the use of scarce water resources for the production of export crops. This is especially crucial bearing in mind that asparagus production takes place in the Peruvian coastal regions under desert conditions and that asparagus production consumes high amounts of irrigation water. For producing one kg of asparagus, around 1.3 m³ is needed, most of which is used in the growing and processing phases (Hepworth et al. 2010, Bartl et al. 2012). The issue of water scarcity related to the agro-export sector has also been pointed out in the GLAMUR WP2 report (Del Pozo-Vergnes, 2014).

The water related problems differ between the two largest production regions of Ica and La Libertad:

Irrigation water in Ica is mainly pumped from groundwater reserves as there are hardly surface water resources. As aquifer recharge is not happening at the same speed as the water is extracted, the water resources are constantly diminishing. Currently, the water table is decreasing by around 1 m per year and depending on the location the water table at some wells is up to 150 m below the surface (pers. comm., 2014). In order to slow down the overexploitation of the aquifer the National Water Authority (ANA – Autoridad Nacional del Agua) has prohibited the perforation of new wells and to deepen existing ones (ANA, 2011). The water stress in Ica has been the subject of critical NGO reports, blaming the asparagus export industry for being responsible for unsustainable water extractions (Hepworth et al., 2010). Moreover, water is available for very low prices: Surface water costs around 0.018 USD/ m³ and groundwater from wells costs on average 0.25 USD/ m³ (pers. comm., 2014). The water scarcity does not only have negative implications for the population of Ica, but also for the agro-export companies themselves, for which water is the limiting factor of production.

In La Libertad, a large irrigation project named Chavimochic has been implemented since the 1960s. It brings water from the Santa River to the coastal valleys and has thus been crucial for the transformation of deserts into agricultural lands. However, it is criticised that the project has mainly benefitted large export companies and not small farmers. Between 1994 and 2006 nearly 44,000 hectares of new land have been developed, of which nearly 38,000 hectares have been bought by 11 agro-industrial companies. Alone Camposol, the biggest export company has acquired more than 10,000 ha of land (Burneo, 2011).

3.3.3 Social issues – Labour relations

From a social and ethical perspective, issues related to working conditions and labour welfare in the asparagus chain are debated.

On the one hand, asparagus production and processing is very labour intensive and provides huge employment in the production regions. This has led to practically no unemployment in these areas and thus improved social equity. In 2011 it has been estimated that 50,000 jobs had been created in the asparagus sector along the Peruvian coast, of which 60% are women (Cannock, 2011). Workers in the agro industry are supposed to receive formal contracts giving them access to social security benefits. According to Cannock (2011) agricultural wages have increased by 31.5% between 2005 and 2008 and workers employed by exporting companies earn about 30% more than those working for companies serving the local market.

On the other hand, some stakeholders criticize that wages are still extremely low and often paid only on piece rates. Furthermore, employment is often temporary and workers do not have security of employment. Thus it is possible, that workers only get a job during the peak seasons and are unemployed for the rest of the year. Moreover, bad working conditions and labour right violations such as discrimination against union members, long working hours and dismissal of workers during ‘seasonal recessions’ have been criticised (e.g. USLEAP, 2013). The latter two are legally protected under the controversial Law 27360 (see chapter 3.3.5).

3.3.4 Role of standards and certifications

Around 95% of the Peruvian exports are going to the US and the EU (Annex E). These countries have very stringent quality and safety requirements for fresh produce that they import. Whereas public standards are set by public authorities and focus mainly on food safety and quality, private standards are set by private companies and non-public organizations and add environmental and ethical aspects. The Peruvian asparagus sector has adapted to these requirements and many companies have implemented private standards such as GLOBALG.A.P. and food safety and management systems, e.g. HACCP. This has increased the reliability and efficiency of the asparagus supply chain. (Schuster and Maertens, 2013)

Regarding public standards, the Asparagus National Technical Committee of Standardization (ANTCS) has been created in 1998 by the private and public sector together with INDECOPI (Instituto Nacional de Defensa de la Competencia y de la Protección de la Propiedad Intelectual, the main national institution responsible for standardization and accreditation) with the goal of developing food safety and quality standards in order to strengthen the reputation of Peruvian asparagus. These national technical standards (NTP) are harmonized with the Codex Alimentarius and include standards such as NTP 209.401:2001 on hygiene practices for fresh asparagus handling (Díaz Rios, 2007). A list with NTPs for fresh asparagus can be found in INDECOPI (2011:178). Furthermore, the Peruvian government has engaged in the improvement of

the Servicio Nacional de Sanidad Agraria (SENASA) which monitors compliance with food safety requirements and food standards.

3.3.5 Role of public policies and institutions

Public policies have played a prominent role in supporting the growth of the Peruvian asparagus sector. Since the 1990s fruit and vegetable exports have been promoted by the government in order to increase the competitiveness of the agro-export sector and thus, foster economic development. More specifically, institutions and policies have been created that facilitate access to land and water resources, enable foreign direct investment and provide cheap labour inputs.

An important law for increasing the competitiveness of the agro-export sector has been the national “Decree Law 22342” which exists since the 1970’s and which allows non-traditional export companies and farms to employ workers on short-term contracts for an indefinite number of times. This law also includes an “intermittent modality” which allows companies to grant their workers “temporary unpaid leave” in case of seasonal volatility of work load. The “Agricultural Sector Promotion Law 27360” establishes a special regime for agricultural workers and keeps costs for the companies low (see Schuster and Maertens, 2014): It has lowered the tax burden for agricultural companies and lowered contributions to the social security system (4% instead of 9% as in the general labour regime). However, Law 27360 has been heavily criticised because of decreased protection of labour rights in the agro-industry (e.g. by Ferm, 2008). For instance, workers in the agroindustry have only 15 days of annual vacation (compared to 30 days in the general labour regime), a daily minimum wage of 29.26 Soles/ day instead of 750 Soles/ month but which includes the severance pay and the Christmas and national holiday bonus, a compensation of arbitrary dismissal of 15 days’ pay per year worked (instead of 45 days) (Chacaltana, 2007, Schuster and Maertens, 2014). Initially, the Law was meant to be temporary but it has finally been extended until 2021.

Furthermore, the 1991 Foreign Investment Promotion Law that has been introduced under the Fujimori government led to the equal treatment of foreign and domestic investors and liberalized land markets. This has not only attracted foreign investment but also investors from other sectors such as mining that invested in the agro-food sector (Del Pozo-Vergnes, 2014).

Besides these laws, other collaborations and initiatives of the agro-industry and the state have influenced the asparagus value chain and helped to increase Peru’s comparative advantage. In 1998, the Peruvian Institute of Asparagus and Vegetables (IPEH) has been formed with the help of the Peruvian Export Promotion Commission PROMPEX. The members of IPEH are agro-export companies and account for roughly 80% of all asparagus exports. It is a very powerful organization and an important communication channel for local and foreign government agencies. For instance, PROMPEX and IPEH have played an important role in the creation of Frío Aéreo (see chapter 3.1).

At an international level, free trade agreements (FTAs) have provided the basis for the tremendous growth of the Peruvian asparagus sector. Especially FTAs with the US and the EU are of importance for the asparagus sector as these are the main export markets. In the early 1991 the Andean Trade Promotion and Drug Eradication Act (ATPDEA) came into force which granted Peruvian asparagus exports tariff-free access to the US market. Furthermore, a Free Trade Agreement (FTA) has been signed with the US in 2006. The EU-Peru FTA has been signed in January 2012 and will lead to the reduction of tariffs for fresh asparagus from 10.2% to 0%. Generally, tariffs have been reduced from 66% in July 1990 to 3.4% in 2011 due to unilateral reductions and FTAs (Cannock, 2011).

4 Research design

4.1 Research questions

In the GLAMUR project there are three overall research questions, applicable to all case studies:

- A.1) What are the key food chain performance issues with regards to a global-local comparison?
- A.2) What is the methodological strength and weakness of pairwise comparative analysis?
- A.3) What are the specific interactions of the food chains under study and the policy settings?

Research questions A.1 and A.3 have already been partially answered in the presentation of the critical issues in sections 2 and 3.

In addition to these overarching questions, we have developed specific research questions for the Belgian and Peruvian asparagus chains described above. These questions result from the main issues that have been identified in the quickscan, the research on case study contexts and earlier work packages of the GLAMUR project:

- B.1) What differences in **land and labour productivity** exist between local and global chains?
- B.2) How are the **labour conditions** in each chain?
- B.3) How does the chain contribute to the **economic development** of the region?
- B.4) What is the total **water use** of each chain per unit of asparagus? How does this compare to water availability in the region?
- B.5) How important are private **standards, certifications and labels** in the chains?

B.6) How are **costs and benefits** distributed among actors in the different stages of the chains?

4.2 Selection of attributes and their relation with the research questions

The above listed research questions can be linked to some of the attributes of food chain performance that have been identified for each of the GLAMUR partner countries within the scope of WP 2 and that have been synthesised by Kirwan et al. (2014). For the asparagus case studies, we are focusing on five attributes representing environmental, social and economic aspects related to local and global asparagus supply chains. Namely, these attributes are resource use, labour relations, contribution to economic development, creation and distribution of added value and governance. The attribute selection has been based on a literature review, discourse analysis and stakeholder interviews in Peru and Belgium. All attributes and research questions are closely linked to the critical issues described above: water issues, labour relations and the influence of standards and certifications on the functioning of the chain. The identification of these issues has been straightforward as these are the topics that are mostly debated by all stakeholders, especially in the Peruvian chain.

Following we list the selected attributes together with a definition from the WP2 synthesis report (Kirwan et al., 2014) in parenthesis and a brief explanation of their relevance for the global-local comparison and performance assessment of fresh asparagus supply chains. In some cases the issues identified above relate to more than only one attribute (e.g. the importance of standards and food labels belongs to the attribute 'governance' but also to 'food security'). In these cases, we have selected the attribute considered the most appropriate. However, linkages to other attributes are explained.

4.2.1 Resource use

"the use and management of the resources used to make food"

This attribute has been selected due to its relevance mainly for the Peruvian asparagus sector which relies heavily on scarce water resources. This leads to many debates between local stakeholders, the civil society and government agencies around the sustainability of producing an export product in a desert region. Moreover, the use of land and labour also fits into the definition of this attribute. Land resources are especially scarce in the Flemish case and thus, an efficient use of land is extremely important. Differences in climate and production methods lead to differences in the ecological efficiency of asparagus production in the two countries and thus it is interesting to assess and compare the overall efficiency of resource use of local and global chains, including economic and ecological aspects. Thus, the resource use attribute is closely linked to the efficiency attribute defined as "a relative, measurable, quantitative ratio between inputs and outputs".

4.2.2 Labour relations

“worker-related social issues”

In both countries under study many migrant workers are employed for asparagus production, often earning low wages and sometimes experiencing bad working conditions. Especially in Peru, labour laws are weak and labour relations in asparagus production are highly debated, especially in the countries of consumption as has been outlined in section 3.3.3. Thus, questions about the difference in labour relations between local and global asparagus production arise. For this reason the attribute ‘labour relations’ has been chosen for assessing the performance of local and global asparagus chains.

4.2.3 Contribution to economic development

“the contribution that food supply chains can make to economic development at a national, regional and local level”

Contribution to economic development is an important attribute when comparing local and global asparagus chains. Whereas asparagus production in Flanders has a very limited impact on regional economic development due to the small size of the sector, the Peruvian sector has led to tremendous export growth and thus benefited the economy at a national and regional level. This attribute is especially important when thinking about possible positive development effects of a global food supply chain: The consumption of imported products can have positive impacts on the economic development overseas. At the same time, consumers might prefer the consumption of local products in order to support their local farmers. Thus, this attribute has been selected by the research team

4.2.4 Creation and distribution of added value

“how value is created and how it is distributed within the food value chain”

The creation and distribution of added value in the three asparagus chains provides an interesting analysis of supply chain performance due to the different number of actors in the local and global chain and due to differences in size and economic importance of the Flemish and the Peruvian asparagus sector. Thus, this attribute has been selected in order to assess differences between the distribution of added value in a supply chain originating in a developing country and a chain from a European country.

4.2.5 Governance

“regulation and governance structure”, “power and democracy”

In the asparagus case, the attribute ‘governance’ relates especially to the impact of private standards, certifications and labels in governing the global chains. In both, the Peruvian and Flemish supermarket chain the importance of adherence to standards is important for getting market access and has been identified as a critical issue based on

stakeholder interviews and literature review. The increasing importance of standards and certifications implies a shift of power away from producers to downstream stakeholders in the chain. The issue of standards and certifications is also related to the attribute 'food safety' which includes the "attempts to guarantee the safety of food products", "the rules, regulations and standards that producers, processors and other food chain actors must follow to reduce health risks associated with food". Another attribute related to standards and labels is 'traceability', defined as "ensuring the safety of the food supply chain and protecting people and the environment from harm". In the food chains under consideration it is tried to increase traceability through the use of standards and certifications. Thus, this is an important issue regarding the performance of both chains.

4.3 Selection and description of performance indicators

Based on the attributes and the related research questions mentioned above we have defined a set of indicators that will ultimately be used to assess and compare the performance of the different asparagus supply chains. Most indicators have been adapted from the indicators elaborated in the SAFA Guidelines (FAO, 2013a and FAO, 2013b). These guidelines provide a holistic framework for the sustainability assessment of food and agricultural supply chains. Within the SAFA framework, a set of 118 indicators related to four broad dimensions of sustainability (good governance, environmental integrity, economic resilience, social wellbeing) has been developed. These four broad dimensions are subdivided into 4-6- universal themes per dimension and furthermore detailed into sub-themes with associated sustainability objectives. For example, in the dimension "Social wellbeing", one theme is called "decent livelihood" and the sub-theme "quality of life". One of the indicators representing this sub-theme is the wage level of employees. For selection the indicators for GLAMUR we have compared our set of performance attributes listed in the previous section with the SAFA themes and sub-themes and assessed the suggested indicators against their suitability for our case studies.

Moreover, a large set of descriptive indicators has been compiled, based on the grid of potential indicators circulated by the GLAMUR WP leaders. These descriptors have been used to sustain the context description of the supply chains. In Annex G a list of descriptors of the Peruvian asparagus chain is provided.

In Table 2 we summarize the final set of performance indicators that we use for assessing and comparing the performances of the Flemish and the Peruvian asparagus supply chains. The indicators are listed according to the performance attribute they correspond to. A more detailed definition of each indicator is given in Table 4.

Table 2: Final set of performance indicators, related attributes, research questions and data collection methods

Dimension	Attribute	Used indicators	Research questions	Data collection methods
Environmental/ Economic	Resource use	<ul style="list-style-type: none"> • Land productivity • Labour productivity • Water use efficiency • Water withdrawal 	B1, B4	<ul style="list-style-type: none"> • Desk based research • Interviews with Flemish farmers • Stakeholder interviews in Peru
Economic	Contribution to economic development	<ul style="list-style-type: none"> • Regional hiring • Regional employment generated 	B3	<ul style="list-style-type: none"> • Desk-based research • National statistics • Interviews with Flemish farmers • Worker survey in Peru (Schuster and Maertens, 2013/2014)
Economic/ Social	Creation and distribution of added value	<ul style="list-style-type: none"> • Profit distribution 	B6	<ul style="list-style-type: none"> • Desk-based research • Company statements
Economic/ Social	Governance	<ul style="list-style-type: none"> • Labels/ certifications 	B5	<ul style="list-style-type: none"> • Research within the division on certifications in Peru (Schuster and Maertens, 2013)
Social/ Ethical	Labour relations	<ul style="list-style-type: none"> • Wage level • Collective bargaining and association • Work contracts • Wage payment • Working hours • Decent working conditions 	B2	<ul style="list-style-type: none"> • Stakeholder interviews in Flanders • Interviews with Flemish farmers • Worker survey in Peru (Schuster and Maertens, 2013/2014)

4.4 Data quality check

The quality of the data used for constructing the indicators has been checked using the Pedigree matrix approach from Lewandowska (2004) as explained in the GLAMUR WP3 case study guidelines. With this approach, an indicator quality score is calculated for each indicator by assessing five criteria: (i) reliability of the source, (ii) completeness of the data, (iii) temporal correlation between data observation and the period under study, (iv) geographical correlation between data observation and the area under study, (v) further technological correlation between the data and the processes under study. For each criterion a score between 0 (best case) and 0.8 (worst case) is given based on a comparison of the data under study and a general data quality description provided in the matrix. The overall indicator score is then built by summing up the individual scores for each criterion. Thus, the best score that can be achieved is 0 if an indicator achieves a score of 0 for each criterion. The worst possible indicator score is 4.

According to the Pedigree matrix the data collected for both chains is of overall good quality with an average score of 0.83 for Belgium and 0.89 for the data on the Peruvian asparagus supply chain. More details on the indicator quality and the scores for each criterion are provided in Annex H.

5 Methods of data collection

In the following table we list the methods of data collection that have been employed for gathering qualitative as well as quantitative data in Peru and Belgium. Basically, we have used four methods of data collection.

First, **qualitative unstructured interviews** with key respondents and stakeholders involved in the Peruvian or the Belgian asparagus supply chain. These interviews have not followed a predetermined structure but have been used to get a better understanding of the asparagus sector, the functioning of the supply chains and to identify the critical issues. In Peru, eight asparagus producers – ranging from a cooperative of small scale farmers over medium sized companies to the biggest agro-export company Camposol – have been visited and interviewed. Moreover, different water use organizations (*Juntas de Usuarios de Agua*), the National Water Authority (ANA) and the Chavimochic project – a huge irrigation project along the Peruvian coast covering more than 140,000ha - have been visited in order to discuss water related issues such as the overexploitation and distribution of water resources in the agricultural sector. Moreover, government officials and researchers have been interviewed regarding critical issues of the asparagus supply chain. Furthermore, different NGO's that support farm workers in the agro-export industry and smallholders have been visited. Representatives of a big Belgian retailer have been met to discuss their asparagus supply chain configuration. In Belgium, field visits have been paid to asparagus farmers and BelOrta – Europe's largest co-operative auction and the most important auction for Flemish asparagus. Moreover, we have interviewed a representative of the Flemish farmer's association responsible for vegetable growers. Interviews and farm visits in Peru took place between February and April 2014. In Belgium, interviews were conducted between May and October 2014.

Second, **quantitative data** has been collected from different sources. This has often been done together with the qualitative interviews. The quantitative data includes the quantities of inputs used in the production process, prices, time series of cultivated areas, etc. In addition to the stakeholders mentioned above, the Peruvian and Belgian national statistics offices have provided quantitative data as well as Frío Aereo, the logistics provider responsible for the airfreight of Peruvian asparagus to Europe.

Third, we use data collected through **surveys**. In Peru, 95 asparagus exporting companies have been surveyed by Schuster and Maertens (2015) between July and September 2011. The questionnaires included recall questions on certification to private food standards, on ownership and management structure, on processing and production procedures, and on sourcing and marketing strategies. Moreover, two rounds of a survey among young workers in the horticultural agro-export industry in the regions of Ica and La Libertad have been carried out in August/ September 2013, and in February/March 2014 (Schuster and Maertens, 2013/2014). In that survey, questions have been asked on the workers' socio-demographic background, economic and employment situation, health, education, overall wellbeing, and employment and working conditions between August 2013 and February 2014. In the first round, 592 workers have been surveyed. In the second round, 528 workers of the original sample could be re-surveyed and 85

additional workers have been surveyed only in 2014. In Belgium, a small survey of three asparagus farms has been carried out in September/October 2014 in order to gather information on asparagus production practices, resource use, labour relations, prices and other supply chain characteristics. The farms are all situated in the Flemish region of Limburg, the main asparagus production region in Belgium.

Furthermore, information has been collected from a **literature and document review** and from publicly available trade and agricultural production databases. There are some previous studies on the Peruvian asparagus sector, mostly focusing on the production and processing stage. There is hardly any literature on the Belgian asparagus sector due to its limited economic importance.

Table 3: Methods of data collection in the two case study countries

Data Collection Method	Target Respondents/ Information Source	
	Peru	Belgium
Qualitative unstructured interviews	<ul style="list-style-type: none"> ▪ Export companies ▪ Small farmers ▪ Transport company ▪ Government officials ▪ Civil Society ▪ Academia ▪ Retail company ▪ National Water Authority (ANA) 	<ul style="list-style-type: none"> ▪ Farmers ▪ Auction representative ▪ Farmer's association ▪ Retail company
Collection of quantitative data from key respondents and secondary sources	<ul style="list-style-type: none"> ▪ Government agencies ▪ Export companies ▪ Transport company ▪ National Statistics Office (INEI) ▪ Regional Agrarian Offices ▪ National Water Authority (ANA) 	<ul style="list-style-type: none"> ▪ Big retailer ▪ Auction representatives ▪ Belgian statistics office
Surveys	<ul style="list-style-type: none"> ▪ Two survey rounds of nearly 600 workers each in the agro-industry in August/September 2013 and March/April 2014 (Schuster and Maertens, 2013/2014) ▪ Survey of 95 asparagus agro-export companies in 2011 (Schuster and Maertens, 2015) 	<ul style="list-style-type: none"> ▪ Survey of three asparagus farmers in the province of Limburg in September/October 2014



Literature and Document Review	<ul style="list-style-type: none">▪ Scientific studies▪ Reports▪ Sustainability reports of companies	<ul style="list-style-type: none">▪ Scientific studies▪ Reports from retail groups
General quantitative data	<ul style="list-style-type: none">▪ FAOstat	

6 Results

6.1 Performance indicators for the local and global chain

The main result of our research – a list of food chain performance indicators - is summarized in Table 4. Following the table we briefly explain the underlying data and the steps for calculating each indicator. Moreover, we depict the method of benchmark definition and calculation below the table. It is very important to take into account the case study context information when interpreting and comparing the indicator values.

In the subsections that are following we discuss and compare the indicator values of the local and global asparagus supply chain for each performance attribute. The local chain is the Belgian supermarket chain and the global chain the one originating in Peru.

Table 4: Performance indicators for Peru and Belgium

INDICATORS							Benchmark			Data quality class	
#	Indicator name	Main attribute	Definition	Unit	Value Peru	Value Belgium	Definition	Value (low)	Value (good)	DQD' A	DQD' B
1	Land productivity (physical)	Resource use	yield/acreage	t/ ha	11.37	8.67	lowest and highest yield worldwide	0.5 (Finland)	22.9 (Iran)	1.2	0.4
2	Land productivity (economic)	Resource use	(yield*farm gate price)/ acreage	EUR/ ha	9,398	17,668	-----	0	n.a.	1.2	0.4
3	Labour productivity (physical)	Resource use	yield/farm worker	t/ worker	7.30	6.19	-----	0	n.a.	2.2	0.6
4	Labour productivity (economic)	Resource use	(yield*farm gate price)/ farm worker	EUR/ worker	6,025	11,316	-----	0	n.a.	2.2	0.6
5	Water use efficiency (per ton)	Resource use	consumptive water use through evapotranspiration (water footprint) per ton	m ³ / t	1,137	889	lowest and highest asparagus WF worldwide	511 (Poland)	3,583 (Canada)	1.4	1.4
6	Water use efficiency (per ha)	Resource use	consumptive water use through evapotranspiration (water footprint) per ha	m ³ / ha	12,928	7,707	-----	-----	-----	1.4	1.4
7	Water withdrawal	Resource use	% of water used of asparagus sector (blue water	%	1.49	0.12	-----	0	100	1.4	1.4



			footprint)/ total agricultural water withdrawal								
8	Wage level	Labour relations	Workers wage level/local living wage	share	1.91	0.88	-----	0	>1	0	0.8
9	Wage payment	Labour relations	% workers who receive at least minimum wage	%	77	99	-----	0	100	0	n.a.
10	Collective bargaining and association	Labour relations	% of workers being member of a labour union	%	<5	<5	-----	0	100	1.6	1
11	Work contract	Labour relations	% of workers having signed a legally binding work contract	%	68	99	-----	0	100	0	n.a.
12	Working hours	Labour relations	% of workers whose working hours are compliant with national laws	%	77	99	-----	0	100	0	0.8
13	Decent working conditions	Labour relations	% of workforce with access to clean sanitary facilities and drinking water	%			-----	-----	-----		n.a.
			a) Drinking water	%	79		-----	0	100	0	n.a.
			b) Toilet	%	94		-----	0	100	0	n.a.
			c) Shower	%	64		-----	0	100	0	n.a.
14	Regional hiring	Contribution to economic development	% of migrant workers (i.e. not from same region)	%	48	99	-----	100	0	0	1.4
15	Regional employment generated	Contribution to economic development	number of field workers (in 2012)	number	51,578	420	-----	0	n.a.	2.2	1.2
16	Profit distribution	Creation and distribution of added value	price_farm/price_supermarket	%	6.23	23.61	-----	0	100	0.4	0.4
17	Labels/Certification	Governance	% of producers/export companies being certified, having a label	%	38	99	-----	0	100	0	0.6

¹ DQD: Data Quality Distance according to the Pedigree matrix (Annex H)

Land productivity (physical)

FAO (2014) provides worldwide yearly yield data by crop and by country (t/ha). Thus, this indicator was directly taken for asparagus yields in Peru and Belgium. The latest data is available for the year 2012. As a benchmark for this indicator we use the lowest and highest yield of asparagus worldwide. These happen in Finland (0.5 t/ha) and in Iran (22.9 t/ha). However, the value reported for Iran is extremely high and according to the FAO (2014) data Peru has the third highest asparagus yield in the world. Belgium follows on the fourth place.

Land productivity (economic)

The gross economic land productivity (EUR/ha) in 2012 has been estimated by multiplying the quantity produced (FAO, 2014) with the farm price (FAO, 2014) and then dividing the product by the acreage used for production (FAO, 2014 for Peru and Belgian Statistics Office, 2014 for Belgium). Thus, the costs involved in asparagus production are not considered here. The farm price provided by FAO in USD/t has been converted to EUR/t using the average exchange rate of 2012². This yields:

Belgium: $(2,600 \text{ t} * 1,828 \text{ EUR/t}) / 269 \text{ ha} = 17,668 \text{ EUR/ha}$

Peru: $(376,645 \text{ t} * 825 \text{ EUR/t}) / 33,063 \text{ ha} = 9,398 \text{ EUR/ha}$

The low bound benchmark for this indicator is 0 as we are only considering gross returns which cannot be smaller than zero. There is no upper benchmark as in theory the economic land productivity might be infinitely high.

Labour productivity (physical)

Labour productivity is defined as the output produced (in tonnes) per worker. Production data per country has been taken from FAO (2014) for the year 2012 (see Annex C for time series data).

For the case of Belgium, the total number of field workers has been estimated by multiplying the average number of workers per ha (1.56, based on farm interviews) with the total ha of asparagus production in Belgium in 2012 (269 ha, see Annex A). This gives us a number of 420 farm workers in the asparagus sector in 2012. The number of field workers in the whole sector in Peru has been estimated by multiplying the average number of workers per ha (1.56, assuming the same number of workers per ha as in Belgium, this figure is coherent with information from Danper (n.d.)) with the total hectare of asparagus production (FAO, 2014). This estimate only includes unskilled agricultural workers in the asparagus industry. By dividing production (FAO, 2014) by the total number of workers,

² <http://www.oanda.com/currency/average>

we receive the productivity per worker in 2012: 6.19 tonnes/worker in Belgium and 7.30 tonnes/worker in Peru.

Belgium: $1.56 \text{ workers/ha} * 269 \text{ ha} = 420 \text{ field workers}$
 $2,600 \text{ tonnes} / 420 \text{ workers} = 6.19 \text{ tonnes/worker}$

Peru: $1.56 \text{ workers/ha} * 33,063 \text{ ha} = 51,578 \text{ field workers}$
 $376,645 \text{ tonnes} / 51,578 \text{ workers} = 7.30 \text{ tonnes/worker}$

As we do not have data for this indicator for different countries, we set the lower benchmark at 0 which would indicate no production per worker. There is no upper benchmark as the higher the yield per worker, the better.

Labour productivity (economic)

The economic labour productivity in 2012 has been estimated by multiplying the total yearly production with the farm gate price (both data obtained from FAO, 2014) and then dividing the product by the number of field workers.

Belgium: $(2,600 * 1,828 \text{ EUR/t}) / 420 \text{ workers} = 11,316 \text{ EUR/worker}$

Peru: $(376,645 * 825 \text{ EUR/t}) / 51,578 \text{ workers} = 6,025 \text{ EUR/worker}$

As with the indicators above, the lower benchmark of this indicator is 0 which would mean no economic gains per worker. This is based on the assumption that there are no losses involved in asparagus production. There is no upper benchmark as the higher the value the better.

Water use efficiency (per tonne and per ha)

Mekonnen and Hoekstra (2010) have estimated the average national and subnational water requirements of a number of different crops and countries. Their estimates include all the water a plant needs for evapotranspiration and is calculated on a 5 arc minutes spatial scale. We take the average national water consumption of asparagus produced in Belgium and Peru. The water use efficiency per ha is obtained by multiplying the efficiency per tonne with the yield per ha.

Belgium: $889 \text{ m}^3/\text{tonne}$
 $889 \text{ m}^3/\text{tonne} * 8.67 \text{ tonnes/ha} = 7,707 \text{ m}^3/\text{ha}$

Peru: $1,137 \text{ m}^3/\text{tonne}$
 $1,137 \text{ m}^3/\text{tonne} * 11.37 \text{ tonnes/ha} = 12,928 \text{ m}^3/\text{ha}$

The benchmarks have been set as follows: For the water use efficiency per tonne, we use the lowest and highest national water consumption for asparagus production as calculated by Mekonnen and Hoekstra (2010). In Poland only 511 m³/tonne are consumed whereas the highest volume of water is consumed for asparagus production in Canada (3,583 m³/tonne). Unfortunately, we do not have a benchmark for asparagus production per ha.

Water withdrawal

The water withdrawal has been calculated by multiplying the total asparagus production of 2012 with the average blue water footprint (i.e. the consumption of surface water) (Mekonnen and Hoekstra, 2012). This volume is then divided by the yearly water withdrawal of the national agricultural sector (AQUASTAT, 2014). For Belgium, the latest information is provided for the year 2007 and the volume of water withdrawn by the agricultural sector amounted to 0.037*10⁹m³/year. In Peru, the latest data is for the year 2008 and the volume of water withdrawn amounts to 12.12*10⁹m³/year.

Belgium: $(2,600t * 17.16m^3/t) / (0.037 * 10^9m^3) = 0.0012$ (0.12%)

Peru: $(376,645t * 478.48 m^3/t) / (12.12 * 10^9m^3) = 0.0149$ (1.49%)

As this indicator is a percentage value, the benchmarks are set at 0% and 100% respectively.

Wage level

For Belgium, we assume that the wage level for agricultural workers is compliant with the national minimum wage of 851 EUR/month as we do not have accurate data for this indicator. The data in Peru has been collected by conducting two rounds of a workers survey in August/September 2013 and March/April 2014 (Schuster and Maertens, 2013/2014). The average monthly wage received by the workers in our sample in Peru is 240 EUR.

We divide these values by the respective local living wage for one person in Peru and Belgium as estimated by wageindicator.org for the year 2014. We take the upper bound estimate of the living wage which is defined as “the monthly net wage needed [to] afford a decent standard of living for the individual worker” in the most expensive part of the country. This is done as the coastal region in Peru is among the most expensive areas in Peru. The living wage includes “cost of food based on local consumption patter[n]s, a monthly rental of an apartment in a non-central area, transportation costs and 10% allowance for other costs (clothing, medical care, education, culture...)”.

Belgium: 851 EUR/month / 970 EUR/month=0.88

Peru: 240 EUR/month / 126 EUR/month=1.91

The lower hypothetical benchmark for this indicator is 0 which would either mean that the monthly wage is practically zero or that the living wage is infinitely large. We have set

the upper benchmark at one which would indicate that the monthly wage covers exactly the living cost. Every value larger than one is thus beneficial for the worker.

However, when looking at these figures one has to keep in mind that employment in the asparagus sector is not provided all year round and that especially in Peru, employment contracts are very unstable. On average, workers in the Peruvian agro-industry are only employed for 7.4 month/year (Schuster and Maertens, 2013/2014). Thus, although the monthly average wage might cover the living wage, workers might not work during the whole month and be unemployed outside the main production season. Thus, when assessing and comparing these figures one must be extremely cautious.

Wage payment

For wage payment (i.e. the percentage of workers that receive at least the minimum wage) in Belgium, we assume that practically all workers are paid the minimum wage. Data for Peru come from the survey of Schuster and Maertens (2013/2014). Thus, the value of this indicator is 99% for the Flemish asparagus chain and 77% for Peru.

The low and upper benchmark of this percentage values are 0% and 100%, respectively.

Collective bargaining

The number of organized workers is very low in both countries and no reliable quantitative information could be obtained for this indicator in both cases. Thus we assume that less than 5 percent of the workers are organized in each country.

The indicator is expressed as a percentage and thus, the benchmarks are set at 0% and 100%.

Work contracts

For Belgium we assume that all farmers comply with the law and thus, all workers have a work contract. Information from Peru comes from the worker's survey of Schuster and Maertens (2013/2014). Thus, the indicator value for the local chain is 99% and for the global chain 68%.

The lower and upper benchmarks of this indicator are 0% and 100%, respectively.

Working hours

For Belgium we assume that practically all farmers comply with the law and thus, agricultural workers work 9 hours/day and 50 hours/week during the asparagus season. The value for the indicator is set at 99%. Information from Peru comes from Schuster and Maertens (2013/2014) and includes the average actual working hours of field and processing plant workers in the agro-industry compared to the generally allowed 8 hours/day. This has been 77% in our sample.

The benchmarks of this indicator are set at 0% and 100%.

Decent working conditions

No detailed data about working conditions in the Belgian asparagus sector are available. Data for Peru comes from Schuster and Maertens (2013/2014). The indicator is subdivided into three subcategories indicating the percentage of the workforce at the field and processing level with access to (a) clean drinking water, (b) toilet and (c) shower facilities.

Benchmarks for all indicators representing decent working conditions are 0% and 100%, indicating the worst and the best case scenario, respectively.

Regional hiring

This indicator measures the share of migrant workers in the asparagus sector. For Belgium, the share of migrant workers on asparagus fields has been estimated being nearly 100% by a representative of the farmers union. Migrants in this case are defined as people not having their permanent residence in Belgium. For Peru, migrants are defined as coming from a department other than the asparagus producing department (i.e. Ica or La Libertad) and the information comes from Schuster and Maertens (2013/2014).

In contrast to the other indicators that are expressed as percentages we have set 100% as the lower benchmark indicating a negative contribution to regional economic development. On the other hand, a value of this indicator of 0% would mean that all workers are from the same region which would be positive for economic development of the region. Thus, 0% is set as the upper benchmark.

Regional employment generated

This is the full-time equivalent of people working on the field which has been estimated for Belgium by taking the average number of workers per hectare (1.56 obtained from the farm interviews) and multiplying it with the total hectares of asparagus in Belgium in 2012 (FAO, 2014). The same steps have been followed for estimating the number of asparagus field workers in Peru:

Belgium: $1.56 \text{ workers/ha} * 269 \text{ ha} = 420 \text{ workers}$

Peru: $1.56 \text{ workers/ha} * 33,063 \text{ ha} = 51,578 \text{ workers}$

For this indicator zero, i.e. no regional employment generation is set as the lower benchmark. There is no upper benchmark as the higher the number of jobs created, the better for the region.

Profit distribution

The farm gate price relative to the final price of the product in the supermarket has been taken as a proxy for profit distribution. Average yearly producer prices for different products are provided by FAO (2014) and the most recent available prices for asparagus are for the year 2012. For the supermarket price we use for Peru the average price received per kg over the past 24 months for asparagus, i.e. from December 2012 until November 2014. Specifically, we have received prices for a 200g box of green asparagus tips (3.84 EUR) and for a bunch of white asparagus (3.72 EUR) from a Belgian retail company. The unweighted average price per kg is thus $(5 \cdot 3.84 + 2 \cdot 3.72) / 2 = 13.32 \text{ EUR/kg}$. For Belgian white asparagus, the average prices received for a box of 500g of fresh white asparagus during the season (April until June) has been 4.425 EUR in 2013. In 2014 this was much lower, only 3.328 EUR/box. The average per kg is thus 7.75 EUR/kg.

Belgium: $(1.83 / 7.75) \cdot 100 = 23.61\%$

Peru: $(0.83 / 13.32) \cdot 100 = 6.23\%$

Thus, in Belgium, asparagus producers receive nearly 24% of the final price that is paid by consumers in the supermarket. On the other hand, Peruvian producers only receive around 6% of the supermarket price.

As lower and upper benchmarks for this indicator we set 0% and 100% respectively. However, both values would represent an extremely unequal profit distribution. However, the higher the percentage value of this indicator, the higher the share of the final price the farmer receives.

Labels/certifications

The percentage of companies that have at least one certification has been estimated by Schuster and Maertens (2013) for Peruvian agro-export companies. This has been 38% of the companies in the year 2011. For Belgium we assume a higher percentage as all farmers being member of the BelOrta auction (i.e. most asparagus farmers) have to be GLOBAL.G.A.P. and Flandria certified. For this reason, the auction has a group certification covering the asparagus producers.

The benchmarks of this indicator are set at 0% and 100%.

In the following subsections we compare the indicator values of the local and global asparagus supply chain for each food chain performance attribute.

6.2 Resource use

The attribute resource use is represented by seven indicators. It becomes clear that when comparing land and labour productivity, the Flemish supply chain performs better when considering economic productivity whereas the Peruvian chain performs better regarding

the ratio physical output/input. For instance, asparagus yield in Peru has been 11.37 tonnes/ha in 2012, compared to 8.67 tonnes/ha in Belgium. As stated above in Peru, up to two harvests are possible per year which increases land productivity. However, when considering the price received per unit of land and labour input, the Flemish chain performs better. This is due to a much higher price received by Belgian farmers compared to their Peruvian counterparts: Whereas the average price received per tonne is 1,828 EUR in Belgium, this is only 825 EUR in Peru, i.e. less than half the price. Thus, the high physical productivity in Peru cannot compensate for the relatively low price received for asparagus. Not surprisingly, asparagus production in Peru requires much more water than production in Belgium. This is mainly due to differences in climate as in Peru, asparagus production takes place in desert areas with practically zero rainfall. Moreover, these differences might to a lesser extent also be due to different varieties. The difference in consumptive water use per tonne of asparagus amounts to nearly 250 m³ between the two countries. The last indicator belonging to the attribute resource use compares the irrigation water use for asparagus production to the total water used by the agricultural sector. In Peru, this amounts to 1.49% whereas in Belgium this only represents 0.12%. Thus, this percentage is more than twelve times higher in Peru due to the higher importance of asparagus production for the agricultural sector.

6.3 Labour relations

Regarding labour relations in asparagus production we can compare the performance of the local and global asparagus chains based on five indicators. In most cases, the Belgian chain performs better, e.g. regarding the payment of the minimum wage, providing legal work contracts and the compliance of working hours with national standards. However it is important to keep in mind that the indicator values for Belgium are based on assumptions as no detailed data is available on labour relations. When comparing the wage level of asparagus field workers to the local minimum wage, the Peruvian chain performs better: The wage worker's receive is nearly twice as high as the local living wage whereas in Belgium, the minimum wage is below the local wage. But it is very important to consider that in Peru, employment in the horticultural export sector is very unstable and workers generally do not work all year round. Thus, although on a monthly basis the wage in Peru might be higher than the local living wage, it might be lower when considering the yearly wage. Moreover, the local living wage we have used for our calculations only considers the money needed by an individual person. More money is needed if a worker has to sustain a family. We also see that in Peru, only 77% of the workers in our sample receive the minimum wage whereas we assume that nearly all workers in the Flemish asparagus chain are paid the minimum wage. In the case in Peru it is, however, questionable whether the national minimum wage covers the workers' basic needs. For instance, Schuster and Maertens (2014) find that 28 percent of the sampled households fall below the regional poverty line of 335 Soles/ person/ month when taking into account the average number of employed people per household and the household size.

In both chains, the percentage of workers who are members of a labour union is extremely low. This is mainly due to the fact that there are hardly permanent workers in asparagus production which makes it difficult to organize.

6.4 Contribution to economic development

Two indicators are related to the attribute contribution to economic development. First, the share of migrant workers in the asparagus sector. In Belgium, nearly all workers come from other countries. In Peru, nearly half of the workers come from outside the production regions and migrate to the coastal areas in order to work in the horticultural sector. We estimate that in Peru, around 51,500 workers have been employed for working on asparagus fields in 2012. Thus, the sector provides a huge number of jobs and contributes to the economic development of the production regions. Compared to this number, the employment impact of the Flemish asparagus sector is very small, generating an estimated 420 jobs a year. These figures illustrate the huge difference in the size of the Peruvian and the Belgian asparagus sector.

6.5 Creation and distribution of added value

As a proxy for assessing the creation and distribution of added value we have calculated an indicator called profit distribution. It measures the percentage share of the price the farmer receives compared to the price the consumer pays in the supermarket. Thus, on average a Peruvian farmer only receives around 6% of the price the consumer pays whereas a Belgian farmer receives nearly 24%. Thus, although the supermarket price of Peruvian asparagus is higher than the price of Belgian asparagus (13.32 EUR/kg vs. 7.75 EUR/kg), Peruvian farmers receive much less than their Belgian counterparts. There are many possible reasons for these differences. First, Peruvian asparagus is mainly of the green variety and Belgian asparagus is mostly white. This can lead to price differences. Second, Peruvian producers might sell their produce in much higher quantities than Belgian farmers, leading to a lower price per unit. Third, the global Peruvian asparagus supply chain involves more stakeholders than the local chain and thus, the final price of sale needs to be shared between more actors.

6.6 Governance

The attribute governance is represented by only one indicator: The percentage of producers or export companies that are certified or have a food label. In the Flemish chain, all asparagus producers are members of the cooperative auction which has a GLOBALG.A.P. group certificate for its members. Thus, all producers need to comply with the regulations. Furthermore, the auction requires compliance with Flandria standards. In Peru, nearly 40 percent of the agro-export companies comply with at least one certification scheme. This percentage is thus much lower in Peru than in the local chain.

7 Discussion and conclusion

In this report we have described asparagus supply chains from Belgian and Peru and their respective contexts. Furthermore, we have depicted the way of constructing performance indicators related to supply chain attributes that have been developed in earlier stages of this research. These findings will be compared at a later state of the GLAMUR project (WP4). However, we can already discuss some preliminary findings regarding the local-global comparison, and the methodology applied for defining and calculating the supply chain performance indicators.

7.1 Preliminary discussion of the local-global comparison

So far we have seen that the context of Peruvian and the Belgian asparagus production is extremely different, mainly due to huge differences in the size of the two sectors. Whereas in Peru asparagus has been grown on more than 33,000 ha in 2012, in Belgium only 269 ha of asparagus have been cultivated. This acreage corresponds to one large-sized asparagus growing company in Peru. Moreover, there is a large difference in the availability of natural resources, such as land and water, and the policy context in the two countries. For instance, land is abundantly available at the Peruvian coast where thousands of hectares of desert land have been turned into agricultural land since the 1980's. On the other hand, Flanders is a very urban region and basically all land is already used. Regarding water resources it becomes clear that water is an extremely scarce resource in the Peruvian desert areas a limiting factor for further expansion of the asparagus sector. The availability of water for asparagus production is not an issue in Belgium. Regarding the policy context we have seen that the Peruvian government is actively promoting asparagus production and exports, which together with cheap water and labour inputs led to a high degree of competitiveness of the sector. Thus, policy regulations and support have played a big role regarding the growth of the global asparagus chain. A critical issue that is important for governing the local as well as the global chain are standards and certifications. These are required by producers in both chains.

But besides all these differences, a consumer in a European supermarket who wants to purchase asparagus is in fact faced with the decision of whether to buy asparagus from Belgium or from Peru – at least during the Belgian asparagus season. Thus, we have tried to elaborate performance indicators that capture the most prominent debates on the sustainability of asparagus production in the two countries.

The final dataset consists of seventeen indicators, most of which are comparable between the local Flemish case and the Peruvian export chain. The indicators represent five attributes of which four correspond to the three dimensions of sustainability on one is overarching the dimensions: Environmental dimension (attribute: resource use), social dimension (attribute: labour relations), economic dimension (attributes: contribution to economic development, creation and distribution of added value), overarching (attribute: governance). A limitation of our data is that most of the indicators consider only the production stage (e.g. labour productivity or water use). This is due to the fact that most

data is available for the farm stages and accurate information of the whole supply chain is often difficult to obtain.

Regarding data collection there is much more sector wide and company specific data and information available on the Peruvian asparagus sector. Moreover, the sustainability and future competitiveness of the sector is much more debated in Peru. This is of course due to the large size and high economic importance of asparagus production in Peru. Large surveys of asparagus export companies and farm workers in the agro-export industry have been available to the research team. Most of the information on the Belgian asparagus sector comes from expert interviews and farm visits. Only three farms have been interviewed in detail and thus, average data from these farms is not representative of the whole sector.

It is important to bear in mind that the indicators we have calculated have to be assessed cautiously and considering the context information as explained above. We only consider one point in time or average values when calculating the indicators (e.g. yields of a specific year, average prices, etc.). These values might however fluctuate over the years which might lead to considerable changes in our indicator estimates. Moreover, we had to estimate certain values (e.g. the number of workers per hectare in Peru) as no detailed information could be obtained otherwise. Nonetheless, we have tried to be consistent among the two case studies and have documented all assumptions we have made.

7.2 Discussion of the methodology

We could identify several strengths and weaknesses of the methodology applied in WP3.

First, the selection of the performance attributes has been mainly based on the critical issues that have been identified through expert and stakeholder interviews and a literature review. However, the final selection of the attributes has been done by the research team and not by the stakeholders themselves due to the time lag between field research in Peru and the start of WP3. The selected attributes cover the main dimensions of sustainability and the critical issues of the Flemish and Peruvian asparagus chains.

Second, the set of indicators has been selected based on data availability and the indicators suggested by the SAFA guidelines. These indicators give some insights into the comparative performance of the two asparagus chains. However, they only present snapshots of very specific supply chain aspects and the national and sectorial context needs to be taken into account when making statements about the chain performance. The identification of the benchmarks has been mostly straightforward, especially in the case of percentage values where benchmarks are usually between 0% and 100%. However, we consider benchmarks not to be of a very high importance when doing only a pairwise comparison. Such a comparison can be done by only comparing the indicator values of the local and the global chain against each other. For this same reason we have decided not to use scores for our indicators (i.e. categorizing indicator values into bad – medium – good based on a percentage score, for instance). The use of scores would reduce accuracy of our indicators without adding value to the analysis.



Moreover, we think that the use of the Pedigree matrix approach for assessing the quality of the data has some shortcomings. A benefit of the approach lies in simplifying the assessment of data quality by subdividing data quality into five basic criteria. It can happen that an indicator scores very bad in one criterion and very good in the other four criteria and is still considered to be of very high quality. However, imagine an indicator which is only based on one observation (worst score for completeness), but it is verified primary data (best score for reliability of source), it is very recent data and from the area under study (best scores for temporal and geographical correlation), and it considers the technology under study (best score for technological correlation). Still, we would not consider an indicator based on only one observation as being of very good quality (as the Pedigree matrix would suggest). Nonetheless the matrix is indeed helpful in thinking about different aspects of data quality and in ranking the data obtained.

References

ANA (2011) Resolución Jefatural N° 330. <http://www.ana.gob.pe/media/378783/resol330.pdf>.

AQUASTAT (2014) Main country database. <http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en> (accessed on 9 February, 2015).

Bartl, K., Verones, F. and Hellweg, S. (2012) Life Cycle Assessment Based Evaluation of Regional Impacts from Agricultural Production at the Peruvian Coast. *Environ. Sci. Technol.*, 2012, 46 (18), pp 9872–9880.

Belorta (2014) www.belorta.be (accessed on 15 October 2014).

Benson, B.L. (2009) 2009 update of the world's asparagus production areas, spear utilization and production periods. California Asparagus Seed and Transplants, Inc., USA.

Burneo, Z. (2011) The process of land concentration in Peru. CEPES, CIRAD, International Land Coalition.

Cannock, G. (2011) Peru and China as competitors in world markets: The asparagus case. Presentation prepared for the FAO workshop on agricultural trade linkages between Latin America and China. Rome, September 2011.

Chacaltana, J. (2007): El boom del empleo en Ica. In: *Desafiando al desierto: realidad y perspectivas del empleo en Ica* (Chacaltana, J. Ed.), CEDEP, 2007, Lima.

CIA (2014) The world factbook: Peru. <https://www.cia.gov/library/publications/the-world-factbook/geos/pe.html> (accessed on 4 February, 2015).

Danper (n.d.) Informe de gestión ambiental y social – IGAS. <http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=38351218> (accessed on 11 December 2014).

Del Pozo-Vergnes, E. (2014) GLAMUR programme – WP2. Peru case study. First full draft. IIED, London.

Días Rios, L. (2007) Agro-industries characterization and appraisal. Asparagus in Peru. Agricultural Management, Marketing and Finance Working Document 23. Food and Agriculture Organization of the United Nations, Rome.

FAO (2013a) SAFA – Sustainability Assessment of Food and Agriculture systems. Guidelines. Version 3.0. Food and Agriculture Organization of the United Nations, Rome.

FAO (2013b) SAFA – Sustainability Assessment of Food and Agriculture systems. Indicators. Food and Agriculture Organization of the United Nations, Rome.

Ferm, N. (2008) Non-traditional agricultural export industries. Conditions for women workers in Colombia and Peru. In: *Gender & Development* 16 (1), pp. 13-26.

Fernández-Maldonado, E. (2010) ¿Exportación sin explotación o modernización excluyente? Paradojas de un modelo de crecimiento. In: *Trabajo & desarrollo* 9, pp. 30-35.

GlobalG.A.P. (2014) Online certificate validation tool. https://database.globalgap.org/globalgap/search/Certificate_V4.faces?cert=529771&lang=en (accessed on 15 October 2014).

Hepworth, N. D.; Postigo, J. C.; Guemes Delgado, B.; Kjell, P. (2010) Drop by drop. Understanding the impacts of the UK's water footprint through a case study of Peruvian asparagus; Progressio, CEPES and Water Witness International: London, UK, 2010.

INDECOPI-Instituto Nacional de Defensa de la Competencia y de la Protección de la Propiedad Inelectual (2011): DanPer Trujillo and Civil Association Frío Aéreo, Peru. In: ISO. *Economic benefits of standards*, pp 161-198.

INEI – Instituto Nacional de Estadística e Informática (2012): IV Censo Nacional Agropecuario 2012. <http://www.inei.gob.pe/estadisticas/censos/>

INEI (2014): Nota de prensa n° 153. 29 September 2014. <http://www.inei.gob.pe/media/MenuRecursivo/noticias/nota-de-prensa-n153-2014-inei.pdf> (accessed on 13 October 2014).

Kirwan J, Maye D, Bundhoo D, Keech D, Brunori G (2014) GLAMUR WP2 - Scoping/framing general comparative report on food chain performance (deliverable 2.3). Countryside and Community Research Institute, University of Gloucestershire, UK.

Mail online (2010) Tesco under fire for selling asparagus from Peru... in town famous for producing the vegetable. By Sean Pulter, 11 May 2010. <http://www.dailymail.co.uk/news/article-1277180/Tesco-selling-asparagus-Peru--town-famous-producing-vegetable.html>.

Mekonnen, MM and Hoekstra, AY (2010) The green, blue and grey water footprint of crops and derived crop products. Value of Water Research Report Series No. 47. UNESCO-IHE, Delft, the Netherlands.

O'Brien TM & Díaz Rodríguez A (2004): Improving Competitiveness and Market Access for Agricultural Exports Through the Development and Application of Food Safety and Quality Standards. The Example of Peruvian Asparagus. Inter-American Institute for Cooperation on Agriculture (IICA). Coronado, Costa Rica.

OECD (2007): Market access and private standards. Case study of the Peruvian fruit and vegetable markets. OECD Working Party on Agricultural Policies and Markets.

PRI – Public Radio International (2012): Despite economic gains, Peru's asparagus boom threatening water table. By Cynthia Graber, 23 January 2012. (accessed on 14 October 2014).

Schuster, M. & Maertens, M. (2015): The Impact of Private Food Standards on Developing Countries' Export Performance: An Analysis of Asparagus Firms in Peru. *World Development* 66, 208-221

Schuster, M. & Maertens, M. (2014): Do labor standards benefit workers in horticultural export chains in Peru? Bioeconomics Working Paper Series 2014/10. KU Leuven, Belgium.

Schuster, M. & Maertens, M. (2013/2014): Farm worker survey 2013 and 2014.

Schuster, M. & Maertens, M. (2013): Do Private Standards Create Exclusive Supply Chains? New Evidence from the Peruvian Asparagus Export Sector. *Food Policy* 43, 291-305.

Schuster, M. & Maertens, M. (2012): Private Food Standards and Firm-Level Trade Effects: A Dynamic Analysis of the Peruvian Asparagus Export Sector. In: Beghin, J.C., Ed. *Non-Tariff Measures with Market Imperfections: Trade and Welfare Implications*. Frontiers of Economics and Globalization Series of Emerald Press.

Shimizu, T. (2006): Expansion of Asparagus Production and Export in Peru. Discussion Paper 73, Institute of Developing Economies.

Statistics Belgium (2015) <http://statbel.fgov.be/> (accessed on 4 February, 2015).

Statistics Belgium (2014) Personal correspondence.

The Guardian (15 September 2010): How Peru's wells are being sucked dry by British love of asparagus. <http://www.theguardian.com/environment/2010/sep/15/peru-asparagus-british-wells> (accessed on 13 October, 2014).

UN Comtrade Database (2013) <http://comtrade.un.org/>

USLEAP (2013) <http://www.usleap.org/articles/world%E2%80%99s-leading-asparagus-company-violates-worker-rights-says-peruvian-union> (accessed on 24 September 2014).

Van Bellgem (2013) Fruit and vegetables deserve a quality mark. In: food insights, 22-27. myeden.be/upload/Magazine-Food-Insights-201320140103151747.pdf (accessed on 17 February 2015).

VLAM (2013) Thuisverbruik van hoeveproducten 2012. <http://www.vlam.be/> (accessed on 4 February, 2015).

Vredeseilanden/VECO (2013): Learning lessons for inclusive business models with Colruyt. A case study on canned green asparagus from smallholders in Peru. Leuven, Belgium.

Annexes

Annex A: Number of asparagus producing holdings and cultivated area in Belgium, Flanders and Wallonia, 2009-2013

Year	Location	Holdings	Area (ha)
2009	Flanders	162	166
	Wallonia	12	8
	Belgium	174	174
2010	Flanders	154	188
	Wallonia	14	9
	Belgium	168	197
2011	Flanders	125	205
	Wallonia	16	22
	Belgium	141	227
2012	Flanders	129	229
	Wallonia	17	41
	Belgium	146	269
2013	Flanders	137	279
	Wallonia	20	48
	Belgium	157	326

Note: The cultivated area of the two regions do not always sum up to the area of Belgium due to rounding differences.

(Source: Statistics Belgium, 2014)

Annex B: Belgian fresh asparagus imports by origin (tonnes), 2000-2013

Year	Exporter			Peru/ Non-European (%)
	World	Non-European countries	Peru	
2000	2024.1	129.7	103.2	79.5
2001	2327.1	102.9	89.7	87.1
2002	2199.6	186.6	169.3	90.7
2003	2673.3	157.7	129.4	82.1
2004	3371.4	545.7	526.1	96.4
2005	3836.2	1037.0	938.1	90.5
2006	4161.2	1372.0	1324.9	96.6
2007	4001.9	1404.0	1356.9	96.7
2008	3981.2	1352.8	1279.0	94.5
2009	4515.1	1510.9	1426.4	94.4
2010	3996.6	995.7	940.0	94.4
2011	4658.8	1324.6	1170.7	88.4
2012	4960.4	1454.5	1298.4	89.3
2013	5646.4	1748.1	1436.6	82.2

Note: Import figures from for Peruvian asparagus to Belgium are higher than export figures from Peru to Belgium (Annex E). This is assumed to be due to re-exports of asparagus entering Belgium.

(Source: Own calculations based on UN Comtrade, 2013)

Annex C: Peru and Belgium: Production, area and yields of asparagus, 2000 to 2012

Year	Peru			Belgium		
	Production (tonnes)	Area harvested (ha)	Yields (tonnes/ha)	Production (tonnes)	Area harvested (ha)	Yields (tonnes/ha)
2000	168356	20984	8.0	1182	128	9.23
2001	184061	19038	9.7	800	140	5.71
2002	181165	18981	9.5	1000	149	6.71
2003	189601	18470	10.3	1000	160	6.25
2004	192533	18912	10.2	960	160	6.00
2005	206026	18192	11.3	960	160	6.00
2006	259954	20041	13.0	1020	141	7.23
2007	284103	23547	12.1	1100	156	7.05
2008	328374	29758	11.0	1200	171	7.02
2009	313880	29467	10.7	1500	174 ^b	8.62
2010	335209	30896	10.8	1680	196 ^b	8.40
2011	392306	33144	11.8	1981	227 ^b	9.91
2012	376645	33063	11.4	2600	269 ^b	8.67
2013	383144 ^a				326 ^b	
2014					380 ^c	

Sources:
 FAOSTAT (2013)
^a Ministerio de Agricultura y Riego (2012)
^b Belgian statistics office (2014)
^c Pers. comm. with auction representative (2014)

Annex D: La Libertad: Monthly production of fresh asparagus for export (tonnes), 2000-2013

Monthly production of fresh asparagus in the La Libertad region from 1993 to 2013 (tonnes)													
Year	Total	Jan	Feb	Mar	Apr	May	Jun	Jun	Aug	Sep	Oct	Nov	Dec
1993	342.0	22.0	9.0	-	-	-	-	13.0	15.0	49.0	47.0	41.0	146.0
1994	326.0	69.0	45.0	22.0	15.0	5.0	0.0	0.0	0.0	30.0	33.0	46.0	61.0
1995	23.8	20.8	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	59.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	17.0	6.0	35.0
1999	151.0	2.0	4.0	1.0	0.0	0.0	0.0	0.0	0.0	32.0	34.0	43.0	35.0
2000	1.311.8	69.4	74.0	37.2	49.7	53.4	89.1	130.9	160.4	118.3	94.7	191.0	243.7
2001	1.360.4	89.9	108.1	84.4	71.1	75.6	51.6	69.4	56.0	91.8	63.9	147.7	450.8
2002	4.531.2	2489.4	146.5	234.6	211.0	202.5	162.9	163.1	157.1	176.3	200.8	196.0	191.0
2003	4.788.2	374.6	236.3	312.4	272.2	110.3	193.2	425.0	377.7	190.0	265.8	969.9	1.060.8
2004	6.124.2	602.5	147.5	251.6	202.9	182.4	399.3	899.8	169.1	292.4	437.7	1.235.0	1.304.1
2005	8.157.8	250.0	259.7	283.5	298.3	200.5	728.5	1303.4	587.4	360.6	553.5	1.565.6	1.766.8
2006	9.080.6	1025.0	458.2	627.5	442.1	377.8	978.5	965.3	372.3	316.7	739.9	1.341.8	1.435.4
2007	10.048.2	629.7	532.6	542.3	383.4	597.1	765.2	732.2	651.0	1181.7	1.190.1	1.338.5	1.504.5
2008	13.244.0	1254.3	1452.4	951.7	737.0	714.5	880.8	1384.4	1111.8	791.4	1.442.5	1.437.3	1.086.1
2009	13.174.1	913.5	1469.6	1483.7	732.1	610.9	1167.0	972.0	1331.6	355.9	1.397.6	1.784.1	956.2
2010	14.119.4	935.9	1372.5	1390.9	678.4	1048.2	1113.3	954.9	871.1	1079.2	1.006.5	2.047.6	1.621.0
2011	13167.0	1093.2	1.269.6	2009.9	686.1	589.7	841.1	1151.1	622.5	848.6	926.6	1725.6	1403.1
2012	13219.2	1059.1	1971.9	1959.5	307.6	551.0	921.4	902.9	484.5	846.6	1235.8	1937.5	1041.9
2013	9245.6	929.0	1633.7	1153.8	210.2	295.5	396.8	810.7	692.4	490.9	759.7	1171.2	701.7

Note: Includes fresh green and white asparagus, net production after processing. Excludes frozen and canned asparagus.
 Source: Gerencia Regional de Agricultura La Libertad. Boletín Agroindustrial 1980-2009. Cuadro 068. <http://www.agrolalibertad.gob.pe/?q=node/147> and LAL_espárrago from 2011 to 2013 (<http://www.agrolalibertad.gob.pe/?q=node/146>)

Annex E: Quantity and destinations of Peruvian fresh asparagus exports (tonnes), 2000-2013

Year	World	Europe*	Belgium	USA	% Europe	% USA
2000	37008.8	6303.3	227.9	30261.9	17.0	81.8
2001	34550.1	6712.6	45.3	27525.3	19.4	79.7
2002	52784.2	9413.9	53.5	43023.6	17.8	81.5
2003	67088.3	13378.2	161.1	53128.2	19.9	79.2
2004	72064.0	15076.7	670.9	55757.4	20.9	77.4
2005	80021.3	18861.3	762.3	59132.6	23.6	73.9
2006	92806.8	21548.8	540.6	68612.7	23.2	73.9
2007	96357.2	22678.5	473.1	70126.9	23.5	72.8
2008	109808.3	27036.6	208.7	79615.5	24.6	72.5
2009	122131.1	30131.4	218.2	87663.4	24.7	71.8
2010	123511.3	31822.5	347.4	85634.2	25.8	69.3
2011	124504.3	32464.8	532.7	84421.3	26.1	67.8
2012	118034.2	32920.5	613.1	77700.4	27.9	65.8
2013	124461.7	30804.0	951.5	86647.9	24.7	69.6

Note: Figures only include fresh and chilled asparagus (HS code 70920).

* Europe includes EU27 countries plus Norway and Switzerland.

(Source: COMTRADE, 2013)

Annex F: Trade values of fresh and chilled asparagus exports, 2000 to 2013

Year	Trade value (1000 USD)	Value per kg (USD)
2000	53798.1	1.5
2001	52435.3	1.5
2002	82980.0	1.6
2003	108342.8	1.6
2004	141544.9	2.0
2005	160015.0	2.0
2006	187364.3	2.0
2007	235701.4	2.4
2008	230427.3	2.1
2009	250822.9	2.1
2010	290683.7	2.4
2011	291828.0	2.3
2012	342201.1	2.9
2013	411827.2	3.3

Note: Figures only include fresh and chilled asparagus (HS code 70290).

Source: COMTRADE, 2013



Annex G: Descriptors of the Peruvian asparagus supply chain

#	Descriptor	Value/Description
1	FUNCTIONAL UNIT	1 kg, asparagus is bunched á 500g
2	Local name	fresh green asparagus
3	Content of the product	fresh product, no ingredients needed
4	Included processes	Production of inputs>agricultural production>packing>transportation>retailer
5	Packaging material	No specific label, but indication that asparagus has been produced in Peru. Packing material: Only a plastic strap around the bunched asparagus in the supermarket (sometimes put into a plastic bag)
6	Differentiation of the product	no
7	Technology	Fresh product, no transformation of the product (besides packing)
8	Seasonality of production	Fresh green asparagus can be harvested around the whole year. However, the production is adapted to the needs of the overseas clients.
9	Criteria 1: physical/geographical distance	very large physical distance between production (Peru) and consumption (Belgium)
10	Criteria 2: governance and organization issue	<p>Short highly integrated with large grower/exporter/suppliers. Buyer-driven, with co-innovation between grower/exporter and retailer.</p> <p>GLOBALGAP and USGAP certified for EU and US markets</p> <p>Important role of UK supermarket standards (for IPM and GAP, biodiversity strips etc) which “through their monitoring processes have raised general standards of production, environmental issues and worker rights – though they have yet to tackle the water issue effectively.”</p> <p>Fresh asparagus is either produced by the export companies themselves on owned or rented land or sourced from external producers – or a combination of both. Contract arrangements specify quantities, deadlines and reference prices are mentioned. Oral agreement are very common in sourcing relationships with small producers.</p> <p>The share of produce that was sourced from external producers has decreased over time. Only about 6% of the total volume of exported asparagus is now sourced from small producers (down from 10 to 15% in the late 1990s). This is mainly due to increasing technical demands and standards.</p> <p>The sharp export growth since the early years 2000s has mainly been driven by an increase in vertically integrated production by export companies themselves. In order to guarantee supply volumes, or because of bad experiences with contract farmers, or to improve traceability. Also the Agricultural promotion law introduced in 2000 provided asparagus exporters with tax advantages and lower cost burdens on hired employees, making own production on owned or rented land more interesting.</p>



11	Criteria 3: resources, knowledge and technology	<p>Capital- and labour-intensive.</p> <p>Capital: Main players are domestic investors; little foreign investment in the business. Relatively large firms dominate the cluster.</p> <p>Labour: Asparagus activity provides an estimated 50 000 jobs decentralized along the Peruvian coast, of which 60% are women. Production is not yet mechanized.</p> <p>Workers employed by agribusinesses earn about 30% more than those working for agricultural firms that serve the local market.</p> <p>Growers in Ica reported that labour costs were about \$8 per worker per day in 2008, higher than in other parts of the country. Ica has reached the point where labour for the exporting agricultural companies is getting scarce, driving wages higher</p> <p>Success of Peruvian asparagus is built on major infrastructure investment that has resulted in yields in Peru far higher than competitors (10.64 t/ha in 2009, compared to 4.2 t/ha in US) and reputation for meeting consistently high quality standards for quality and freshness of what is a perishable product:</p> <ul style="list-style-type: none"> • Greenhouse-grown plug seedlings • Drip irrigation • Professional agronomists • Cold chain and logistics, controlled temperature environment <p>“Asparagus is harvested on day 1, chilled, packed and flown to the UK on day 2. By day 3, the asparagus is on the supermarket shelves without any break of the all-important cool-chain.”</p> <p>The technological innovation in asparagus also made it easy to extend the new transport technology to other high value export crops -- artichoke, peppers etc.</p> <p>Rising labour costs may result in mechanisation.</p>
12	Criteria 4:role of the territory, identity	<p>Grown along the coastal strip (La Libertad, Ancash, Lima, Ica) on irrigated desert land.</p> <p>Territory doesn't play a role in defining the identity. It rather has a negative connotation for consumers due to long distances from the place of production to the consumer.</p>
13	SYSTEM BOUNDARIES	From production of inputs until supermarket shelf
14	Description of the chains' steps	<p>2005 census showed around 1576 asparagus producers in Peru, of which 82% had less than 10 ha of asparagus land. The remaining 276 are large producers cultivating between 11 and 50 ha (11.29%), between 51 and 100 ha (3.24%) or more than 100 ha (2.98%).</p> <p>Bimodal production: Small producers (<10ha) highly informal, heavily rely on family and informal labor input, use traditional production techniques, and frequently plant asparagus as cash and export crop next to crops for the local market and for own consumption.</p> <p>Large producers (>10 ha) often registered farms, participating in formal labor markets, adopting modern inputs and technologies, and business oriented (see below)</p> <p>There are around 100 export companies.</p> <p>The biggest grower/exporters are Camposol and DANPER in Trujillo. Other big exporters are Sociedad Agricola Viru and Complejo Agroindustrial Beta.</p> <p>Camposol is the largest asparagus export company in Peru (and in the world). Set up in 1997 it now has more than 25,000 ha in northern Peru. Camposol generates ~ 7,000 - 10,000 jobs directly in low and high production seasons. Diversifying into avocado, table grapes, citrus. Has sustainable development strategy.</p> <p>In 2008 there were 3 import companies of fresh green asparagus from Peru in Belgium</p>
15	Geographical scope of the supply chain	<p>Inputs (US, Israel.)> Production (Peru)>Import and Supermarket (Belgium)</p>



16	Distance between each steps by effective road distance	around 550km from field (La Libertad) to airport (Lilma/Callao) around 10500km until Schiphol airport in Amsterdam around 200 km until the produce arrives in the central distribution center of the Belgian retailer
17	Total distance between first and last steps of production	around 1100km
18	Distribution channels of the product	supermarket
19	Land surface used for the production	See #24
20	Country population and population in the area of production	Peru: 30,814,175 (2014 est) La Libertad Region: 1,617,050 (2007 Census)
21	Population density	Peru: 23/km ² La Libertad Region: 63/km ²
22	Population growth rate	Peru: 0.99% (2014 est.) (CIA factbook)
23	Average age	Peru: total: 27 years male: 26.3 years female: 27.7 years (2014 est.) (CIA factbook)
24	Climatic conditions	Very dry, hardly rain. Desert area.
25	Topography	Plain coastal area (2,414 km of coast, CIA factbook)
26	Soil type	sandy
27	Type of water availability	Need for irrigation (Water comes mainly from large irrigation projects, esp. PECH in La Libertad), sometimes wells



Annex H: Data quality assessment using the Pedigree matrix

#	Indicator	Belgium							Peru					Total	Quality class
		DQD 1	DQD 2	DQD 3	DQD 4	DQD 5	Total	Quality class	DQD 1	DQD 2	DQD 3	DQD 4	DQD 5		
		Reliability	Completeness	Temporal correlation	Geographical correlation	Technological correlation			Reliability	Completeness	Temporal correlation	Geographical correlation	Technological correlation		
1	Land productivity (ton/ha)	0.2	0.2	0	0	0	0.4	A	0.4	0.8	0	0	0	1.2	B
2	Land productivity (EUR/ha)	0.2	0.2	0	0	0	0.4	A	0.4	0.8	0	0	0	1.2	B
3	Labour productivity (t/worker)	0	0.6	0	0	0	0.6	A	0.8	0.8	0	0.4	0.2	2.2	C
4	Labour productivity (EUR/worker)	0	0.6	0	0	0	0.6	A	0.8	0.8	0	0.4	0.2	2.2	C
5	Water use efficiency (m3/t)	0.2	0	0.2	0.2	0.8	1.4	B	0.2	0	0.2	0.2	0.8	1.4	B
6	Water use efficiency (m3/ha)	0.2	0	0.2	0.2	0.8	1.4	B	0.2	0	0.2	0.2	0.8	1.4	B
7	Water withdrawal	0.2	0	0.2	0.2	0.8	1.4	B	0.2	0	0.2	0.2	0.8	1.4	B
8	Wage level	0.2	0	0	0.4	0.2	0.8	A	0	0	0	0	0	0	A
9	Wage payment	n.a.						A	0	0	0	0	0	0	A
10	Collective bargaining and association	0.6	0.2	0	0.2	0	1	B	0.8	0.8	0	0	0	1.6	B
11	Work contracts	n.a.							0	0	0	0	0	0	A
12	Working hours	0.2	0	0	0.4	0.2	0.8	A	0	0	0	0	0	0	A
13	Decent working conditions	n.a.							0	0	0	0	0	0	A
14	Regional hiring	0.6	0.8	0	0	0	1.4	B	0	0	0	0	0	0	A
15	Regional employment generated	0.4	0.8	0	0	0	1.2	B	0.8	0.8	0	0.4	0.2	2.2	C
16	Profit distribution	0.2	0.2	0	0	0	0.4	A	0.2	0.2	0	0	0	0.4	A
17	Labels/ Certification	0.2	0	0	0.2	0.2	0.6	A	0	0	0	0	0	0	A
	Average						0.83	B						0.89	B

Source: WP3 case study guidelines citing Ciroth, 2012 and Lewandowska, 2004.

Note: DQD – Data quality distance