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# The Market of grain legumes in Germany

## First results of the EU-project LegValue

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The EU project "LegValue", started on 01-06-2017, has as its main objective the promotion of legume-based cultivation systems and establishment of agri-food chains in the EU. The whole project is coordinated by Fréderic Muel (TERIN, in France). The main task of the project team at the Department of Agriculture is the analysis of the market of legumes in Europe (Work package 3: WP3), supervised by Bruno Kezeya Sepngang under the direction of Prof. Dr. Marcus Mergenthaler. Ina Stute has been working on the project as a correspondent under the direction of Prof. Dr. Bernhard C. Schäfer. Wolfgang Stauss (i.green Institut) supports the project management.



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AMI: Agrarmarkt information.

BLE: Bundesanstalt für Landwirtschaft und Ernährung.

BZL: Bundesinformationszentrum Landwirtschaft.

CAP: Common Agricultural policy.

DemoNetErBo: Demonstrationsnetzwerkt Erbse und Bohne.

DESTATIS: Statistisches Bundesamt.

DVT: Deutscher Verband Tierernährung.

EU: European Union.

FAO: Food and Agricultural Organisation.

LLH: Landesbetrieb Landwirtschaft Hessen.

OVID: Verband der Ölsaatenverarbeitenden Industrie in Deutschland.

WP3: Workpackage 3.

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## Abstract

The production of domestic legumes can constitute a more sustainable protein source in feeding troughs and food plates in European countries. However, it remains a challenge to realize legumes' potential in research and practice. The cultivation of legumes provides ecosystem services within crop rotations at the farm level but also at larger scale going beyond farm boundaries. The narrow farm-level economic potential of domestic grain legumes is not comparable to that of cereals and oilseed rape. Furthermore, the practical knowledge among farmers for the cultivation of grain legumes is often missing. These aspects can partly explain the decline in legume crops and the reasons for today's overseas imports of protein-rich soybeans into Europe. Increasing the market transparency of legumes could possibly create incentives to shift priorities to more legume production. In this work, Germany serves as an example to describe one of the major legume markets in Europe. A mixed methodological approach based on quantitative and qualitative analyses was employed in this study. Quantitative data of the analysed parameters production, domestic consumption, imports and exports were obtained from international (Eurostat and FAO) and national (Destatis, AMI, BLE and OVID) databases. Expert interviews were conducted in order to qualify the data obtained and to validate the description of the market structure of grain legumes in Germany. Besides production, use, exports and imports, price setting systems for grain legumes in Germany were described. In fact, in the EU, 2.1% (2015) and in Germany about 1.06% (2017) of agricultural land was used for the cultivation of pulses for grain production. This very small proportion of legume crops has a low production as a direct consequence. Due to this situation, the trade in domestic grain legumes such as field peas, field beans and lupins has been conducted in niche markets in Germany. Thus, detailed market information is only known by a small group of stakeholder. A market of grain legumes has to develop with an increasing production. This increased supply of grain legume on the market is mainly due to policy supports. Legumes' main end use in Germany is for animal feeding, whereby a high proportion of the production is for intra- and inter-farm use. There is a small but emergent market for legumes based products in the food sector in Germany. But they have a marginal proportion of the total supply of grain legumes. Furthermore, it was also found that individual farmers do not have any significant influence on prices as it is common in agricultural commodity markets. In asymmetric trade relations, prices are rather influenced by compound feed producers, processors and traders. They use different models or methods under the consideration of price influencing factors like the production, the end use and prices of substitutes to set the prices.

# Deutsche Zusammenfassung

Körnerleguminosen können eine nachhaltigere Proteinquelle in Futtertrögen und als Lebensmittel in europäischen Ländern darstellen. Es bleibt jedoch eine Herausforderung, das Potenzial von Leguminosen in Forschung und Praxis zu realisieren. Der Anbau von Leguminosen bietet Ökosystemleistungen innerhalb der Fruchtfolge auf der Ebene der landwirtschaftlichen Betriebe, aber auch in größerem Maßstab, die über die Grenzen der landwirtschaftlichen Betriebe hinausgehen, wie z.B. die Verringerung der Nitratbelastung des Grundwassers und die Möglichkeit, Bienen eine Nahrungsquelle zu bieten. Das geringe betriebswirtschaftliche Potenzial von heimischen Körnerleguminosen ist jedoch nicht vergleichbar mit dem von Getreide, welches in der Mischfutterproduktion verwendet wird oder Raps, aus dem Pflanzenöl und Schrot für die Fütterung hergestellt wird. Darüber hinaus fehlt oft das praktische Wissen der Landwirte zum Anbau von Körnerleguminosen. Diese Aspekte erklären zum Teil den Rückgang von Anbauflächen mit Leguminosen. Die Nachfrage nach Eiweißfuttermitteln wird durch Übersee-Importe proteinreicher Sojabohnen nach Europa gedeckt. Eine Erhöhung der Markttransparenz des Leguminosenmarktes könnte möglicherweise Anreize schaffen, die Hülsenfruchtproduktion attraktiver zu machen. Diese Arbeit beschreibt den deutschen Leguminosenmarkt beispielhaft für Europa. In dieser Studie wurden gemischte methodische Methoden angewendet, die auf quantitativen und qualitativen Analysen basieren. Quantitative Daten der analysierten Parameter Produktion, Inlandsverbrauch, Importe und Exporte wurden von internationalen (Eurostat und FAO) und nationalen Datenbanken (Destatis, AMI, BLE und OVID) bezogen. Um die gewonnenen Daten zu qualifizieren und die Beschreibung der Marktstruktur von Körnerleguminosen in Deutschland zu validieren, wurden Experteninterviews durchgeführt. Neben Produktion, Nutzung, Export und Import werden Preissetzungssysteme für Körnerleguminosen in Deutschland beschrieben. Tatsächlich wurden in der EU 2,1% (2015) und in Deutschland etwa 1,06% (2017) der landwirtschaftlichen Flächen für den Anbau von Hülsenfrüchten für die Getreideproduktion genutzt. Aufgrund dieser sehr geringen Produktionsmenge kann der Handel mit heimischen Körnerleguminosen wie Felderbsen, Ackerbohnen und Lupinen als Nischenmärkten in Deutschland beschrieben werden. Detaillierte Marktinformationen sind daher nur kleinen Gruppen von Interessenvertretern bekannt. Der Markt für Körnerleguminosen muss sich mit steigender Produktion entwickeln. Dieser Anstieg der Anbauflächen und damit des Angebotes von Körnerleguminosen auf dem Markt ist hauptsächlich auf politische Unterstützung zurückzuführen. Das Haupteinsatzgebiet von Leguminosen in Deutschland ist die Tierfütterung, wobei ein hoher Anteil der Produktion für den inner- und zwischenbetrieblichen Gebrauch bestimmt ist. Es gibt in Deutschland einen kleinen, aber aufstrebenden Markt für den Einsatz von Hülsenfrüchten in der Humanernährung. Dieser hat bisher jedoch einen marginalen Anteil an der gesamten Nachfrage. Außerdem wurde festgestellt, dass einzelne Landwirte nicht in der Lage sind, den Preis zu beeinflussen, wie es allgemein in großen Warenmärkten der Fall ist. In asymmetrischen Handelsstrukturen wird dieser von Mischfutterherstellern, Verarbeitern und Händlern bestimmt. Sie verwenden unterschiedliche Modelle oder Methoden unter Berücksichtigung von Preiseinflussfaktoren wie den Preisen von Substituten, der Produktion und der Endnutzung, um Preise festzulegen.

# 1. Introduction

Legumes are a protein-rich crop and play an important role in animal and human nutrition (Abel, 2016). Furthermore, their cultivation generates a range of eco-system services. In crop rotation for example, the nitrogen supply through their rhizobia, the break of pathogen´s life cycle and diseases, the weed control, and the preservation of the biodiversity can be noted (ALPMANN et al., 2013; SPIEGEL et al., 2014). Nevertheless, their isolated farm-level economic performance excluding crop rotation effects is not comparable to cereals and rape seed, which are also substitutes in compound feeds. Additionally, the know-how about the cultivation practices of grain legume is limited (SCHMIDTKE & KLÖBLE, 2013). Furthermore, past and recent policy frameworks have not been favourable for legumes in Europe. These aspects can partly explain the decline in legume acreage and can be the reasons for today´s large import of protein feed into Europe. In fact, 2.1 % of the agricultural land in the EU was dedicated to the growing of dry grain legume in 2015 (EUROSTAT, 2017). The "protein deficit" in Germany in 2015 is estimated by 2.37 million t which represents 65 % of the total protein consumption (SCHMIDT, 2017). This protein deficit is derived from the raw protein imports. According to Destatis, grain legumes covered 1.06 % of the German´s agricultural area in 2017. This very low proportion of legumes cultivated area has as direct consequence a low production in the respective region. Thus, the trade of domestic grain legumes such as field peas, faba beans and lupins in Germany and in Europe has been conducted in niche markets so far (VOISIN et al., 2014). Consequently, detailed market information is only known by a small group of stakeholders.

The main goal of this report is to provide information for a more transparent and efficient legume market. At the same time, this exemplary market report of grain legumes in Germany is an integral part of the LegValue-project. In this respect, the report should support project correspondents in the various European countries to better understand the focuses of the WP3 (Economic analysis of European legume markets). Indeed, this report should be considered as a guideline for the reports of the other countries. At the end, a summary of all countries and crop specific reports will be used to reach the first two deliverables of the WP3. For the first task (Description of the legume market heterogeneity) the main examined parameters are production, domestic consumption, imports and exports. Several relevant price information schemes for grain legumes in Germany are collected for the second task (Elaboration of price setting schemes for legumes markets) of the WP3. For these investigations, semi-structured interviews were undertaken to contextualize and qualify the collected data from different databases.

# 2. Methods

Field peas (Ger. Felderbse/Futtererbse, lat. *Pisum sativum,* subsp *arvense*), broad and field beans also known as faba bean (Ger. Puff- und Ackerbohne, lat. *Vicia faba*) and soybeans (Ger. Sojabohne, lat. *Glycine max*) including soybean meal were the investigated grain legumes in this report. Field peas and faba bean were selected based on their higher total production and soybeans were chosen because of the huge quantity of their national consumption in Germany. A mixed methodological investigation was undertaken in this study. Several data bases, international (Eurostat and FAO) and national (Destatis, AMI, BLE and OVID), were explored and used for a basic quantitative description of the German grain legume market. The investigated period was from 2013 to 2017.

**Quantitative analysis:**

The collected secondary data have been drafted in an integrated database structure in excel. These data are aggregated for the whole market in Germany.

The data for the production were collected from the EU-database Eurostat, directly under http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do or indirect through http://ec.europa.eu/eurostat/data/database -> Agriculture, forestry and fisheries -> Agriculture (t_agr) -> Agricultural production (t_apro). Numerically, the parameter production is the product of cultivated area and yield. These two parameters, cultivated area and yield, can also be explored through the ways mentioned above.

The quantities, values, and foreign trade countries of the imports and exports for field peas, faba beans and soybeans are obtained by Destatis (Statistisches Bundesamt). The data of the year 2017 are provisional. According to the report on the quality of the foreign trade data for Destatis (QUALITÄTSBERICHT, 2017), the percentage of missing data after the first publication is very small, so that the data can be used for an analysis. The description of the way until the data is: www.destatis.de -> Database GENESIS -> Themes -> 51/Foreign trade -> 51000 -> 51000-0013 (for the yearly foreign trade) / 51000-0016 (for the foreign trade countries) -> select the years and the commodity Class by enter *WA0713*(for faba beans and field peas) or *WA120* (for Soyabeans) as code in the box below “Attributes”, than validate the selected code by clicking on the Display field (on the right side the box below “Sort key” -> then chose the interested crops -> accept -> Value retrieval. The foreign trade data for soybean meal are partially collected from the FAO (http://www.fao.org/faostat/en/#home -> Explored Data -> Food Balance -> Food balance Sheets) and OVID (http://www.ovid-verband.de/unsere-branche/daten-und-grafiken/). In some cases, the national consumptions were calculated based on the production, imports and exports. Only the repartition of the national consumption (food, feed, processed, seed and loss) for the year 2013 for field peas and soybeans could be obtained by FAO, through the way described above.

**Qualitative analysis:**

The obtained data were analysed to identify information gaps and to quantify the market of grain legumes in Germany. In order to close information gaps and to highlight open questions, expert interviews with diverse stakeholders, including experts from agronomic research were undertaken. In total, 16 experts were interviewed (see in the appendix). Due to their experiences and their current occupations, they are considered as experts in legumes in Germany. Data from the qualitative expert interviews were used to qualify the quantitative data analysis and to validate the

schemes of the flow of goods of grain legumes in Germany. The interviews were semi-structured, this means in this case that a flexible sequence of questions has been followed and the duration of each interview has been adapted to the specific circumstances. As consequence, each interview partner had a wide flexibility to interact. The used language was German.

The first semi-structured interview wave was done by three of the authors of this report. The interviews were conducted separately and the records were done by writing. This happened in December 2017 and the duration of each interview was estimated by 30 minutes on average. To close this section, an intern workshop at the FH-SWF with the three interviewed partners and three other scientific assistants was undertaken. The workshop was guided by a power point presentation with several quantitative data and open questions that were discussed during the workshop. It took around 90 minutes and the record was done by the digital voice recorder DM-670 from the trademark Olympus. These “face to face” guided surveys and the intern workshop were useful to gain more confidence in the topic and to optimise the interview guideline of the survey with the stakeholders.

The second semi-structured interview wave was done with stakeholders by telephone. This happened in February and March 2018 and the duration of each interview was 27 minutes on average with widths from 17 to 57 minutes. What is more, the records were done by audiotape. Thirteen actors from different sectors of activities and different regions were interviewed: breeders, famers, cooperatives, traders, processor and compound feed producers. Four interview guidelines were developed to guide the stakeholder specific interviews (see the interview guidelines in the appendix). A comparison of the respective interview results was conducted in an anonymous way by a structuring content analysis. Basic categories for the analysis where derived deductively from the literature. The basic categories were complemented inductively during data analysis by additional subcategories. The used tool is a so-called “synthesis matrix”. The statements were assigned to the units, structured in terms of content and then paraphrased, generalized and reduced. This synthesis matrix served as the basis for a discussion. An alternative to this tool is the MAXQDA-software that is more complex and could be able to quantify automatically the statements of the qualitative analyses. Due to the small sample of the interviewed actors, the synthesis matrix is also appropriate and easier for the analysis of the obtained data.

# 3. Result and Discussion

According to Eurostat, the production of dry legumes and protein crops for the production of grain (including seed and mixtures of cereals and legumes) has increased in the last five years, from 225,600 t in the year 2013 to 571,000 t in 2017. In 2017 field peas (298,000 t) and faba beans (188,000) were the most produced grain legumes in Germany, followed by soybeans with 65,700 t and sweet lupins with 52,000 t. Although the cultivated area of sweet lupins (29,000 ha) is still higher than this for soybeans (19,100 ha), the amount of produced soybeans has surpassed this of sweet lupins.

## 3.1 Description of the legume market heterogeneity

### 3.1.1 Field peas

Field peas are the most produced grain legume in Germany. According to AMI (2018), 7 % of the cultivated area of field peas in 2016 was produced organically. This means that the largest share of cultivated field peas in Germany is conventional. The share of organic cultivated area of soybeans (22 %), faba beans (31 %) and lupins (33.2 %) in the same year was higher than this for field peas. Experts explain this discrepancy with the longer recommended break in cultivation of field peas. Field peas have a recommended break in cultivation of eight years while it is only five to six years for faba beans. Therefore a maximum cultivation area in specific crop rotations is given for agronomic reasons. Other experts do not agree and state that the subject break in cultivation should also concern conventional farming. The diseases derive from the soil and could not be completely controlled by the application of pesticides. The experts agreed that the share of organic field peas is smaller than those for faba beans, lupins and soybeans in Germany, because peas grow on good soil or locations and organic farms tend to be in locations with poor soil conditions. On the other hand, it should be noted that there is probably a survey error in the estimated numbers, as a lot of winter peas are grown as intercrops mostly with oat in organic farming, which are not included here. As intercropped peas are harvested jointly with oat and no technical and financially feasible post-harvest separation is possible, intercropped peas will not constitute part of the pea supply in aggregate markets. Therefore, the estimated 7 % of field peas in cultivated area in organic farms seems smaller than in the reality, but should still stay smaller than those for faba beans, lupins and soybeans.

The smallest amount of protein content of peas compared to the other grain legumes can be another aspect to explain this result. Due to the fact that there are fewer alternatives of protein sources in organic farms, the cultivation of grain legumes with higher protein content like faba beans and lupins is more attractive on organic farms. On the market level, the biggest processor of field peas in Germany, Emsland-Stärke (Eng.: Emsland-Group), only deals with conventional peas at the moment. Emsland-Stärke processed more than 75,000 t field peas in the year 2016. That represents around 1/4 of the total national consumption of field peas in Germany. This concentrated and substantial demand is considerably higher than demand from a single market actor for faba bean or domestic soya.

Figure 1 shows the aggregated supply balance of field peas (*P. sativum*) in Germany from 2013 to 2017. The production of field peas has been increasing continuously, from around 130,000 t in 2013 to 298,000 t in 2017. Cultivated area of peas has decreased from 85,500 ha in 2017 to 74,900 ha in 2018. Assuming the same yield levels as in 2017 this would correspond to a production of around

261,000 t in 2018. The leap of the production between 2014 and 2015 is mainly caused by the new greening measures of the common agricultural policy (CAP) that started its implementation in 2015. The CAP introduced the direct payment to farmers who grow legumes, as legumes cultivated areas are considered as ecological focus areas. Their weighting factor has increased from 0.7 to the factor 1.0 at the same time not allowing plant protection products any more (Wobser, 2018). Not being able to use plant protection products on peas make them less attractive to conventional farmers. This can mainly explain the expected decrease in cultivated area and in production from 2017 to 2018.

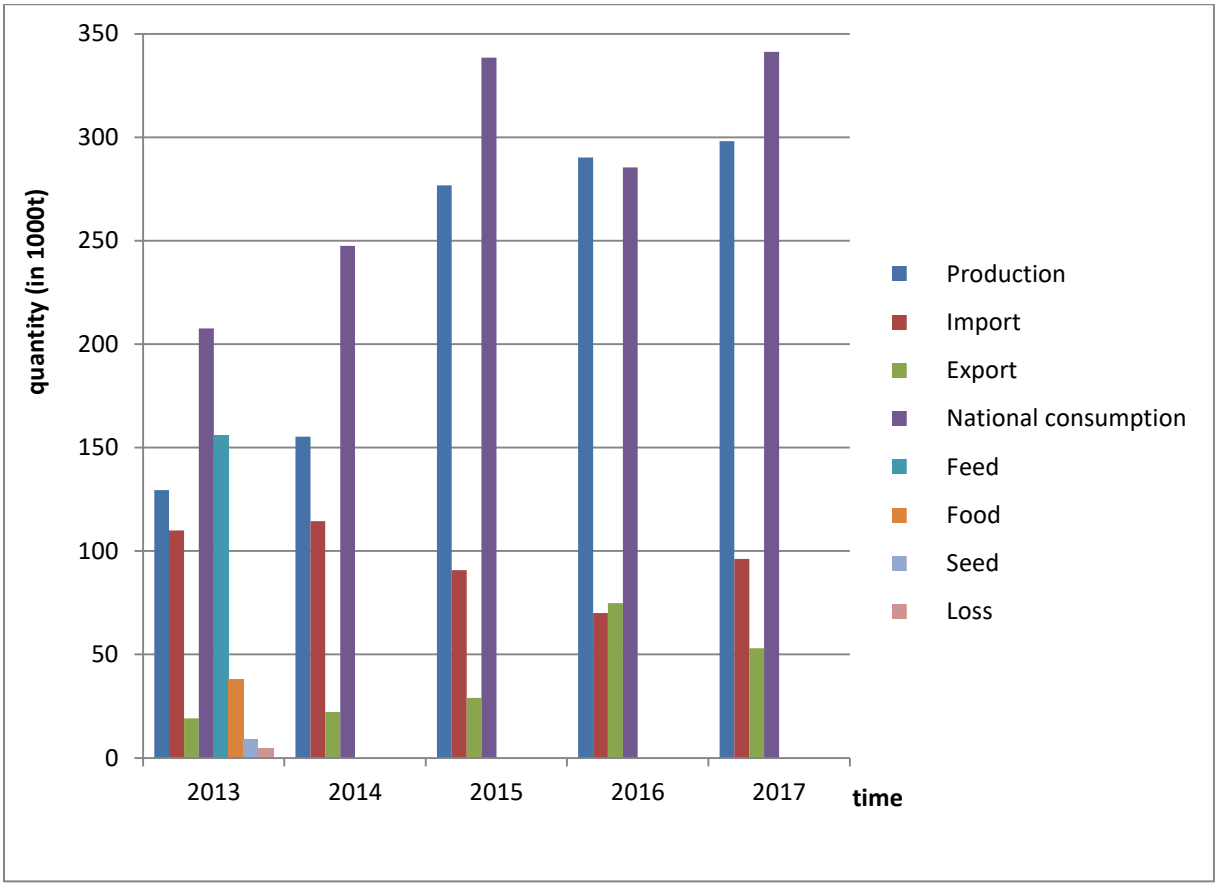


**Figure 1**: Supply balance of field peas in Germany from 2013 to 2017. There were no data available on the distribution of national consumption (feed, food, seed and loss) for the years 2014 to 2017 (FAO, November 2017). Primary sources: FAO, Eurostat and Destatis.

The decline in national consumption in 2016 is linked to the strong increase in exports and the decrease in imports from 2015 to 2016. By looking at the increasing trend of the export during the years, it can be deduced that the increased production has led to pressure on domestic market prices, which improved the competitiveness in international markets for exports. This opened up further markets abroad. At the same time imports became less attractive for foreign suppliers. From 2013 to 2017, except the year 2016 the national consumption of field peas was higher than its production indicating higher imports than exports and self-sufficiency between 63 % and 87 %. The trend of the national consumption also increased until 2015. According to the experts, up to the increase in cultivated areas due to greening, almost the volume of the entire produced German peas was processed by the company Emsland-Stärke. Because of risks related to GMO crops, Emsland-Stärke has stopped processing Canadian peas, worrying about cross-contamination by means of transport. This could be an argument for the decline of the imported peas in Germany from 2014 to

2016. In addition to this, the greening effect on domestic production as of 2015 could also explain this decrease in importation of field peas in Germany. In 2017 the foreign trade showed a reverse situation, the decrease in exports and increase in imports. Year to year fluctuations indicate that trade is not conducted in stable and established trade relations but is rather driven by spot market mechanisms.

Based on the FAO (2013), the main use of field peas in Germany is for feed with 75 % of the national consumption; followed by the use for food with 18 % (Figure 2). The experts mention that the share for food has an increasing trend today. This is caused by the increase in vegetarian and vegan consumers and the increase in the processing of peas to starch extraction. It was mentioned that the loss is not a remarkably in this sector.

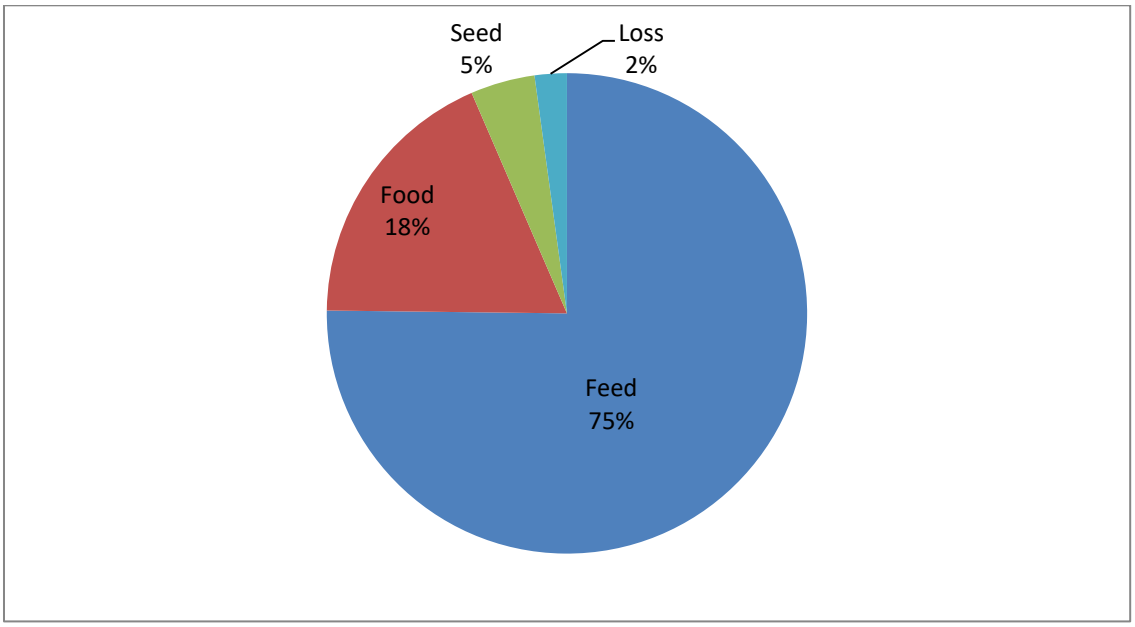


**Figure 2:** Distribution of national consumption of field peas in Germany (2013). Primary sources: FAO (2013).

In the marketing year 2013/2014, 16,000 t field peas were used as raw material by compound feed manufacturers. This represents 0.1 % of the total compound feed in Germany. In the marketing year 2015/2016, it doubled to 0.2 % which corresponds to 40,000 t but dropped to 30,000 t in 2016/17 (BMEL). Estimation for 2017/18 stand at 29,000 t (BLE 2018). This varying and marginal share of field peas in the compound feed is firstly due to its low total production compared to the major components in compound feed. Secondly, the uncertain supply of field peas is said to be an obstacle of their processing in compound feed. Still more than doubling in one year shows that the compound feed industries are able to process increasing amounts of field peas into their formulations of compound feed. Cultivation based on contracts or other measures to stabilize the supply of peas by feed manufacturers play only a marginal role yet. No up-to-date public price information system is available yet to give indications of market over- or undersupply of peas.

The largest share of field peas is used intra- or inter-farm. Comparing the national production of field peas and the total of its monthly purchase for the harvest years 2015 (BLE & BZL-DATENZENTRUM), it can be observed that 126,000 t of the 276,800 t produced in 2015 were sold by the farmers outside farming, which corresponds to 45 % of the yearly production. In 2016, 122,400 t of the 290,000 t produced in this year (42 %) were sold by the farmers outside farming. These results show that the

rest, around 55 % of the produced field peas, are for intra- and inter-farm use. This intra- and inter-farm use of field peas is mostly for feed. Experts could not confirm these numbers indicating a highly fragmented and nontransparent farm-to-farm marketing of peas. On the other side experts assume that the value of legumes in on-farm produced compound feed is higher compared to peas entering compound feed via professional compound feed manufacturers. This could be related to shorter transportation distances for inter- and intra-farm use of peas in highly fragmented markets. Low amounts of field peas entering professional feed manufacturers formulations is related to fragmented markets for peas and a lack of scale-economies in their logistics. For other grain legumes like faba bean and lupin the situation regarding inter- and intra farm use in feed is similar to field peas.

Pig and poultry are the main targeted animals for pea-containing feeds. The amount of useful raw protein of pea in dairy cattle feed is not sufficient for higher performance and the ration must be supplemented with other protein carriers (FREITAG et al., 2006). Therefore, pea-containing feeds are not so attractive for ruminants.

Foreign trade of field peas is more important compared to those of faba beans. While the export of field peas from Germany between the years 2013 and 2016 increased (19,000 t to 75,000 t) which corresponds to 15 % and 26 % of domestic production in the respective years, its import decreased (110,000 t to 70,000 t; 85 % and 24 % of domestic production). These imports and exports (Figure 1) include those for seeds.

Figure 3 shows the countries from which Germany had imported field peas in the years 2013 to 2017. In this graph, the very small amount of seeds is excluded. France, Belgium, Netherlands and the Czech Republic were on average the main origins of the imported field peas to Germany over the years 2013 to 2017 (Figure 3). These are neighboring countries to Germany. They were followed by Lithuania, Poland and Estonia. Czech Republic (18,057 t), Poland (14,481 t) and France (13,707 t) were the three main origins of the imported field peas in Germany in 2017, followed by Russia (6,474 t) and Luxembourg (6,335 t). Except from Czech Republic and Poland, the trends of the import quantity from the other countries were decreasing. Experts explain the continuous increase of import from Poland and Czech Republic with geographic reasons. Emsland-Stärke has a location in Golße where around 30,000 t peas are processed yearly. Golße is nearer to these two countries than to the other neighboring countries indicating that transportation costs might play a role.

Based to the figure 3, the Netherlands and Belgium were the main origins of the German field pea import in 2013. According to the FAO, each of these two countries did not produce more than 3,000 t in this year. Instead they imported enough field peas, 50,320 t for the Netherlands and 140,615 t for Belgium. This leads to the conclusion that Netherlands and Belgium were international trading hubs for the imported field peas in Germany. This can explain the statement of an expert about the huge amount of the imported field peas from Canada by the starch company Emsland-Stärke until the years 2014. According to Destatis, only 1630 t of field peas were imported directly from Canada, whereas the rest would enter Germany via the Netherlands and Belgium. Rotterdam in the Netherlands and Antwerp in Belgium are the main sea ports where Canadian peas enter into the EU.

Figure 4 presents the main countries where Germany exports field peas, from 2013 to 2017. India and the Netherlands were the main importers of German´s field peas on average over the years 2013 to 2017. They were followed by Pakistan, Italy, Switzerland and Lithuania. The principal destination

of the exports from Germany in 2017 was India with 27,528 t. This represents half of the total export of field peas in Germany for the year 2017. Many sources show a high consumption of lens in India as food, too. Furthermore, experts estimated the share of vegetarians in India by more than 30 %. Combined with the previous result, it suggests that India offers a big market opportunity for grain legumes. Hardly any knowledge is available about final use, specific quality and volume requirements and import regulations of peas in India. Potential markets of field peas in Lithuania and Pakistan had been observed in 2016, but they were regressed in 2017. There is no data available for India and Pakistan for the years before 2016. The Netherlands also showed a big interest in German´s field peas in 2016. According to the experts the main use there is for feed, yet still constituting marginal share for similar reasons like in Germany. Probably, the GMO problematic in the Netherlands could explain the exponential increasing of field peas export from Germany to the Netherlands in 2016. Equally to the exports to Lithuania and Pakistan, this market also regressed in 2017. In general, information about use of field peas in destination countries was scarce, scattered and uncertain.

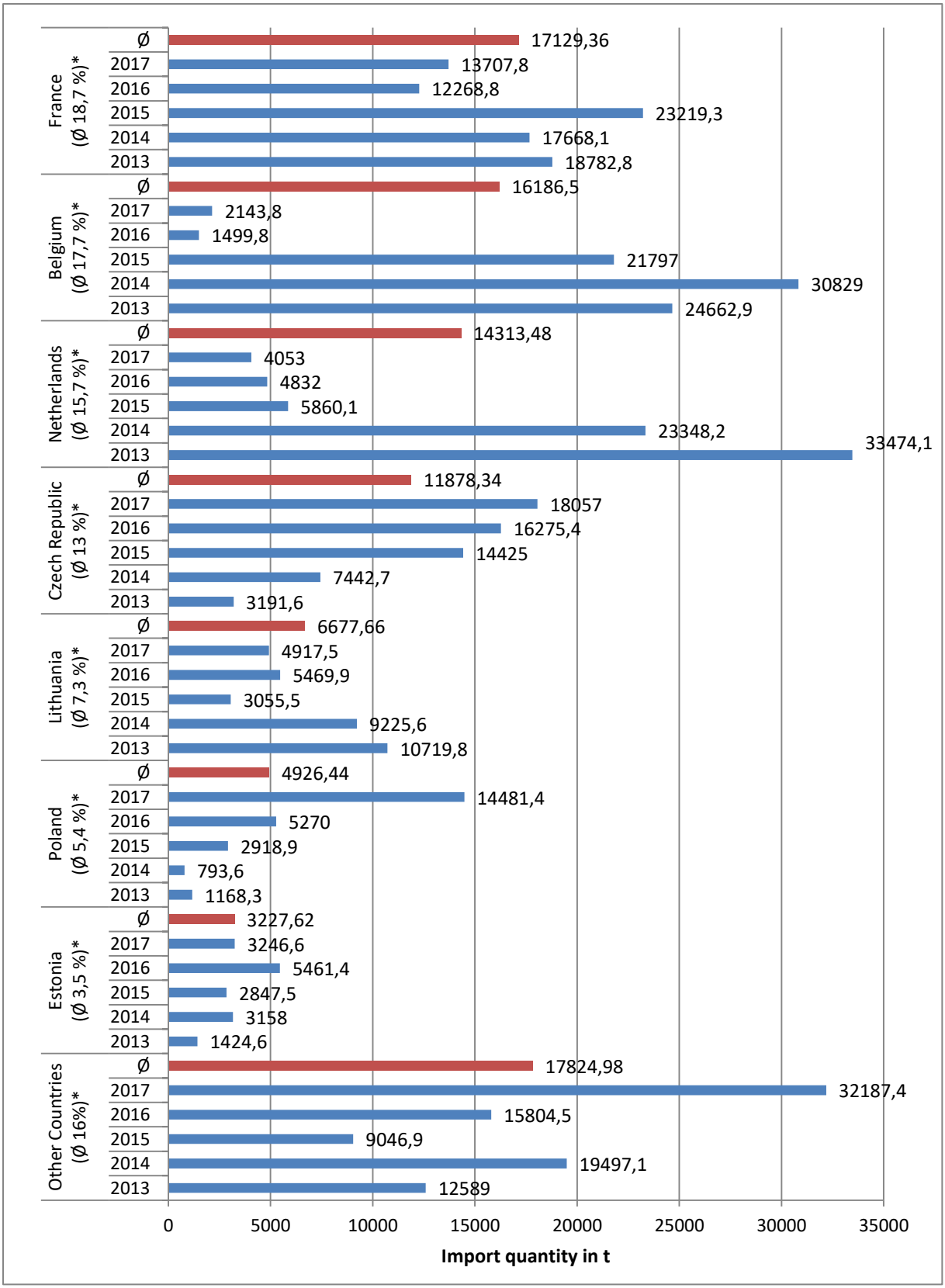


**Figure 3:** The main countries from where Germany imports field peas, from 2013 to 2017. The illustrated countries are ranked descending in terms of their average of trade quantity over these five years. (*): is the share of imports on average over these five years. (Primary source: Destatis, March 2017).

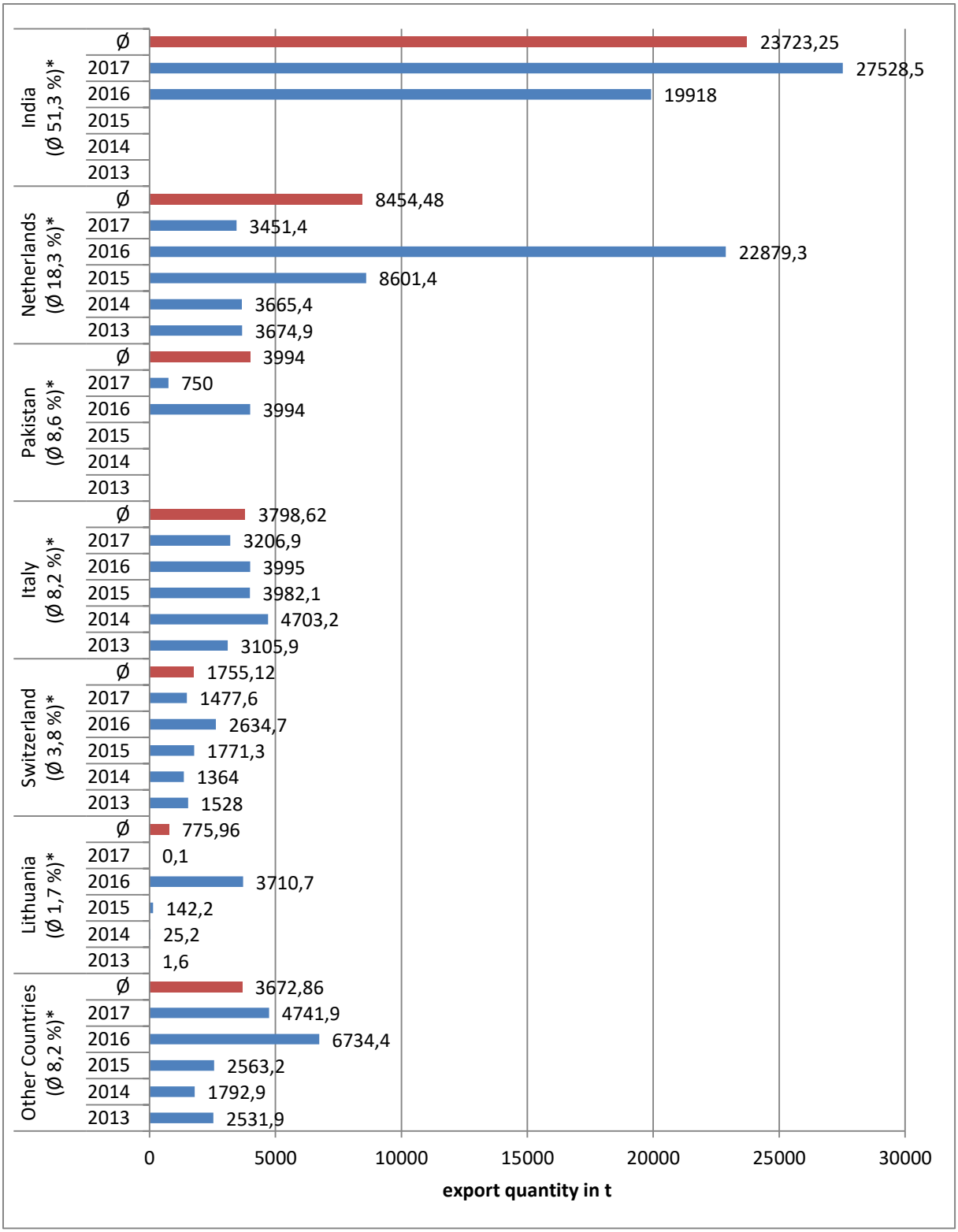


**Figure 4:** The main countries where Germany exports field peas, from 2013 to 2017. The illustrated countries are ranked descending in terms of their average of trade quantity over these five years. (*): is the share of exports on average over these five years. (Primary source: Destatis, March 2017).

### 3.1.2 Faba beans

Faba bean is the second most produced grain legume in Germany. According to AMI (2018), in 2016 31 % of the cultivated area of faba beans was organic farming. This means that around 70 % of the cultivated faba beans in Germany in 2016 were from conventional farming. Compared to the share of the cultivated field peas in organic farming (7 %), those for faba beans (31 %) are very high. The possible reasons for this difference are detailed in chapter 3.1.1.

Figure 5 shows the aggregated supply balance of faba beans (*Vicia faba*) in Germany from 2013 to 2017. The production of faba bean increased continuously, from around 60,000 t in 2013 to 190,000 t in 2017. This tripling of the production is mainly caused by the greening measures of the common agricultural policy (CAP), started its implementation in 2015 that considered legumes cultivated areas as ecological focus area. In addition, many federal states in Germany (Baden-Wuerttemberg, Bayern, Hessen, Mecklenburg-Western Pomerania, North Rhine-Westphalia, Rhineland-Palatinate, Saxony-Anhalt, Schleswig-Holstein, and Thuringia) offer supplementary subsidies within programs like the "diverse crop rotation" (Ger. Vielfältige Fruchtfolge) as impulses for the cultivation of legumes.

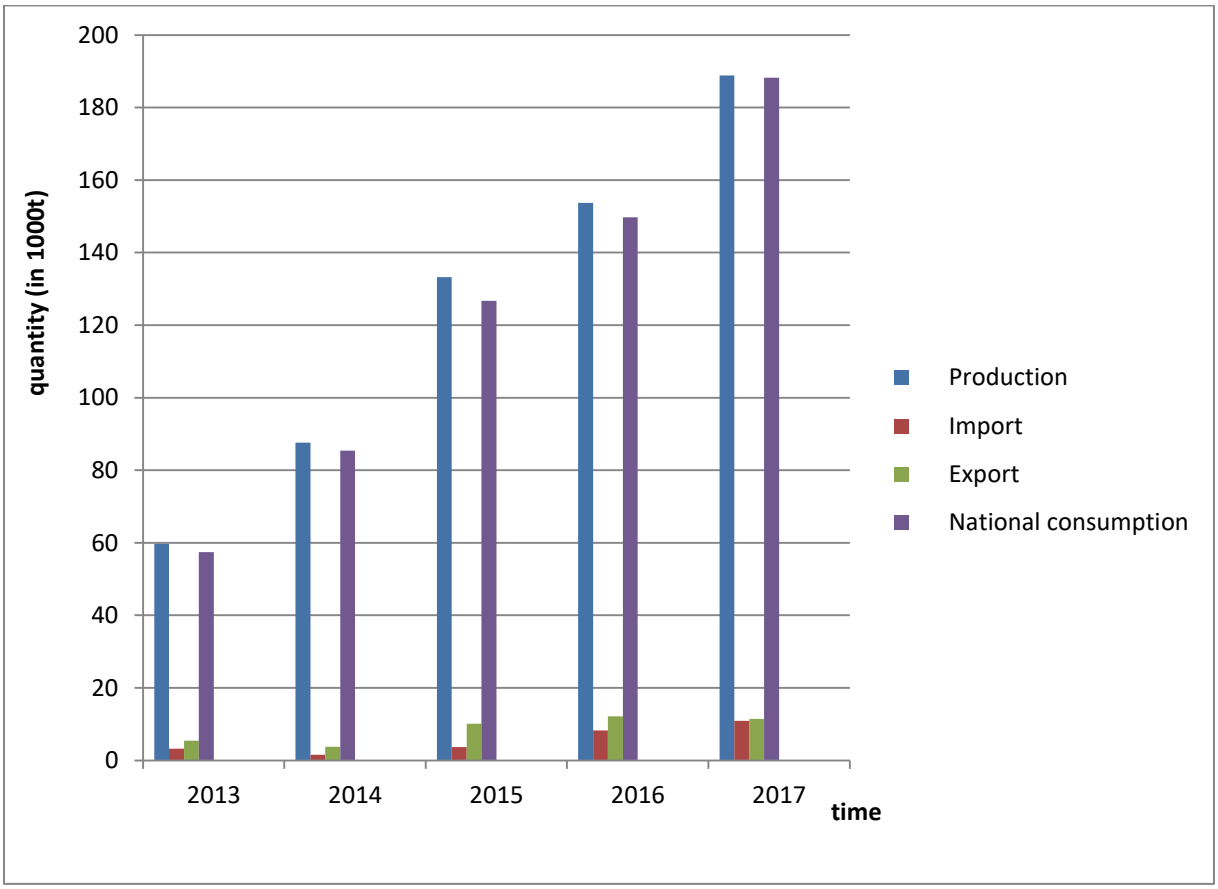


**Figure 5:** Supply balance of faba beans in Germany from 2013 to 2017. There are no data available on imports, exports and national consumption for the year 2017. Primary sources: Eurostat and Destatis.

The trend of the national consumption is increasing. In contrast to field peas, the production of faba beans remained slightly higher than its national consumption. The level of self-sufficiency with faba bean was between 100 % and 105 % in the years from 2013 to 2017. Based on the production, 7 % of faba beans were exports while 4 % were imported in average between 2013 and 2017. Despite the lower percentage of foreign trade in faba beans compared to field peas, it can be seen that there is a relative growth of imports and exports. Comparable to the situation for field peas, it would be

assumed that the increased production has increased the relative competitiveness of faba beans through reduced prices and thereby opened up further markets abroad: increasing of exports. The experts speculated that near-border compound feed factories buy goods from neighbouring countries to ensure a uniform feed ration, when the regional, domestic market offers too little supply. That can explain the fact that even Germany imports faba beans.

By comparing the national production of faba beans and the total of its monthly purchase for the harvest year 2015 (BLE & BZL-DATENZENTRUM, 2017), it can be observed that 52,000 t of the 133,000 produced in 2015 were sold by farmers to traders or processors. This represents 39 % of the yearly production. In 2016, 47,000 t of the 154,000 t produced in this year (30.5 %) were sold by the farmers to traders or processors. These results show that around 65 % of the produced faba beans are for intra- and inter farm-use. The main targeted animals to feed are pig, poultry (vicine and convicine free varieties), dairy cattle (toasted faba beans), and bull fattening. Experts estimated the ration feed/food of faba beans by 90/10. This mean that the use of faba beans in feed is higher than this of field peas with an estimated feed/ food ratio of less than 75/25. In the marketing year 2014/2015, 14,000 t faba beans were used as raw material by the mixed feed manufacturer. This represents 0.1 % of the total compound feed in Germany. In the marketing year 2015/2016, it doubled to 0.2 %, with a use of 38,000 t of faba beans. In 2016/17 it further increased to 44,000 t (BMEL 2018). Preliminary numbers for 2017/18 show an amount of 38,000 t (BLE 2018). It indicates that higher availability and lower prices make faba beans also attractive for compound feed manufacturers.

The foreign trade of faba beans is not as high as those for field peas. Around 10,900 t were imported to Germany in 2017 as compared to 96,100 t for field peas. Lithuania (5,587 t), Poland (2,066 t) and Estonia (1,036 t) were the three main origins of the imported faba beans in Germany in 2017. Figure 6 shows the countries from which Germany imported faba beans from 2013 to 2017. On average over these five years, Lithuania (37.4 %), Poland (15.0 %), Estonia (12.7 %), Netherlands (6 %) and Denmark (5.7 %) were the main exporters of faba beans to Germany. The figure 6 outlines a progressive increasing of faba beans imports from Lithuania, Poland and Estonia while there is a higher year to year fluctuation in imports from the other countries. The main reason for the continuous growths in Lithuania and Poland is probably due to the exponential increase in the production in the last years.

In total, Germany exported around 11,400 t of faba beans in the year 2017. The main destinations of the exports from Germany in 2017 were Italy (6,415 t) and Austria (1,966 t). Figure 7 shows the countries where Germany exported faba beans in the years 2013 to 2017. In this connection, it should be noted that Egypt has had a progressive interest in German faba beans from 2014 to 2016. The exported faba beans through the Hamburg-port are mainly cultivated in the Weser-Elbe area (Northwest of Germany) and are led by the company Fava trade. There was a big decrease in this market in 2017 to observe. Experts spoke of a lack of quality of faba beans due to the heavy infestation of filed beetles in 2017. The most important requirement for this foreign trade is the absence of living faba beans beetles and seeds damaged by this pest in the goods because the imported faba beans in Egypt will be used for food. As consequence of this lack of quality, the export to Italy raised in 2017. This for the use as feed with less quality requirement. Furthermore, the experts considered the rising currency strength of the Euro as a possible obstacle of the exports to Egypt.

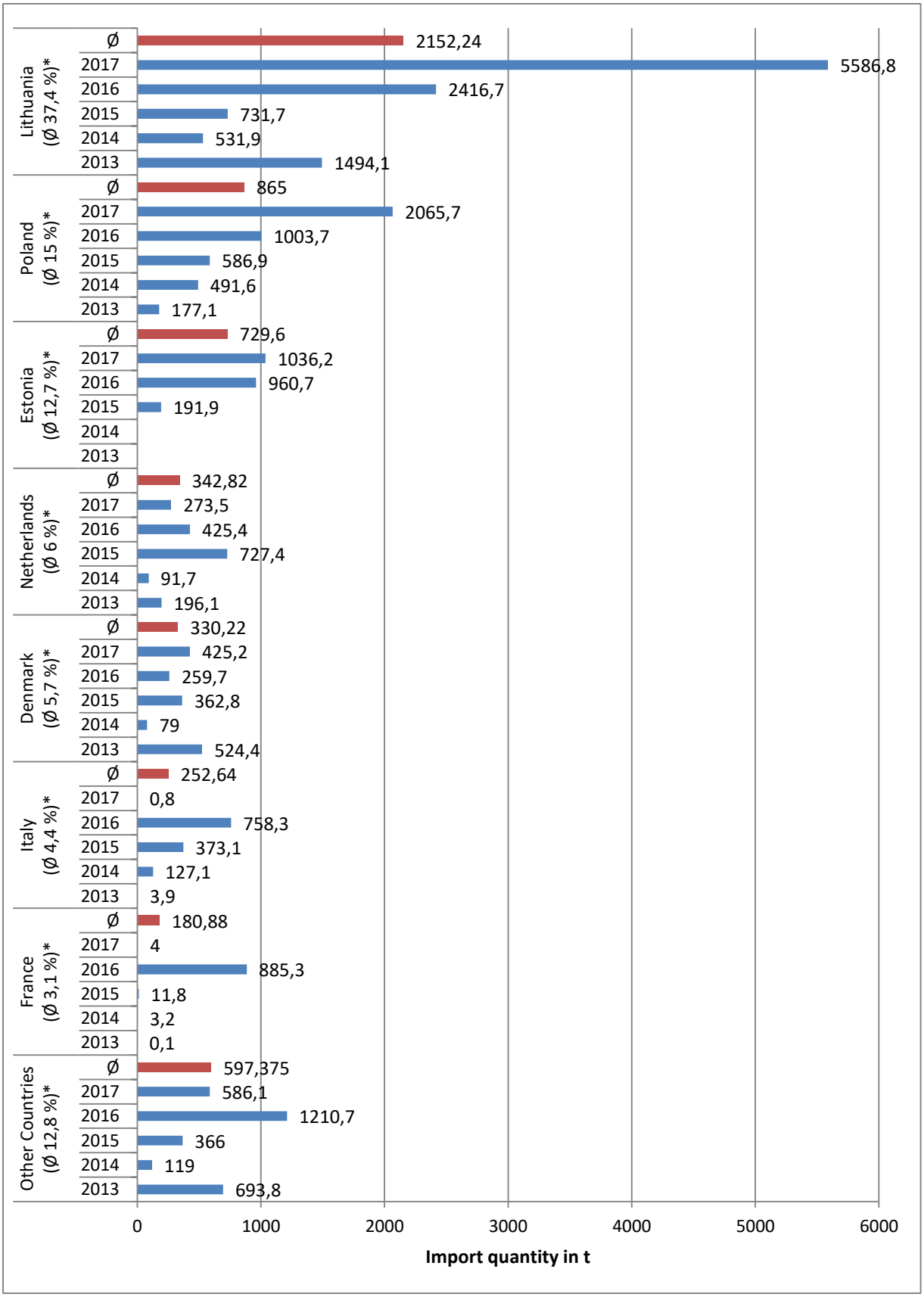


**Figure 6:** Germany's main import countries for faba beans, from 2013 to 2017. The illustrated countries are ranked descending in terms of their average of trade quantity over these four years. (*): is the share of imports on average over these four years. (Primary source: Destatis, April 2018).

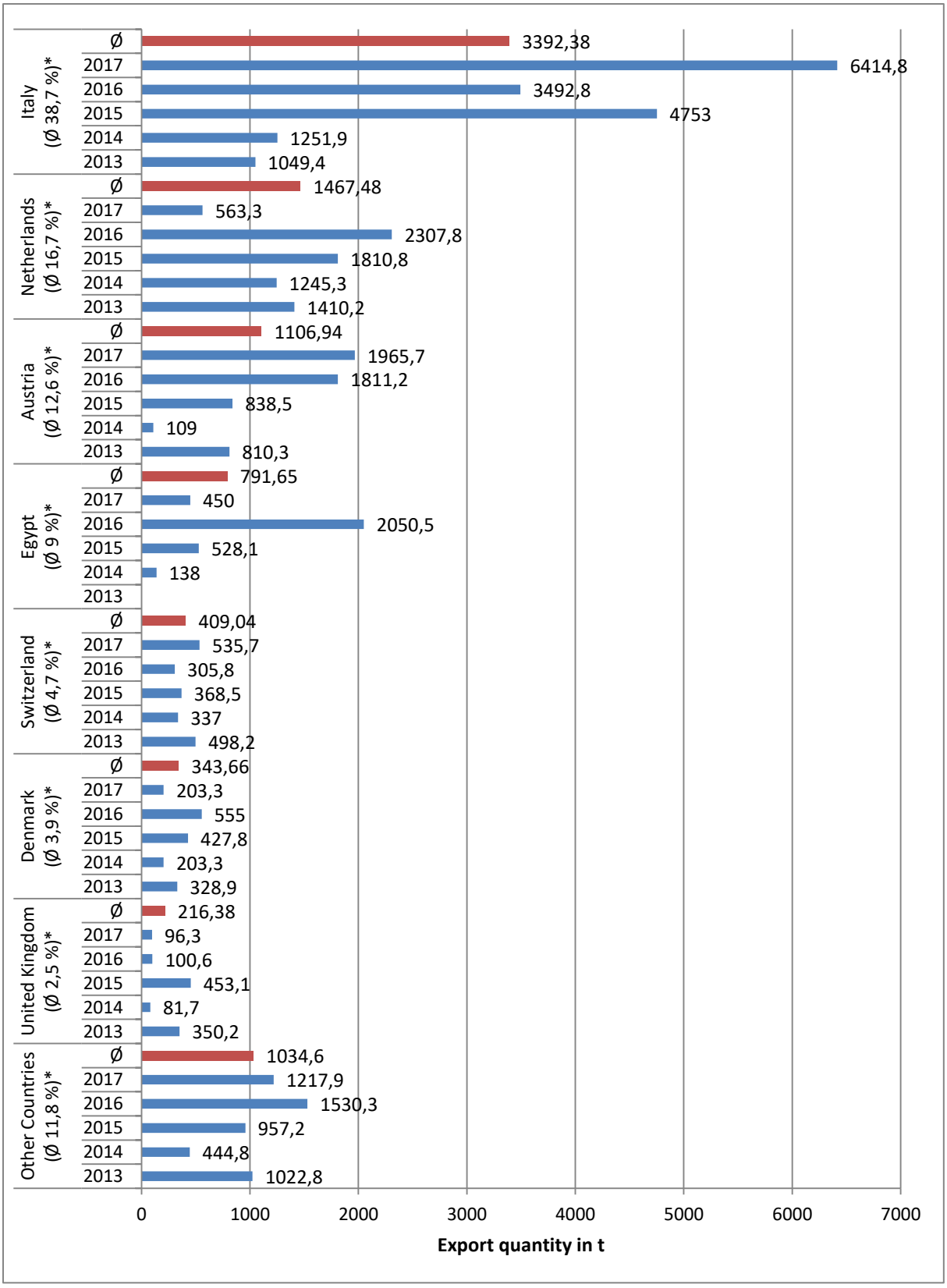


**Figure 7:** The main countries where Germany exports faba beans, from 2013 to 2017. The illustrated countries are ranked descending in terms of their average of trade quantity over these four years. (*): is the share of exports on average over these four years. (**): is previous data fpr this year. (Primary source: Destatis, Mai 2018).

Figures 13 to 16 in the appendix show the unit values of field peas and faba beans for imports and export in Germany with different foreign trade countries. These values are calculated from the values of import or export and the respective foreign trade quantities. The unit values could be useful as price indicator for the markets abroad.

### 3.1.3 Market structure of field peas and faba beans

This chapter is dedicated to analyse the market structure of the domestic grain legumes in Germany. The first goal of this section is to understand how the legumes goods are flowing on the market, which actors are involved and their roles on the market. Secondly, it will help to highlight some value chains of grain legumes. Figure 8 shows an overview of the market structure for grain legumes in Germany on the basis of field peas as example. The key players represented here are farmers to end-users through the traders and processors. The scheme is contextualized with the statements of the interviewed partners. The flow of goods could not be quantified for each sector of activity. But the width of the arrows is an estimation of the volume flows.

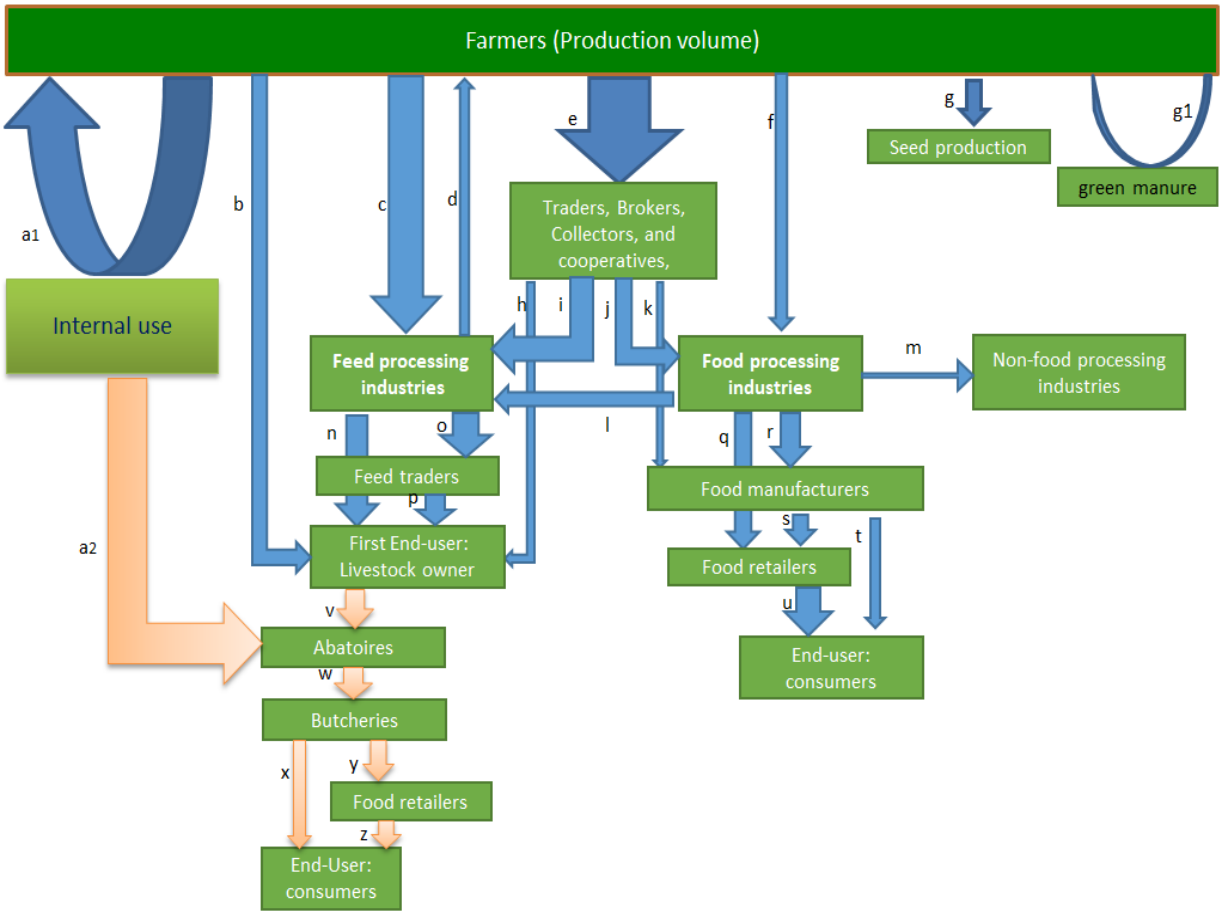


**Figure 8:** Flow of goods of field peas and the key stakeholders on the market in Germany. The lighter arrows are the paths for meat production. The blue ones are the handling of grains or transformed grains.

**Description of the market structure of field peas in Germany:**

a) a1) *Internal use*: this is an important legume path because of its high value added as no intermediaries have to be paid any margins. It can be differentiated into intra-farm use where grain legumes are used on the same farm as feed.
a2) *Internal use -> Abattoirs*: This path shows the way of meat consumption. The fed animals through the own produced grain legumes come later in the abattoirs.

a) *Farmers -> Livestock owner*: This path represents the direct marketing between grain legume producing farm and an animal keeping grain legume feeding farm. This is inter-farm use between different farmers. For this, the livestock owners need their own mixed feed equipment (similar to "h"). The smaller the distance between the produced farmers and the livestock owner is, the more economical this marketing way is. These markets are highly intransparent and spatially fragmented. Minor parts of grain legumes are traded via online platforms like leguminosenmarkt.de.

b) *Farmers -> Feed processing industries*: Direct sales from farmers to feed manufacturers. This way is formally institutionalized by different contracts. Four types of contracts were identified in this investigation: pre-contract before the sowing, pre-contract before the harvest, contract after the harvest and tonnage contract. By the tonnage contract, only the quantity is saved and the later market prices are considered. The type of contract that is most prevalent could not be identified here.

c) *Feed processing industries -> Farmers*: Farmers who bring their peas to feed manufacturers for processing and then use it in their own feed. In contrast to the livestock owners of the arrow "b", they do not have any equipment to mix their own feed. This situation could happen more to the organic farmers because they are more reliant on legumes than conventional farmers.
Examples for compound feed producers: **Raiffeisen Vital Sauerland Hellweg Lippe eG, Gründleinsmühle GmbH, Kaisermühle Gänheim Otmar Kaiser GmbH, Meika Animal Nutrition GmbH, BKF Belziger Kraftfutter GmbH, German Animal Nutrition Cremer GmbH & Co. KG, Bio Eichenmühle GmbH & Co. KG, Ceravis AG and H. Bröring GmbH & Co. KG).** More examples can be found on the homepage of the Germany´s legumes network DemonetErBo.

d) *Farmers -> Traders, Brokers, Collectors, and cooperatives*: Sale to the agricultural trade and cooperatives, which will eventually assume a bundling function between producers and other market players (see arrows "h, i, j, k, l"). A clear separation between the two stakeholders mentioned above with the brokers and collectors is difficult. It seems that there are no brokers and collectors yet who are specialized on legumes.
Example of agricultural cooperatives: **Dreher Agrarrohstoffe GmbH, Ceravis AG, Reiffeisen Weser-Elbe eG, Stader Saatzucht eG, AHG Agrarhandelsgesellschafte GmbH + Co. Warenvertriebs KG and Marktgemeinschaft Ökoflur GmbH. Cooperatives: Marktgesellschaft der Naturland Bauern AG, marketing company Bio Baueern GmbH, Rheinische Ackerbohne, marketing company Bioland Naturprodukte mbH & Co KG.** This way of selling in a group give the farmers more negotiating and market power in such a niche like the legume market.

e) *Farmers -> Food processing industries*: Sale to the food processing industry, which has the necessary technology for processing. This way is usually regulated by cultivation contracts (see “c”). The quality requirements here are stricter (cleanliness, freedom from beetles, humidity). The most important customer of this sector in Germany is **Emsland-**

**Stärke**, with more than 75,000 t of processed peas to starch per year. This represents 1/4 of the produced field peas in Germany.

f) *Seed production*: 5% of total production (FAO, 2013). Example of grain legume breeder: **NPZ, KWS, Limagrain**.

g1) *Green manure*: Traditionally, the use of grain legumes in mixed crops in organic farming has a great importance. Due to the occurrence of soil-borne diseases in peas, the cultivation of grain legumes in the mixed crop had to be severely limited. At least this concerned farmers that cultivated peas, possibly also faba beans, as their main crop.

g) *Traders, brokers, collectors, and cooperatives -> Livestock owner*: Sale of the grain legumes from the agricultural cooperative or the private trading companies to the livestock owners. For this, the livestock owners need their own mixed feed facility (similar to "b").

h) *Traders, brokers, collectors, and cooperatives -> Feed processing industries*: Sale of the grain from the agricultural cooperative or private trading companies to the compound feed industry, which possess the necessary technology for processing. Example: see "d" and "e". Some cooperatives and private trading companies are also feed producers at the same time.

i) *Traders, brokers, collectors, and cooperatives -> Food processing industries*: Sale of the grain legumes from private trading companies or the agricultural cooperative to the food processing industry (example, see "f"). The quality requirements here are stricter (cleanliness, freedom from beetles, humidity). Therefore the prices here are higher than those for the feed processing.

j) *Traders, brokers, collectors, and cooperatives -> Food manufacturers*: Direct sale of the grain legumes from private trading comapnies to the food manufacturers such as **Müllers Mühle**, which ultimately process the raw materials for food purposes.

k) *Food processing industries -> Feed processing industries*: Use of food production residues in feed production. This includes the targeted production of protein concentrates after the separation of starch, which partly ends up in feed production.

l) *Food processing industries -> Non-food processing industries*: In the processing of peas (e.g. **Emsland-Stärke**) the shells are used for the production of fibers. Despite their marginal importance, further utilizations like the production of paints, adhesives and foils by the protein could present the diverse use of pea in the non-food area.

m) *Feed processing industries -> livestock owner*: Direct sale of the processed feed to the livestock owners.

o & p) *Feed processing industries -> Feed traders & Feed traders -> livestock owner*: Indirect sale of the processed grain peas (feed) to the livestock owners by feed distributors. It should be mentioned that most feed processors have their own trading center.

q) *Food processing industries -> Food retailer*: Direct sale of processed grain pea (isolates) to food retailers, e.g. wrapped grain pea. For this the difference between the varieties is to be considered.

r & s) *Food processing industries -> Food manufacturers & Food manufacturers -> Food retailers*: Indirect sale of processed grain peas (isolates) to food retailers through the food manufacturers. At this intermediate stage, the peas are processed into foods, finished products or mixed with other products.

t) *Food manufacturers -> Consumers*: Direct sales from the food manufacturer to the end consumer, if there is a sales outlet or direct sale; for example, on large orders from restaurants, refectories and hotels. The online marketing (such as “Amazon” and “All you need”) of certain products such as the green pea flour from "Müllers Mühle", which is not offered continuously, also provides a possibility of direct marketing.

u) *Food retailers -> consumers*: Sale in the food retailers (**REWE, EDEKA, LIDL, ALDI**, etc.) to end consumers.

v - z) Pathway from the livestock owner through the abattoirs to the end consumer.

c & f) The supply of small quantity from individual farmers is a barrier for the legume market. The formation of cooperatives to ensure a larger supply quantity is an efficient solution.

a, b & d) These three arrows represent the intra- and inter-farm use of grain legumes. This represents about 55 % of the total production of peas and about 65 % of the total produced field bean in Germany.

a2, v, w, x, y & z) These represent the value chain of the meat. The reason for including these areas of activity is the quality criteria of the meat, such as GMO-free products and the regionality, which are important for the consumers nowadays. Hereby, the added value created by the feed consumption (of domestic grain legumes) is further communicated to the end user.

This scheme could also be representative for the market structure of field beans. The biggest difference will be the marked narrowing of production for human food purposes. On the demoNetErBo website there is a list of some market players, including private trading companies, feed producers, processor and feed traders (demoneterbo.agrarpraxisforschung.de).

### 3.1.4 Soybean and soybean meal

The production of soybeans in Germany is much lower than its import. 43,000 t and 60,000 t were produced in the years 2016 and 2017 whereas imports stood at more than 3 million t. According to Destatis (2017), 22 % of the cultivated area of soybeans in 2016 was organic. This means that around three quarters of the cultivated soybeans in Germany are conventional. Equally to the data of the share of ecological cultivated area for field peas (7 %), faba beans (31 %) and lupins (33 %), experts emphasized that these data should be considered as estimations (see chapter 3.1.1). In comparison with the share of ecological cultivated area for cereals (3.8 %) with those for wheat estimated by 2 % (AMI, 2018), it is clear that those for grain legumes are very high in Germany. This confirms the statements of many experts about the future of legumes in organic farming: “Due to the lack of (or

relatively more expensive) alternative-protein source like rape seed meal and soybeans meal which affect the price, the use of legumes in organic farming is of great importance". An increase in trading of organically cultivated legumes due to the decreasing possibility to use plant protect products in conventional production is expected.

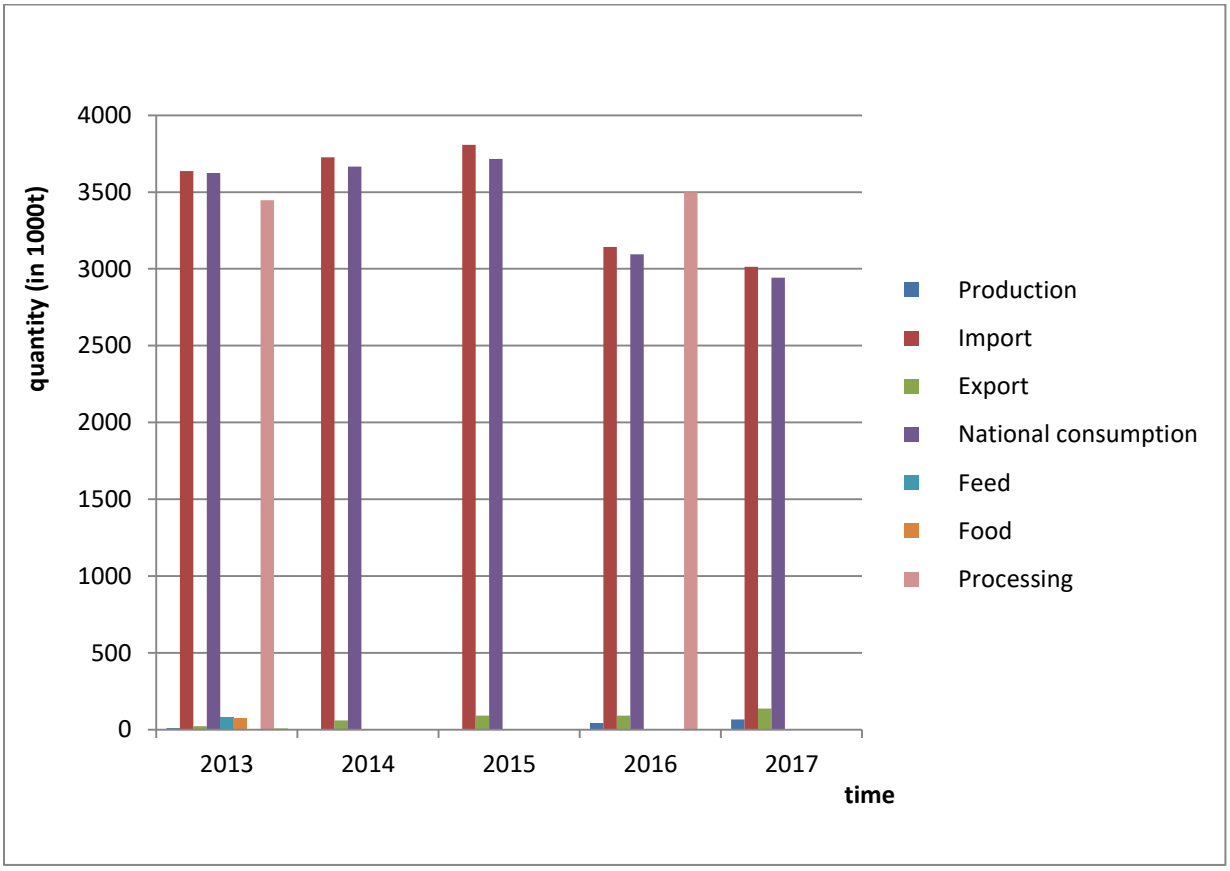


**Figure 9:** Supply balance of soybeans in Germany from 2013 to 2017. There is data gap in the different years. Primary sources: Eurostat, Destatis and FAO.

Figure 9 shows that more than 3.5 million t soybeans were imported in 2013 and in 2014. This is more than the national consumption that is estimated by 3.45 million t (FAO, 2013). The United States (~1.6 million t) and Brazil (~1.45 million t) are the main exporter of soybeans to Germany, followed by Uruguay, Canada, Paraguay, Austria and Argentina (AMI Marktbilanzen Getreide, Ölsaaten, 2015/2016). The main ports of entry are Rotterdam and Hamburg, whereby the port of Rotterdam predominates due to its large capacity. More details about the import of soybeans and soybean meal in Germany are made available by OVID the association of oil-seed processing industry in Germany. Nearly the whole national consumption is processed. The most important process is the oil extraction and the rest, soybeans meal is used as feed compound. The manufacturing of tofu, soy sauce and soy milk confers soybeans a place in the human consumption. According to the BLE (2017) for the marketing year 2015/2016, corresponding to July until June, 3.15 million t soybeans had been processed into compound feed. In the next marketing year 2016/2017, 2.7 million t were processed for the same purpose. The continuous decrease from 2013 until 2017 of soybeans as processed compound into feed is due to the increase of the production of domestic legumes like faba beans, field peas and other forage legumes and a reduction in animal numbers. It was also mentioned that the interest of Donau Soja, means the European Soybeans from the Donau areas with EU-norm, are growing. This fact could also explain the decrease in the oversea imports of soybeans.

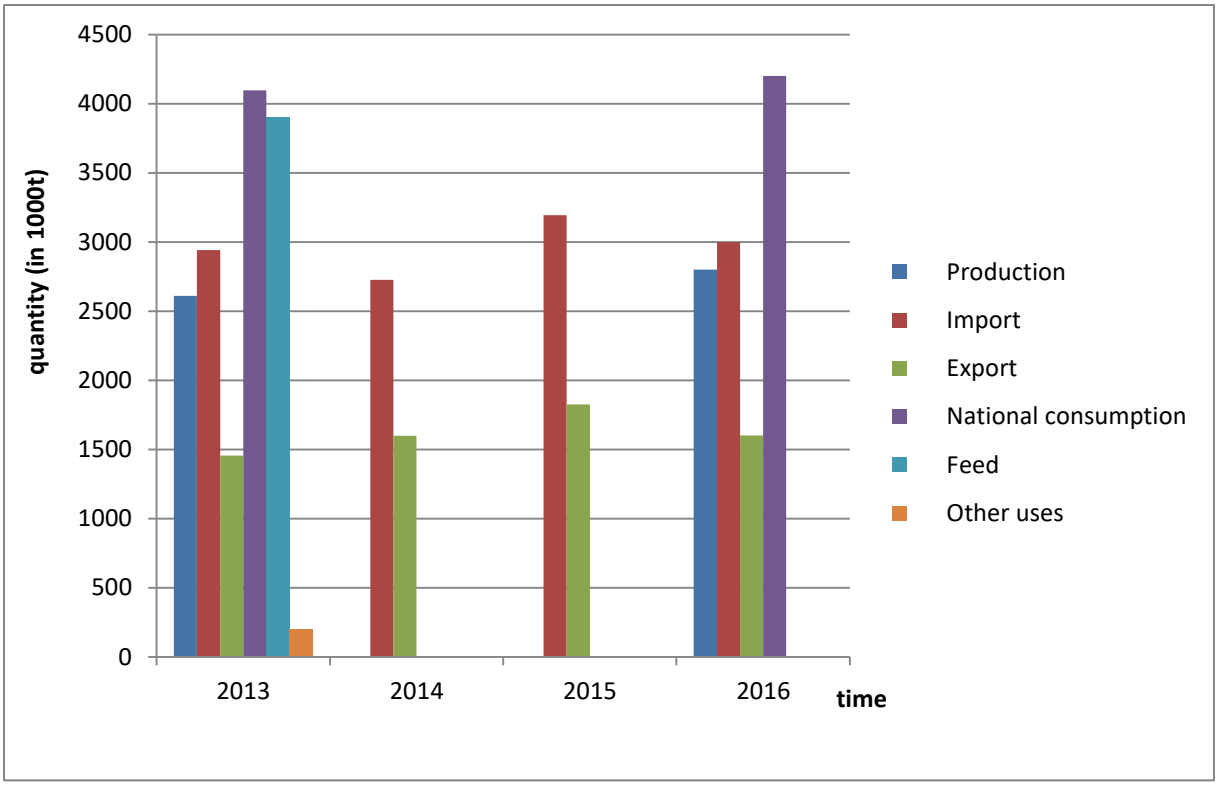


**Figure 10:** Supply balance of soybean meal in Germany from 2013 to 2016. There is data gap in the years 2014, 2015, and 2016. Primary sources: FAO and OVID.

The residues of processed soybeans, after the oil extraction, are called soybean meal. Its production in 2013 was estimated by 2.6 million t (FAO, 2013) and 2.8 million t in 2016 (OVID, 2017). Almost all of it has been used for feed. In the marketing year 2015/2016, 2.9 million t of soybeans meals were used as raw material by the mixed feed manufacturer. This represents 14 % of the total compound feed in Germany with an increasing trend compared with the marketing years before (BLE, DVT). Figure 10 shows the supply balance of soybean meal in Germany with a national consumption of 4.1 million t in 2013. According to PETER GÜNTER and OLIVER KRUG (2016, unpublished) the total available soybean meal in Germany was 4.5 million t in the marketing year 2014/2015. 58 % were destined for pig´s feed, 33 % for poultry and 9 % for cow. Around 3.2 million t of soybean meal were imported in the harvest year 2015/2016 to Germany, mainly from Brazil (~1.6 million t), Argentina (~0.72 million t) and the Netherlands (~0.69 million t) (AMI MARKTBILANZ, 2017). Around 1.8 million t of soybean meal were exported in the marketing year 2015/2016 from Germany, mainly to Denmark (~0.65 million t), the Netherlands (~0.3 million t), Czech Republic (~0.26 million t), Austria (0.16 million t) and Poland (0.11 million t) (AMI MARKTBILANZ, 2017).

Many interviewed partners mentioned the economic efficiency of legume as one of the main obstacles of it production in Germany. While farmers complain about the lower price of legumes, compound feed manufacturers perceive them as being to expensive compared to what legumes offer as value in compound feed ratios. A calculation of SCHMIDT (2017), based on the average from 2005 to 2015 shows that cereals offer 0.82 t/ha raw protein and grain legumes (except soybeans) only 0.72 t/ha. Due to their additional use as oil sources, soybean is more lucrative than faba beans, field peas and lupins in Germany.

### 3.1.5 Market structure of soybeans

The market structure of soybeans is better known than for other grain legumes in Germany. This market is strongly characterized by its two utilization products (oil and protein) and consists exclusively of imported soy. Figure 11 shows a draft of the soybeans market structure in Germany. Compared to figure 8 that shows the market structure of field peas, this scheme presents the importance of oil mill on the soybeans market. The produced soybean meal after the extraction is used by the compound feed producers. The anti-nutritive constituents of soy, so called trypsin inhibitors, are destroyed because of their heat treatment during the extraction. This fact gives the post-extraction soya meal its better digestibility compared to the other mostly untreated domestic grain legumes in compound feeds. The description of the figure 11 can be derived from the description made in Chapter 3.1.3.

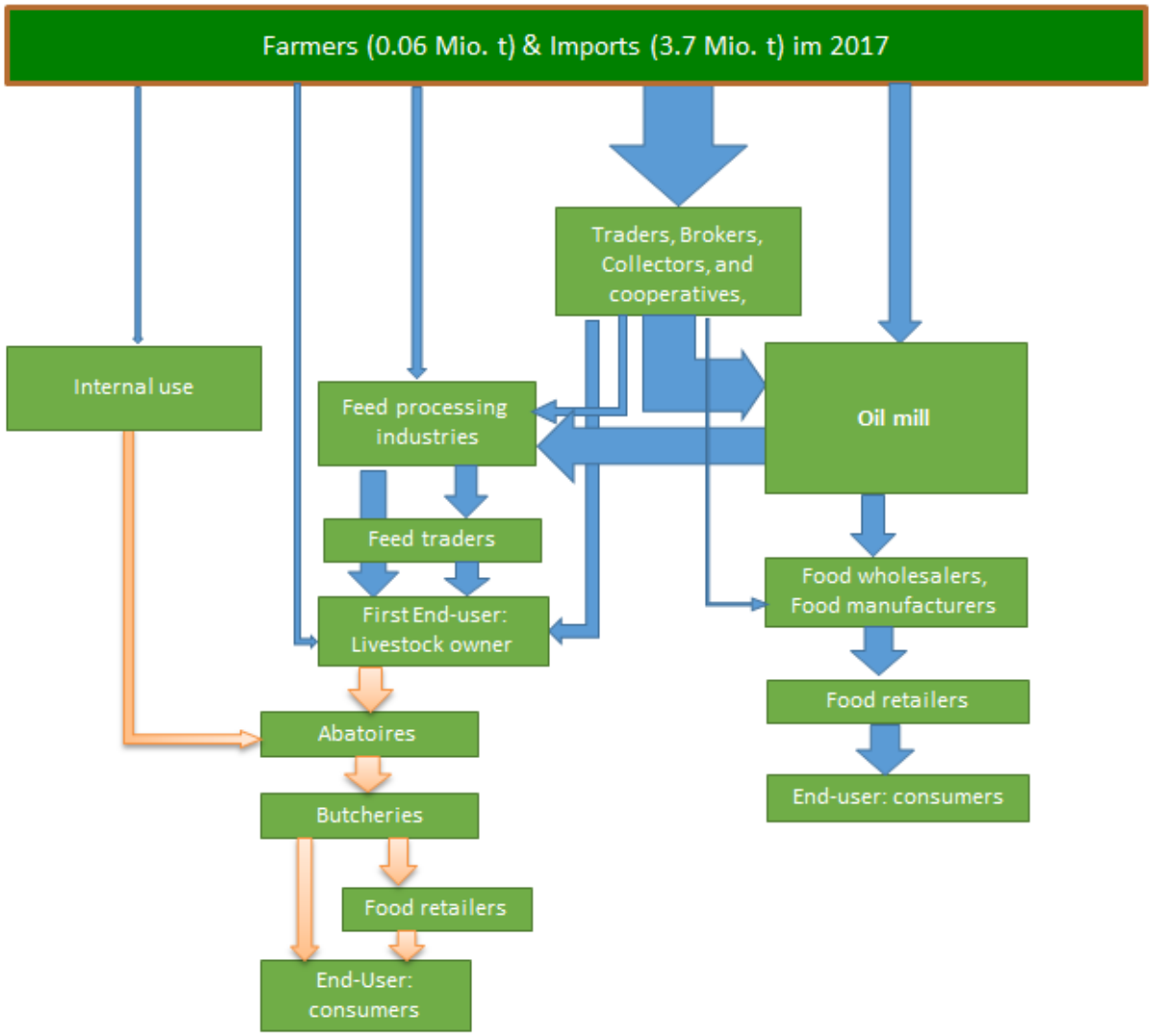


**Figure 11:** Market structure of soybeans in Germany. The lighter arrows are the paths for meat production. The blue arrows are the handling of grains or processed grains.

## 3.2 Prices information of grain legumes

In competitive markets, prices are determined by supply and demand. Through market observation and market information systems prices are made transparent and become available for all market partners. Only few systematic and very basic market information of legumes are available in Germany (e.g. LEL/LfL 2017). In the absence of market information systems for legumes, market participants dealing with legumes use different models or indicators as orientation for the price setting. This is mainly based on the market situation of substitutes for feed compounds like rapeseed meal, soybean meal and wheat. Cross-multiplications are undertaken to determine values for legumes. This makes the system more complex. An expert mentioned that a coupling price (Ger. Koppel-Preis), based on only one substitute, would increase the price transparency on the legume market. In fact, a stakeholder declared that he derives the price of its legume only from the wheat price. He argued that legumes are seen as competitor to wheat on the field. Therefore the field is considered as the limiting factor. Another mentioned possibility to derive the prices was based on the production and the price comparison to the previous years or the mean values of prices of many previous years.

Based on expert evaluations, it seems that the prices of grain legume in Germany are strongly influenced by the traders, the compound feed producers and the starch processing company Emsland-Stärke (EMS) under consideration of the process of substitutes. The individual farmers have no influence on the producer prices. A calculation of the producer price can be illustrated as followed:

| |
|---|
| **Producer price** = Price of the processor (eg. EMS) – Freight cost – Margine of the trader – (Cargo handling charges) |

Traders normally bear the transport costs. This is usually done by transport companies. This formula could explain the difference of prices categories on the table 1. For this, the “price of the processor” should see as the market price there.

**Influencing factors of the price for grain legumes**

There are many factors that influence the prices of grain legumes in Germany. Product quality is a major factor. For an optimal price, humidity content of 14 % $H_2O$, a dirtiness of less than 2 % and free of living beetles are required. Currently, the variety characteristics do not play any role in the market. The prices also depend on the end use, for food (more expensive) or for feed, and therefore for the buyers too. The supply quantity and for some company like Emsland-Stärke, the amount of years to deal with them have an influence on the prices. It was also mentioned that a poor acceptance of legumes based compound feed are influencing negatively the price of grain legumes on the market. This is among others reasons due to the lower quality of legumes compared to rape seed meal for example and the extra treatment to reach a better digestibility. The cropping system as conventional or organic also plays an important role in the price setting for legumes. Almost all interviewed partner estimated the price in organic farming system double than those from the conventional farming system. Prices are also regulated by various contract farming types. Four types of them were identified in this study: pre-contract before the sowing, pre-contract before the harvest, contract after the harvest and tonnage contract. By the tonnage contract, only the quantity is saved and the later market prices are considered. Direct contracts with the processors or the feed producers are

more lucrative for the farmers than through a trader. Nevertheless, it should be accorded more consideration to these stakeholders because of their bundling function on the market.

The table 1 shows different aggregated prices of grain legumes in Germany that were collected on different levels on the market from the legume stakeholders. In this case, aggregated means the average of the noted monthly prices and for all regions in Germany. The producer price (AMI indication: "Frei Erfasserlager") is the price that the farmer receive, included the transport costs. Market price (AMI indication: "Strecke ab Hof") is the price that the next stakeholder in the value chains (traders, collectors, or brokers) receive.

**Table 1:** Aggregated prices of grain legumes in EUR/t for 2013 to 2017 in Germany. These prices are the mean values of the noted monthly prices. Primary source: AMI.

| Crops | Price categories | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|
| **Soybeans** | Producer price | | | | | 357,78 |
| **Field peas** | Producer price | 233,66 | 207,96 | 186,09 | 180,28 | 191,58 |
| **Field peas** | Market price | 244,78 | 219,44 | 191,61 | 183,44 | 197,52 |
| **Faba beans** | Producer price | 220,76 | 192,06 | 169,96 | 146,91 | 158,63 |
| **Faba beans** | Market price | 237,28 | 185,75 | 171,12 | 158,42 | 162,03 |
| **Lupins** | Producer price | | | | | 199,09 |
| **Lupins** | Market price | | | | | 206,67 |

There is a lack of data availability for the prices of domestic soybeans and lupins in the 2013 to 2016. It shows that the market of faba beans and field peas are better developed than those for lupins and the domestic soybeans. Although storage capacity is an advantageous instrument on the market as it allows an inter-temporal exchange of supply and demand, it should be mentioned that old stocks are cheaper than the new ones. Database queries also showed that the prices vary depending on months or period and on the regions. The interviews showed that very few stakeholders really analyses the price during the years. It is assumed that there is still no competitive market for legumes as the available quantity is too small. Figure 12 presents evolution of the market prices (whole sale prices) of field peas and faba beans from 2007 to 2017, in Germany. The prices of field peas are higher than those of faba beans. This is probably due to the more use of field peas in food sector. There are some stakeholders who pay the same price for field peas and fababeans indicating that "peas and beans have the same price for us". It shows an undifferentiated consideration of grain legumes by the stakeholders. This is probably acceptable in the feed sector and it could contribute to the explanation of the nearer prices of 2008, 2009, and 2013 in the figure 12. A divergent course between the two crops from 2013 to 2017 can be observed. This can be explained with the higher value that the starch processing compamy Emsland-Stärke offers for field peas. The up and down of the prices are related to the production in the respective years. Generally, the more it was produced, the lower were the prices.

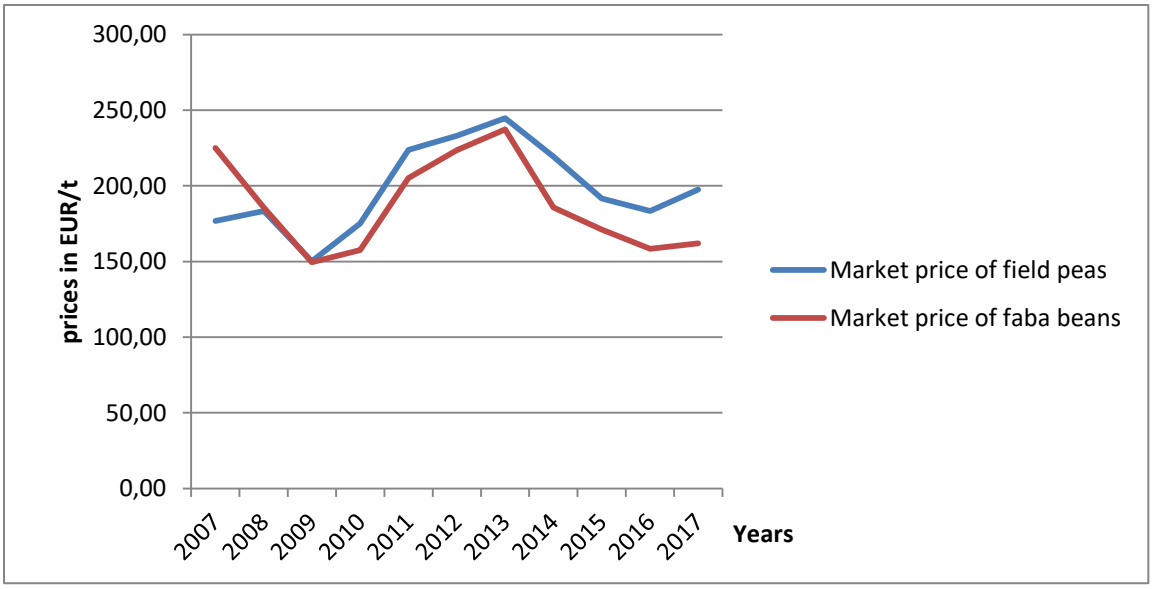


**Figure 12:** The evolution of the whole sale prices of field peas and faba beans from 2007 to 2017, in Germany. Primary source: AMI.

Regional origin and the non-GMO consumption are the main market drivers for these legumes in Germany. Furthermore, a new driving force for the use of grain legumes as feed compound is their low content of phosphorus which reduces the eutrophication and has advantages with regard to legal fertilization requirements. The phosphorus (P) content on the basis of dry matter of rapeseed meal (12.5 % P) and soybeans meal (7.2 % P) are higher than those for faba beans (5.5 % P), field peas (4.6 % P) and lupine (3.2 % P for the blue lupin, 5.6 % P for the yellow lupin and 4.5 % P for the white lupin) (PRIES, 2015; STAUDACHER & POTTHASST, 2014). Furthermore, experts see driving forces for the expansion of legume cultivation in a possible future reduction of rapeseed oil as an admixture of biodiesel from 2020. The resulting lower oilseed rape cultivation could lead to the fact that availability of rapeseed meal reduces and would lead to higher prices for rapeseed meal make grain legumes as substitute more competitive. Therefore the demand of grain legumes in compound feed might increase.

The supply of a secure and more reliable supply of grain legumes is a decisive factor for competitive market development. In Germany, this is largely ensured by some national supportive policies, the formation of agricultural cooperatives and farm networks. The national support policies are varied in the different states, which mainly refers to the programs supporting diverse crop rotations. At the EU-level the consideration of legumes on ecological focus areas promoted their cultivation since 2015. In fact, almost all experts mentioned that the main motivation of growing legumes is the available policy support. As active farm networks at the moment, there are those for peas and faba beans (DemoNetErBo), soybeans (Soja-Netzwerk) and lupine (Lupinen-Netzwerk). The prohibition of crop protection products in ecological focus areas in 2017 will probably reduce the cultivated area and production of grain legumes. This is expected by some experts.

Table 2 summarizes a list of factors that could influence the supply and demand of grain legumes in Germany. They are collected from the conducted interviews.

**Table 2**: Influencing factors on the supply and demand of grain legumes in Germany.

| | **Influencing factors** | |
|---|---|---|
| | **positive** | **negative** |
| **supply** | policy support | low farm-economic viability |
| | legumes networks | restrictions in greening |
| | niche markets | only line varieties on the market |
| | more certified seed | longer break between legumes in rotations |
| | phytosanity on the field | lower availability of pesticides |
| | N- Fixation<br>pre-crop Effect<br>biodiversity<br>ecosystem services | |
| **demand** | regional origin | substitutes |
| | GMO-free consumption | high prices |
| | increasing demand from the industries | acceptance in compound feed |
| | biodiesel without rapeseed | quality (post-harvest treatment) |
| | lower phosphorus content | variation of protein content |
| | higher protein content | suboptimal storage capacity with legumes |
| | lack of alternatives (organic farming) | bean seed beetle |
| | | no guarantee of a constant availability |
| | | ability to be processed<br>lack of technology for processing. |

As for the source of information, some databases were mentioned by the actors. But some of them have expressed their suspicions about the correctness in the databases. Therefore, several channels such as conversations between the stakeholders and trading networks are strongly represented.

A tool or website that provides current and up-to-date prices of domestic grain legumes in Germany could not be identified. There are some institutions and websites that collect and publish several prices of legumes. These prices are specific for different regions in Germany:

- AMI: a subscription is needed to have the raw data. The prices of producers are recorded weekly and reported accordingly. If available, the price ranges are shown in addition to the mean values. Moreover, AMI carries out a calculation of monthly and yearly averages. These prices are available for faba beans, field peas, fresh peas and soybeans for the different regions and for the whole country (aggregated). Table 1 lists some aggregated prices for soybeans, field peas, faba bean, and sweet lupin in Germany. New market information is also available for free on their homepage, (AMI, 2018).
- Proplanta: the wholesale prices (Ger. Großhandelspreise) mainly for soybeans and soybean meal in different regions are frequently published here. Depending on the region, some wholesale prices for field peas and faba beans are also available (PROPLANTA, 2018).

- LLH Hessen: is a regional institution which publishes the producer prices of faba beans, field peas, soybeans and sweet lupines weekly for the region Hessen (LLH, 2018).
- The chamber of agriculture in Sachsen publishes the weekly producer prices of faba beans and field peas for the region Sachsen (LWK SACHSEN, 2018).
- The chamber of agriculture in Schleswig Holstein offers a platform for supply and demand of legumes after registration (LWK SCHLESWIG-HOLSTEIN, 2018). They also publish producer prices of faba beans and field peas for the region Schleswig-Holstein.
- DemoNetErBo: offers a platform for supply and demand of legumes: (DEMONETERBO, 2018). There is a list of stakeholder available that dealing with legume in different regions. A model, according to Löhr, of price calculation for legume is also available on their website. The price depends on the prices of soybeans and wheat, and the utilization: seed multiplication, food, forage for pets, forage for livestock, processors, and export (South Europe).

# 4. Conclusions

The market situation of grain legumes in Germany was analyzed in this report. The focus was on field peas, faba beans and soybeans. Quantitative data were collected from diverse databases and were validated and qualified by guideline-based expert interviews. The reliability of the quantitative data in this niche sector was questioned by some experts. It was suggested that a more frequent and continuous query and publication of data could lead to more precision of legume data by more interest in the data from more stakeholder. Nevertheless, basic connections of production, foreign trade, domestic consumption and partly the use of some grain legumes could be mapped providing a more in-depth understanding of grain legume markets in Germany. The production of grain legumes has continuously increased in the last years. The national consumption of field peas and faba beans has increased, while this for soybeans has decreased. The last couple of years showed a strengthening of foreign trade, mainly with neighbouring countries but also with distant markets like Egypt and India.

The market structure with different actors and the possible connections between them was developed to see the flow of goods on the national level. The main end use for grain legumes is in animal feeding, whereby the own use in compound feed offers the best economic choice for farmers within the current market situation. Therefore, the intra- and inter-farm use of legumes is dominating to different degrees for field peas and faba beans. The processing of field peas to gain starch for food is currently dominating the use in foods and offers an interesting future for the mentioned legume. Except this market, there is a small but emergent market for legumes based products in the food sector in Germany. So far they have a marginal proportion of the total supply of grain legumes. It was shown that market could develop with increasing amounts of the production. This is also linked to factors like consumers' preference for non-GMO consumption, regional origin and reduction of animal based proteins.

Several factors that play a role in the supply quantity and demand on the market were identified. Depending on the involved stakeholder, there are several price indicators used in the flow of goods. The producer prices and wholesale prices were analysed in this report. It has been shown that the prices are influenced by many factors like the uses, the substitutes and the production. Legumes for the use as food are more expensive than those for the use as feed. The essential factor here is the different level of quality. Rape seed meal and soybeans meal, which have high protein content, are substitutes to the domestic grain legumes. Their prices have an influence on those for faba beans and field peas. This only relates to conventional legumes. In the organic farming system where these alternatives are missing the demand is higher. Therefore, it could contribute to the mentioned double prices for organic goods. Furthermore, only the increase in production leads to the decreasing of prices, as it is the case for faba beans. In addition to the increase in the production, the increasing demand, as it is the case for field peas by the starch processing company Emsland-Stärke, could lead to an increase of the prices.

Many experts in this study were not able to make statements about the foreign trade of domestic grain legumes in Germany. On one side, some of them were not aware about an existing foreign trade of field peas and faba beans in Germany. On the other side, some of them questioned the reliability of the data. This calls for better data validation and more effective market information systems in order to give market participants better access to available data.

More interesting than the analysis of single data was to highlight the relative market trends in the last recent years. This should allow to see how the different markets of grain legumes are growing. Non-transparent and fragmented markets for grain legumes in Germany therefore constitute a major barrier for increasing production. A large share of grain legumes does not leave farming and is used as feed either intra-farm or directly between farms without intermediary.

The hopes for a continuous market development of legumes in Germany are based on policy measures. Better justification for public support of grain legumes have to be identified. This could be achieved by making ecosystem services that go beyond farm boundaries more explicit. For agro-ecosystem services being effective within farm boundaries more complete crop rotation assessments are required in order to evaluate grain legumes' benefits not solely on their market generated revenues but also considering benefits to the following crops. Breeding progress could strengthen grain legumes supply in markets. Also important are better market information systems particularly price information systems to make fragmented markets more transparent. This could be a task for policy makers considering grain legumes ecosystem services of which society benefits as a whole. Better market and price information would also lead to better informed economic decisions by actors in the grain legume market. However, it has to be taken into account that better market information might not be in the interest of those actors currently benefiting from fragmented and non-transparent grain legume markets. Generally, having similar market information for the other European countries would be also useful to make better comparisons with other countries having better developed grain legume markets like for example France. The interpretation of the foreign trade for example could be better undertaken in this way.

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# Appendix

## List of the interviewed experts

**Katrin Stevens:** scientific assistant at the FH-SWF in the Department of Agriculture. She is working on the national project "DemoNetErBo" (Farm Network for peas and faba beans) since February 2016. Her main tasks are to advise farmers in the network and the management of the legumes based value chain.

**Petra Zerhusen-Blecher:** scientific assistant at the FH-SWF in the Department of Agriculture since 1989 in different scientific projects. She worked on the national project "Leguan" (2012 – 2014) that aimed to the question why farmers are growing grain legumes, although they are economically unattractive. Now she is working on the national project "DemoNetErBo" (Farm Network for peas and faba beans) since Januar 2016, and her task is to examine the economic viability of grain legumes for farmers and the management of the legumes based value chain.

**Prof. Dr. Bernhard C. Schäfer:** Professor for plant production at the FH-SWF Department of Agriculture Economics since 2002. Beside his occupation in the teaching, he is the scientific director of the experimental farm Merklingsen. He is interested in the renaissance of legumes in the cropping system and therefore is involved in many legume-based projects (GL-Pro, Leguan, DemoNetErBo, LegValue …). As honorary activities, he is the head of the section "protein plants" by UFOP and the chair deputy of the German Agriculture Committee DLG.

**Réné Schwarz:** manager by Raiffeisen vital in Hamm. Agricultural cooperative and compound feed producer. Experience with the use of faba bean in compound feed. Products from conventional farming system.

**Stefan Neumann:** employees since two years by Agrosom. Processor company. Experiences with Extrusion of faba bean and lupines.

**Rudolf Gather:** employees by "Mischfutter Werke Mannheim GmbH (Mifuma) in product management and optimisation since seven years. Compound feed producer. Ecological and conventional products.

**Piet De Vries:** Responsible for buying legumes and rape seed since two years by Ceravis. Trader and compound feed producer. Trading with peas (major as legume), Faba bean and lupin. Products from ecological farming system.

**Michael Mantei:** optimising of formulation of compound feed by ALKA since six years. Trader and compound feed producer. Experiences with Faba bean and peas.

**Stefan Büngener-Schröder:** advisor and optimisation of feed (mainly for pig) by GS agri eG. Compound feed producer. Legumes based feed (Faba bean and peas) only in ecological products.

**Worbest:** saler by Ökoflur. Trader (mainly cereals). Deal with Lupin, Faba bean, Saja and peas. Products from ecological farming system.

**Dr. Michael Hübl:** purchase and sale feed grain, quality management and disposition by Kornbauer. Trader and cooperative. Experiences with Faba bean, peas (both for feed) and Lupine (food and feed). Products from ecological farming system.

**Jan Böse:** international product Manager for pulses by NPZ. A plant breeding company (peas and faba beans).

**Werner Vogt-Kaute:** advisor and ecological breeder by Naturland. Focus on faba bean and peas.

**Andreas Göbel:** marketing consultant by Saaten Union. The only one sales organization of legumes seed in Germany corrently.

**Stefan Flüchter:** farmer; cultivation of rape seed, barley, wheat, mais and Faba bean.

**Pavenstedt:** farmer from Gütersloh. Cultivation of mais and cereals). Conventional farming system.

## Interview guidelines

All questions are always related to legumes.

**Feed Industries und processors**

1) Which legume species do you introduce in your feed compound? (Why these legumes?).
2) What are the levers of legumes on the market? (T3.3)
3) What are the factors that limit the market of this legume? (T3.3)
4) What could be the possible solutions for these negative factors? (T3.3)
5) Are you satisfied with your profit/gain by using legumes? (Difference between the legume species? Which species are more profitable?). (T3.4)
6) What is the main crop in competition with legumes in your feed processing? (T3.2 and T3.4).
7) Who are your suppliers? (national and international)
8) How are the import prices in comparison with the national produced prices? (T3.2)
9) How do the different prices break down? (T3.2)
10) Who defines the prices of your raw legumes? And when? (T3.2)
11) What leads to high prices? (T3.2) [low production, higher demand, …]
12) What leads to low prices? (T3.2) [high production, low storage capacity,…]
13) Specify your qualitative requirement (T3.2 and T3.3).
14) Characterize the storage of your products (capacity, conditions, how long, economic relevance, …), the situation for the other farmers in your country. (T3.2)
15) What is the importance of legume-losses on the market? (During harvest, storage, transport, in %).(T3.2)
16) Who are your Customers? (national and international)
17) Who sells your end products?
18) Do you deal with organic grain legumes?
19) What price differences are between the organic and conventional product? (T3.2)
20) What are the positive factors of organic legumes on the market? (T3.3)
21) What are the negative factors of organic legumes on the market? (T3.3) [the quality, the price, …]
22) On a marketing perspective, what will you say about the future of organic legumes on the market? Maybe in comparison with conventional legumes. (T3.3)

**General questions:**

23) What are the current demand trends of this legume on the market? (T3.1)
24) How/where do you get markets´ information about legumes and what are the obstacles to get them? (Assessment of the data availability). (T3.1)

Is there anything else you would like to add that has not been covered by the questions I have already posed, but is important in the **legumes market**? (We will expect specific answers for each species or general answers for all legumes). (WP3)

**Thanksgiving**

**Traders**

1) With Which legume species do you deal? (Why these legumes?).
2) Do you have any specific motivation to deal with legumes? (T3.3)
3) What are the factors that limit the market of this legume? (T3.3)
4) What could be the possible solutions for these negative factors? (T3.3)
5) What are the levers of legumes market?
6) Are you satisfied with your profit/gain by dealing with legumes? (Difference between the legume species? Which species are more profitable?). (T3.4)
7) What is the main crop in competition with legumes in your business? (T3.2 and T3.4).
8) Who are your suppliers? (national and international)
9) How are the import prices in comparison with the national produced prices? (T3.2)

10) How do the different prices break down? (T3.2)
11) Who defines the prices of your raw legumes? And when? (T3.2)
12) What leads to high prices? (T3.2) [low production, higher demand, …]
13) What leads to low prices? (T3.2) [high production, low storage capacity,…]
14) Specify your qualitative requirement (T3.2 and T3.3).
15) Characterize the storage of your products (capacity, conditions, how long, economic relevance, …), the situation for the other farmers in your country. (T3.2)

16) Who are your Customers? (national and international)
17) What is the importance of legume-losses on the market? (During harvest, storage, transport, in %).(T3.2)
18) Do you deal with organic grain legumes?
19) What price differences are between the organic and conventional product? (T3.2)
20) What are the positive factors of organic legumes on the market? (T3.3)
21) What are the negative factors of organic legumes on the market? (T3.3) [the quality, the price, …]
22) On a marketing perspective, what will you say about the future of organic legumes on the market? Maybe in comparison with conventional legumes. (T3.3)

**Allgemeine Frage:**

23) What are the current demand trends of this legume on the market? (T3.1)
24) How/where do you get markets´ information about legumes and what are the obstacles to get them? (Assessment of the data availability). (T3.1)

Is there anything else you would like to add that has not been covered by the questions I have already posed, but is important in the **legumes market**? (We will expect specific answers for each species or general answers for all legumes). (WP3)

**Thanksgiving**

**Breeders**

1) With legumes species are you breeding? (Why these legumes?).
2) What are your main breeding features? How do you define your breeding features?
3) What are the breeding features of the other legume-breeders?
4) Are there any specific barriers for Legumes breeding? Which Breeding method do you use?
5) How many seed varieties do you have on the market now? How multiply your seeds?
6) What are the factors that limit the market of this legumes seeds? (T3.3)
7) What could be the possible solutions for these negative factors? (T3.3)
8) What are the levers of seed legumes market?
9) Are you satisfied with your profit/gain by dealing with legumes? (Difference between the legume species? Which species are more profitable?). (T3.4)
10) Who are your competitors in the legume´s breeding? (national and international)
11) What is the main crop in competition with legumes in the breeding nowadays? (T3.2 and T3.4).
12) Who defines the prices of your seeds legumes? When and how? (T3.2)
13) What leads to high prices? (T3.2) [low production, higher demand, …]
14) What leads to low prices? (T3.2) [high production, low storage capacity,…]
15) Who are your Customers? (national and international)
16) Do you deal with organic grain legumes?
17) What price differences are between the organic and conventional Seed? (T3.2)
18) What are the positive factors of organic legumes seed on the market? (T3.3)
19) What are the negative factors of organic legumes seed on the market? (T3.3) [the quality, the price, …]
20) On a marketing perspective, what will you say about the future of organic legumes seeds on the market? Maybe in comparison with conventional legumes. (T3.3)

**General questions:**

21) What are the current demand trends of this legume on the market? (T3.1)
22) How/where do you get markets´ information about legumes and what are the obstacles to get them? (Assessment of the data availability). (T3.1)

Is there anything else you would like to add that has not been covered by the questions I have already posed, but is important in the **legumes market**? (We will expect specific answers for each species or general answers for all legumes). (WP3)

**Thanksgiving**

**Farmers and agricultural cooperatives:**

1) Can you describe your farm? (Organic or conventional farming, crop rotations, mixture of cereals with legumes, If yes, for which purposes? (Self-use or selling)

2) Which legume species do you grow? And in how many hectares? For which use? (Food, feed, Processing..)

3) What are your motivations to cultivate these legumes?

5) What are the benefits of legumes to society in general? It is possible to quantified it in Euro?

6) Referring to the advantages of legume like biological nitrogen fixation, break up of crop rotation, diseases control, diversified landscape..., could you estimate the value in Euro per ha for each of these advantages for farmers? (T3.4) [or a general value for these add values]

7) Are you satisfied enough with your profit/gain by planting legumes? (Difference between the legume species? Which species are more profitable?). (T3.4)

8) Who are your customers?

9) Who sells your legumes/ how do you sell your legumes?

10) Who defines the producer prices of your legumes? When and how? (T3.2)

11) What leads to high producer prices? (T3.2)

12) What leads to low producer prices? (T3.2)

13) What is the basis or references for the producer prices? (T3.2) [around 280€/t for fresh pea in France/ this is strongly depend on the price of soybeans, …]

14) Characterize the storage of your products (capacity, conditions, how long, economic relevance, …), the situation for the other farmers in your country. (T3.2)

15) What is the importance of legume-losses after the harvest? (During harvest, storage, transport, in %). (T3.2)

**The legumes market in your country and pricing**

16) Name the most important customers/buyers who work with legumes in your country. (T3.1)

17) Characterize the foreign trade of legume in your country? (import- and export quantity, Import- and export prices, … ). (T3.1)

18) What is the share of the legume production, based on contract farming in your country? (T3.2 and T3.3)

20) Specify qualitative requirement of the customers in your country. (T3.2 and T3.3)

21) How does the qualitative requirement influence the producer prices? (T3.2 and T3.3)

22) How can farmers influence the producer prices of their legumes? (T3.2)

**The 3 three following questions are indirect questions, to have an estimation of the cost, revenues and profit. If the farmers do not understand them, you can ask them directly.**

23) How much is the estimated cost difference of legumes in percentages compared to the most competitive crop based on a one hectare? (T3.2 and T3.4) [number]

24) How much is the estimated revenues difference of legumes in percentages compared to the most competitive crop based on a one hectare? (T3.2 and T3.4) [Number]

25) How much is the estimated profit difference of legumes in percentages compared to the most competitive crop based on a one hectare? (T3.2 and T3.4) [Number]

**Organic vs. conventional farming system**

26) What price differences are between the organic and conventional product? (T3.2)

27) What are the positive factors of organic legumes on the market? (T3.3)

28) What are the negative factors of organic legumes on the market? (T3.3) [the quality, the price …]

29) On a marketing perspective, what will you say about the future of organic legumes on the market? Maybe in comparison with conventional legumes. (T3.3)

Is there anything else you would like to add that has not been covered by the questions I have already posed, but is important in the legumes market? (WP3)

**Thanksgiving**

## Unit values for the foreign trade of grain legumes

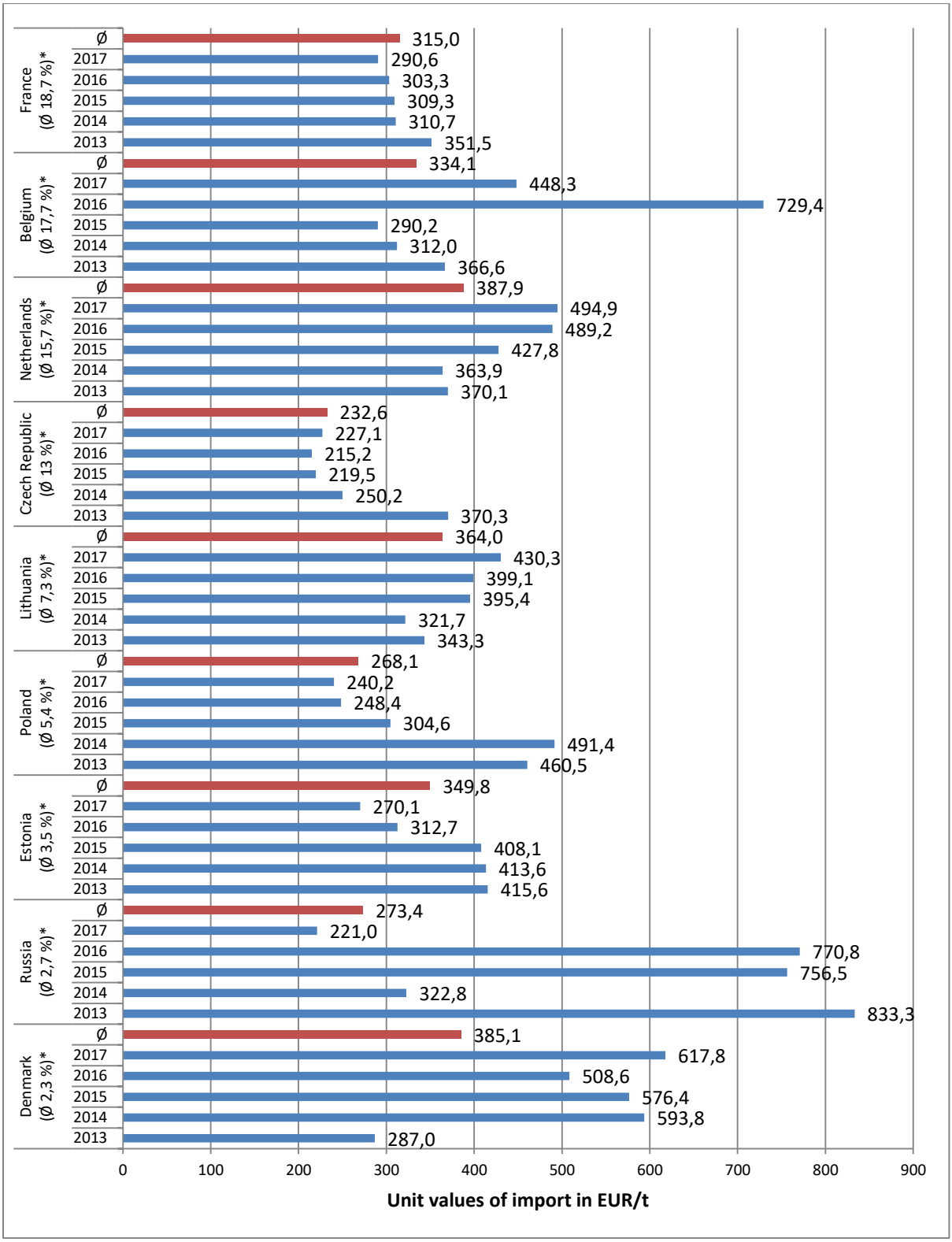


**Figure 13:** Unit value of field peas imports in Germany with different foreign trade countries. The illustrated countries are ranked descending in terms of their average of trade quantity from 2013 to 2017. (*): is the share of imports on average over these four years. (Primary source: Destatis, April 2018).

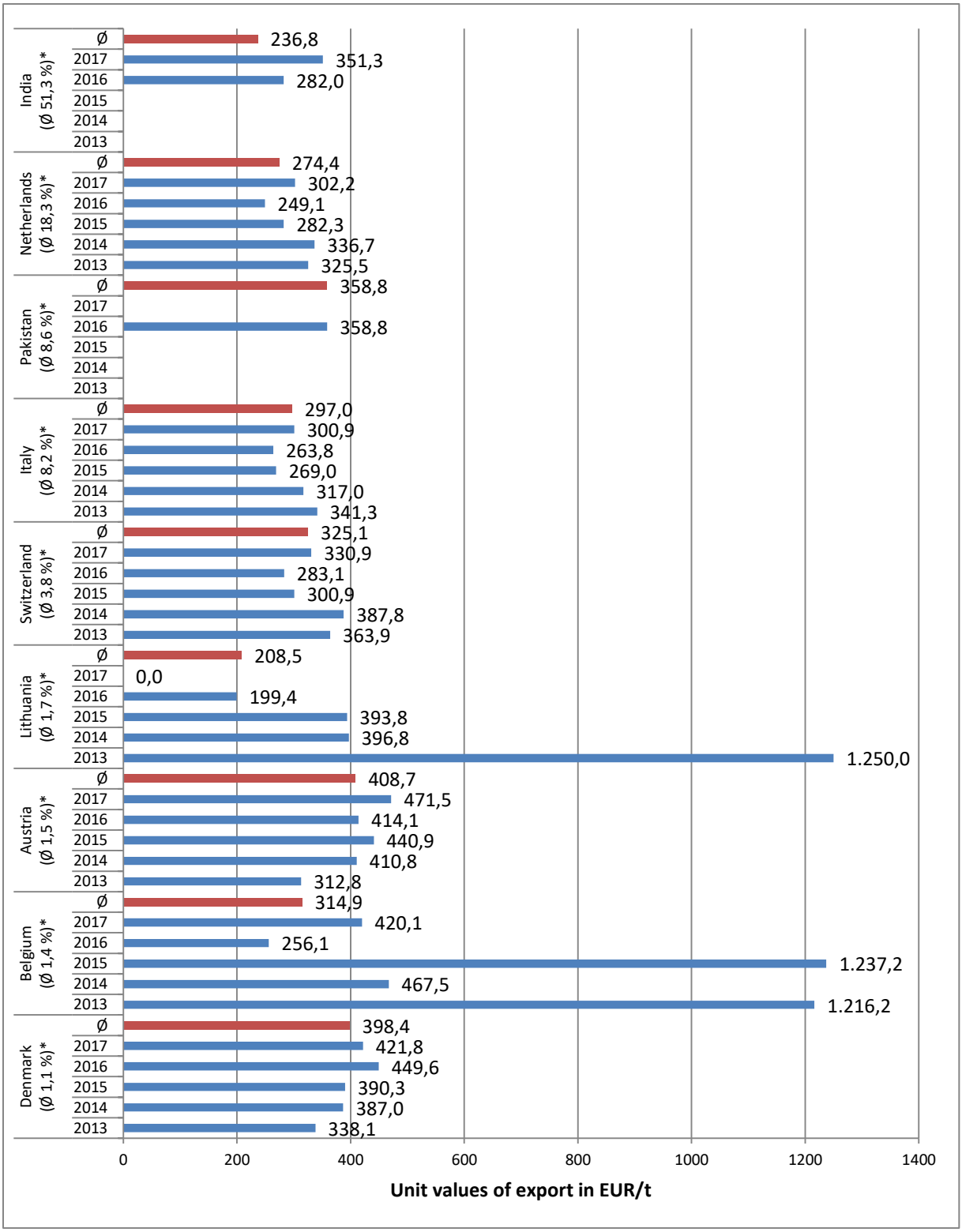


**Figure 14:** Unit value of field peas exports in Germany with different foreign trade countries. The illustrated countries are ranked descending in terms of their average of trade quantity from 2013 to 2017. (*): is the share of imports on average over these four years. (Primary source: Destatis, April 2018).

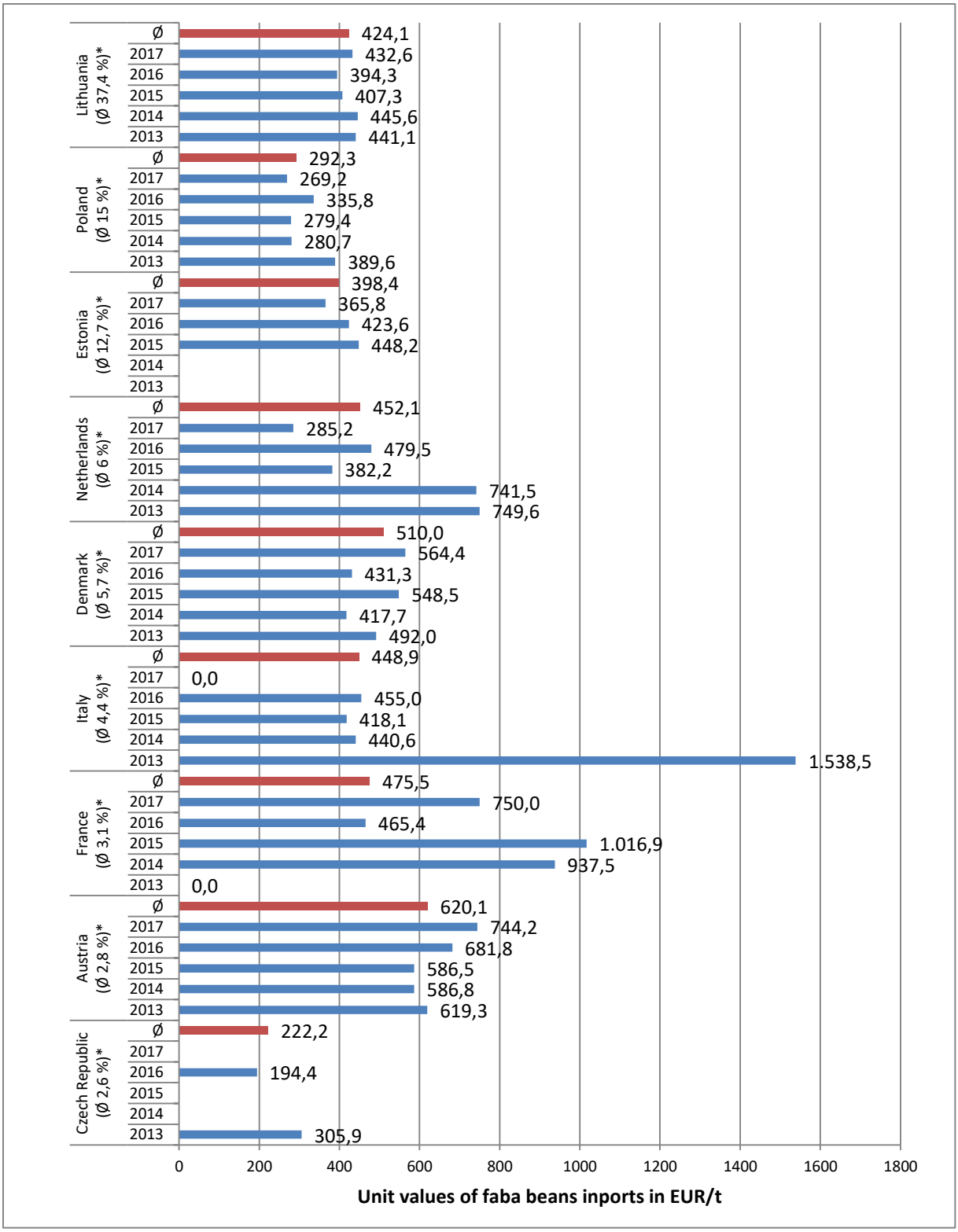


**Figure 15:** Unit value of faba beans imports in Germany with different foreign trade countries. The illustrated countries are ranked descending in terms of their average of trade quantity from 2013 to 2017. (*): is the share of imports on average over these four years. (Primary source: Destatis, April 2018).

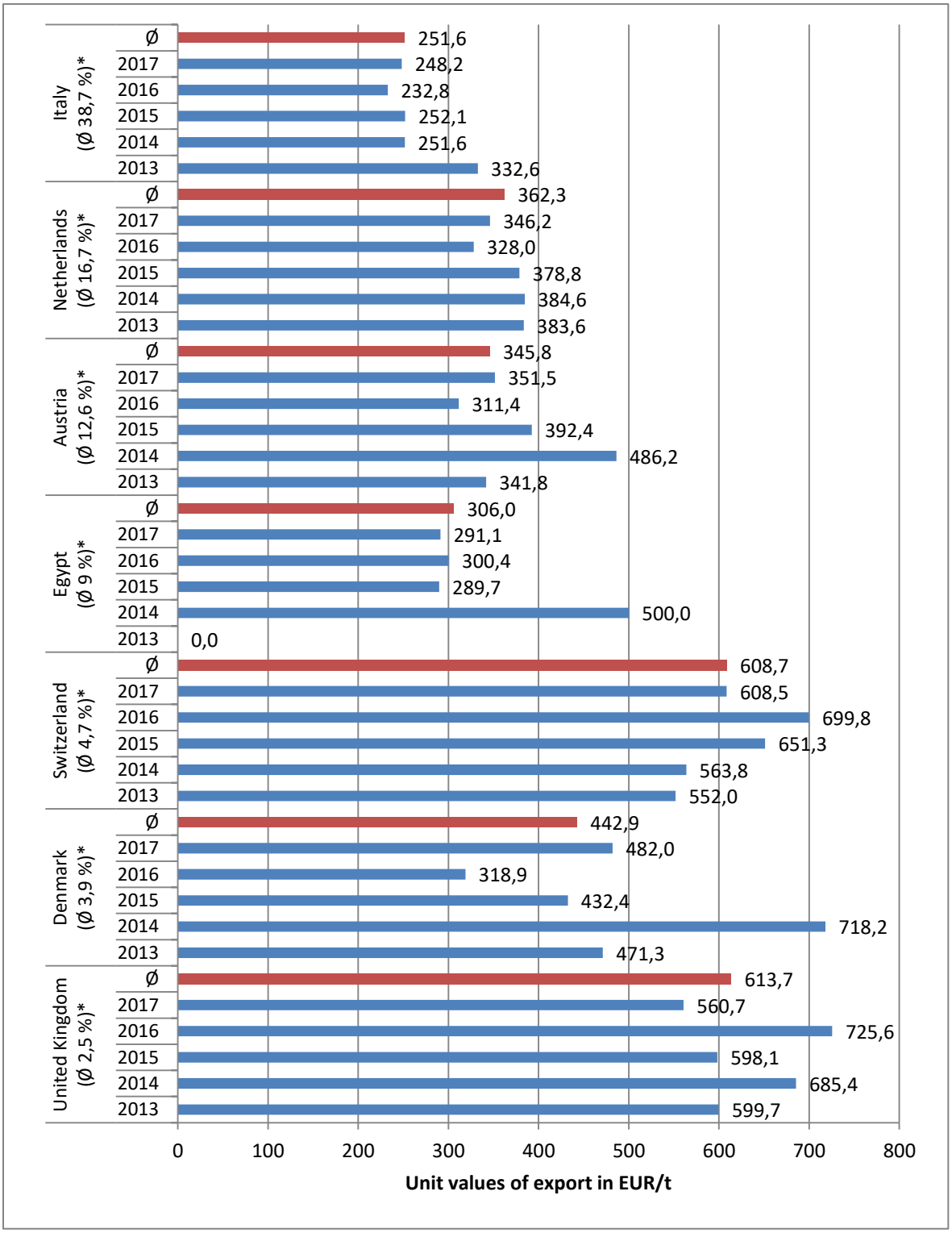


**Figure 16:** Unit value of faba beans export in Germany with different foreign trade countries. The illustrated countries are ranked descending in terms of their average of trade quantity from 2013 to 2017. (*): is the share of imports on average over these four years. (Primary source: Destatis, April 2018).