



DRIVERS OF CHANGE AND DEVELOPMENT IN THE EU LIVESTOCK SECTOR

Meta Analysis as basis for future scenario building

Study carried out by
Federal Office for Agriculture and Food (BLE), Germany

Under the Project:
Support Action to a «Common Agricultural and
wider bioeconomy reSearch Agenda» (CASA)



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Definitions and abbreviations

AEM	Agri-Environmental Measures
AES	Agri-environmental scheme
ATF	Animal Task Force
CAP	Common Agricultural Policy
CASA	“Support Action to a common agricultural and wider Bioeconomy research agenda” (CASA)
challenge	based on CAP objectives, SDGs, Paris Agreement
CWG-SAP	Collaborative Working Group on Sustainable Animal Production
CWG-SAP CASA study	study carried out under the “Support Action to a common agricultural and wider Bioeconomy research agenda”
driver	influencing variable that catalysts change and modulation of a complex system
EAFRD	European Agricultural Fund for Rural Development
EU	European Union (reference: date of the study, pre-Brexit)
GHG	greenhouse gas
ICT	Information and communication technologies
LFA	Less-Favoured Areas
LSU	livestock unit
NUTS	Nomenclature des unités territoriales statistiques
RDP	Rural Development Policy
SCAR	Standing Committee on Agricultural Research
UAA	utilised agricultural area
UNFCCC	United Nations Framework Convention on Climate Change

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Foreword

Providing people with products of animal origin has always been a matter of considerable, albeit changing, importance. The factual premises for ensuring that people living in the Member States and the European Union have an adequate supply of such products have evolved in recent decades. Since the 1950s, the scientific support for and development of the individual fields of expertise around animal husbandry has been growing. To this end, a whole array of analyses has been conducted and measures have been discussed and implemented. As the decades have passed, priorities have shifted. The aim in the 1950s was to produce as much food of animal origin as possible and to subsequently offer these products to the consumer in sufficient quantities and at an attractive price. This was followed by a period which required the regulation of such huge quantities. The (intrinsic) quality of products was also improved. The last two decades in particular have also seen consumer behaviour focus increasingly on process quality, as more issues regarding animal husbandry and aspects of animal welfare are addressed and scrutinised, for example.

In order to strike a balance between the different factors and to identify areas where research is needed, the EU Standing Committee on Agricultural Research (SCAR) set up a Collaborative Working Group on Sustainable Animal Production. The aim of this body was, and is, to record and assess a wide variety of fields.

The present study was designed to set out the analyses developed to date over recent decades in the EU as well as in the Member States, as well as to describe the instruments used and the implications they have. Policy-makers, administrators and economic operators therefore have at their disposal a 'tool kit' which can also be used to help tackle future tasks.

On this basis, scenarios are to be developed for the work that lies ahead and guidelines drawn up for future sustainable animal production. In turn, other research needs will be identified and corresponding projects launched in an effort to fill any gaps in knowledge. I would like to take this opportunity to offer my sincere thanks to CASA for providing funding, to the authors for their high degree of commitment and dedication and to everybody else involved for their collaboration.

Dr. Bernhard Polten, Federal Ministry of Food and Agriculture - Germany

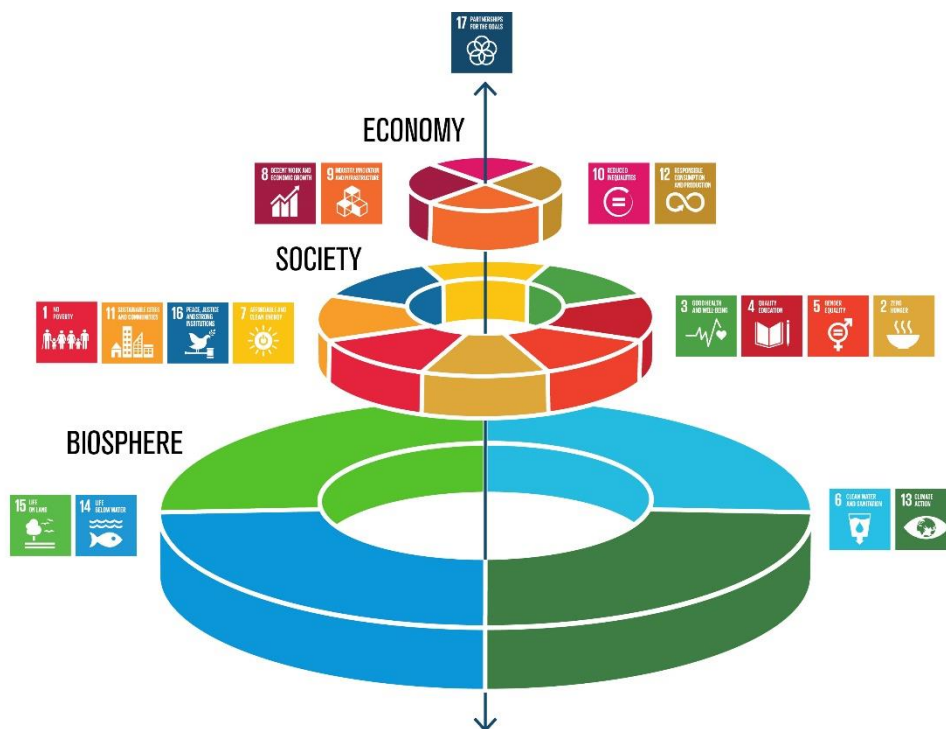
Chair of the CWG-SAP

Bonn, June 2019

1. Introduction

The Collaborative Working Group on Sustainable Animal Production (CWG-SAP) defined sustainable animal production as “economically viable, socially acceptable, with minimal impact on the environment” (“p-approach”: people, planet, profit). According to its Terms of Reference (2019), **CWG-SAP agrees that, in line with UN sustainability goals (Figure 1), future development of the European livestock production sector will need to build on this sustainability triangle – environment, economy and society – and that more sustainable animal production systems:**

- » minimise emissions to soils, water and to the atmosphere;
- » use natural and non- or poorly renewable resources prudently and efficiently;
- » protect and enhance biodiversity,
- » provide public goods and cultural services;
- » meet societal needs and values;
- » provide worthy livelihoods for current and future generations of animal farmers and farm workers;
- » are competitive and resilient over the entire production chain;
- » rely on breeding of robust and resilient animals;
- » rely on sustainable and resilient farming systems;
- » have the highest welfare standards;
- » make efficient use of feed taking into account all aspects of feed utilisation, also with a view to feed/food competition;
- » convert non-edible feedstuffs into valuable human edible protein;
- » convert farms' waste into valuable energy resources (biodigestors)
- » improve overall animal productivity;
- » provide animal products of high quality and nutritional value as well as of good value for money for consumers and the processing industry.



Graphics by Jerker Lönnstedt/Kaste

Figure 1: Sustainable development goals “Wedding Cake” (Azote for Stockholm Resilience Centre, Stockholm University)

However, while undoubtedly progress has been made in some of the sustainability goals concerned, livestock production is not yet sustainable in the sense of the definition by CWG-SAP. In recent decades, the agricultural sector including farmers but also the policy makers and the Member States that shape the framework for the sector, has been facing many challenges like the fight against hunger, ever more tough quality and hygiene targets to protect the consumer and competition in a global market, to name a few.

With a view on the CWG-SAP sustainability goals, this study carried out under the “Support Action to a common agricultural and wider Bioeconomy research agenda” (CWG-SAP CASA study) therefore reflects on the development of the EU livestock sector in the last 60 years and the challenges it had to face. The CWG-SAP CASA study considers the main drivers for farmers and livestock owners including the Common Agricultural Policy (CAP) as one of the most important political drivers of the European Union dating back to the Treaty of Rome in 1957. The retrospective was completed by expert consultations to assess the dynamics which led to the present situation of the EU’s livestock sector and which impacted the development of a more sustainable livestock sector thus far.

The conclusions from this CWG-SAP CASA study provide a background for future scenario building and the development of prospective pathways towards a more sustainable animal production sector in future and provide scientific substantiated guidance on how best to face the many challenges and how to fulfil the objectives set by market and policy with a minimum of trade-offs.

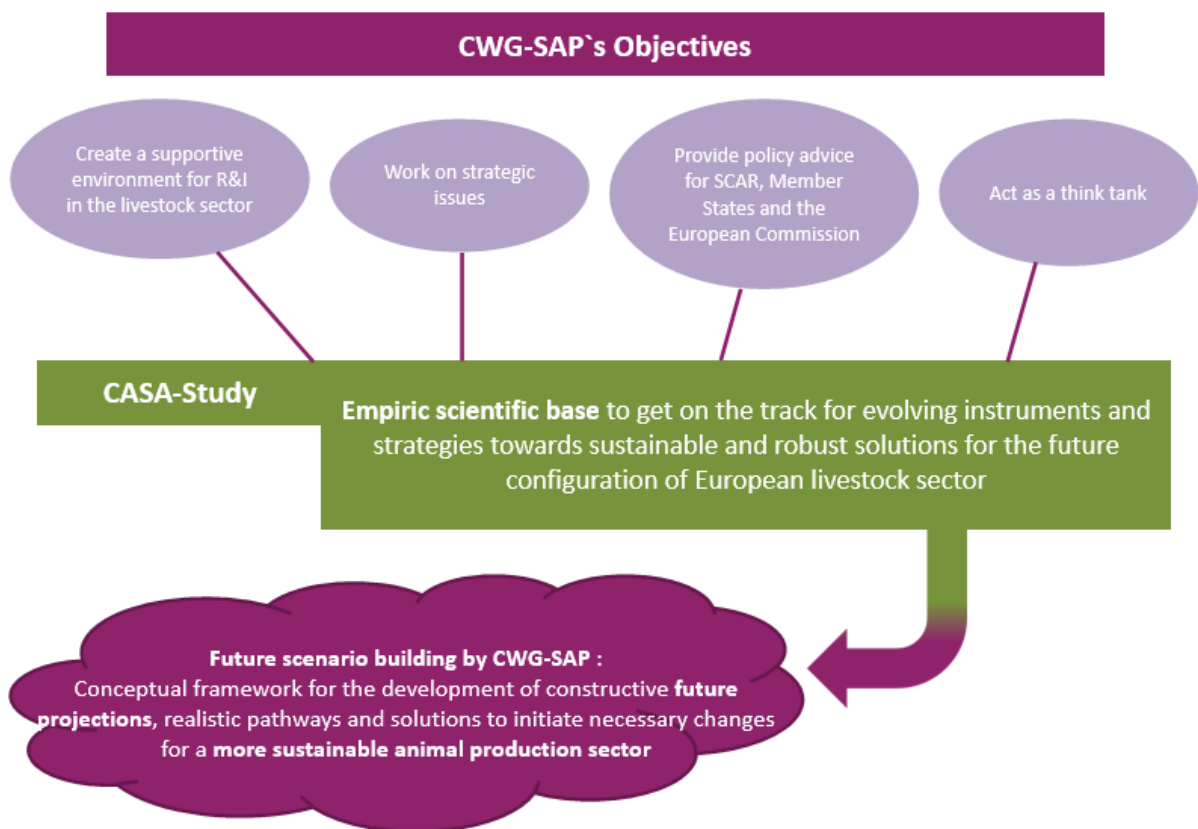


Figure 2: CWG-SAP's objectives and the aim of the present CWG-SAP CASA study

2. Methods

The CWG-SAP CASA study is a desk-top research based mainly on literature referenced in Chapter 9 and experts' consultations via questionnaire as detailed below and Annex 1.

For the desk-top research, publications from a wide range of sources including research project outcomes and communication by the European Commission dealing with the history of EU livestock production, CAP and drivers of change in agriculture and livestock sector were sought. The following limitations apply:

There is a wealth of literature dealing with the development of the European livestock sector in general and the influence of particular political instruments or economic trends from a global level down to the national or regional level. Individual literature studies and scientific papers (see references in Chapter 9) analyse, for example, individual drivers of change and their effects on the livestock sector in the European Union or a specific Member State. Additionally, the website of the European Commission also provides substantial background information on important topics regarding sustainable animal production, the historical development of the CAP as well as explanations and definitions of policy issues at European and national levels. Due to the large timespan and thematic scope of the retrospective analysis of the driving forces that led to the current status quo of the EU livestock sector, the cited literature references and figures included in this study can therefore not claim completeness or prioritisation. In the limited timeframe for the completion of the CWG-SAP CASA study of three months (after the official approval of CWG-SAP continuation by SCAR), the analysis of the reference literature had to be cursory.

In Chapter 4, particular aspects of the driver categories and their implications on the EU's livestock sector are listed exemplary. The listing of the categories is random and does not reflect a ranking of relevance. As all driving forces are interacting dynamically and are mutually dependent the division into categories is only for reasons of clarity.

The description of the European livestock sector in this study can only reflect a very general view: given the time span, European Union refers to a dynamic constellation of Member States from originally six countries in the European Economic Community to currently 28 countries in the European Union. The national implementation of CAP and EU legislation varies between the countries and so do its effects. There are significant differences in livestock production systems between the countries and even regionally on a national level.

Based on the findings of the desk-top research, a questionnaire was created (see annex 1). The objective of the questionnaire was to highlight the significance of the drivers of change and to identify the level of implementation of sustainability in the EU livestock sector. In the first part, the listed drivers of change that influenced the livestock sector during the last decades were to be ranked to establish the influence of each driver on the status quo of the livestock sector. The relevance of each driver was to be assessed on a national, international and global level. In addition, other relevant drivers could be added, if an important influencing factor in the listed compilation was missing. The second part of the questionnaire focussed on the sustainability of the livestock sector. Referring to a sustainability triangle (Figure 24) the status quo of sustainability in the livestock sector had to be evaluated. Furthermore, current EU policy instruments and the most important drivers for a sustainable livestock sector were highlighted by the international experts.

251 experts from all over the European Union were asked to complete the questionnaire based on their expertise as economist and/or agricultural scientist or from a farmers' association and with consolidated knowledge about EU agricultural policy in general and the livestock sector in particular. In the course of the response, 51 questionnaires were evaluated for this study (response rate of 20%). The following tables describe the composition of the returned and evaluated questionnaires. Table 1 lists the countries from which responses were received as well as the number of responses per country. The experts were asked to indicate their respective fields of expertise, for which a selection should be made on the first page of the questionnaire. Table 2 shows how the expert field is

distributed in relation to the 51 questionnaires evaluated. The evaluated questionnaires represent a coverage rate of 61% from the EU-28 Member States (17 out of 28).

Table 1 Composition of questionnaire returns in relation to the EU country considered

Experts from Countries	Completed questionnaires
Austria	1
Belgium	2
Denmark	5
Finland	2
France	2
Germany	4
Greece	1
Italy	2
Latvia	1
Lithuania	2
Netherlands	2
Norway	3
Slovenia	4
Slovakia	3
Spain	11
Turkey	3
UK	3
Σ 17	Σ 51

Table 2: Overview of the respective expert affiliation of the 51 evaluated questionnaires

Field of Affiliation*			
Researcher	Governmental Agency	NGO	Other
31	12	3	7

(*different sum than table 1, as some participants have indicated two fields of affiliation)

3. The status quo of livestock production in the European Union

Livestock production in the European Union is a large economic sector and products of animal origin make up 45% of the EU's agricultural production value. It contributes substantially to the European economy (€168 billion annually, 45% of the total agricultural activity; whereby the national average is much higher in Ireland (74.2%), Denmark (66.4%), UK (60.2%) and Belgium (58.9%) as it depends on the total number of livestock at a national level; ATF, 2017b). The European Livestock sector generates jobs for almost 30 million people (ATF, 2013). "Mixed crop-and-livestock and dairy farms account for the largest share of jobs (37% and 25%), far ahead of pig and poultry farms (8%)" (ESCO INRA, 2016). This is due to the fact, that pig and poultry farms nowadays are typically large farms with high animal

numbers and are characterized by a high standard of mechanisation, which allows for a lower intensity of manpower. Typically, the average European livestock farm is managed by 1 to 2 workers. Family labour continues to decline, and is increasingly replaced by salaried employees, agricultural labour services or other new collective/collaborative arrangements (ESCO INRA, 2016). There are few young farmers in the EUs agricultural sector: 11% of farm managers in the EU are young farmers under the age of 40 years, whereas one third (32%) of farm managers in the EU are 65 years of age or more (referring to the year 2016; Eurostat 2019c). In addition to the economy-supporting potential of labour generation, the animal production sector also enables livelihoods in rural areas and has the potential to bring about a better functioning circular bio-economy (ATF, 2017a).

The **EU livestock population** consists of several species: in 2017, 88 million bovine animals, 150 million pigs and 100 million sheep and goats were held in Europe (Eurostat, 2018). Official numbers of poultry in the EU are not available, but Figure 3 shows the distribution of the livestock population in EU-28 and the different Member States converted to the percentage share in terms of totally kept livestock standard units (LSU).

The majority of livestock numbers is concentrated in just a few Member States. Regarding the bovine population 21.0% is located in France, 13.9% in Germany and 11.1% in United Kingdom. 20% of the European pigs can be found in Spain, 18.4% in Germany and one third is equally divided between France, Denmark, the Netherlands and Poland. About half of the sheep population (45%) is located in the United Kingdom and Spain, whereas the largest proportion of goats is held in Greece and Spain. Figure 4 shows the livestock population in LSU by type in the different Member States.

Livestock population in livestock units by type, EU-28, 2016

(% of total livestock units)

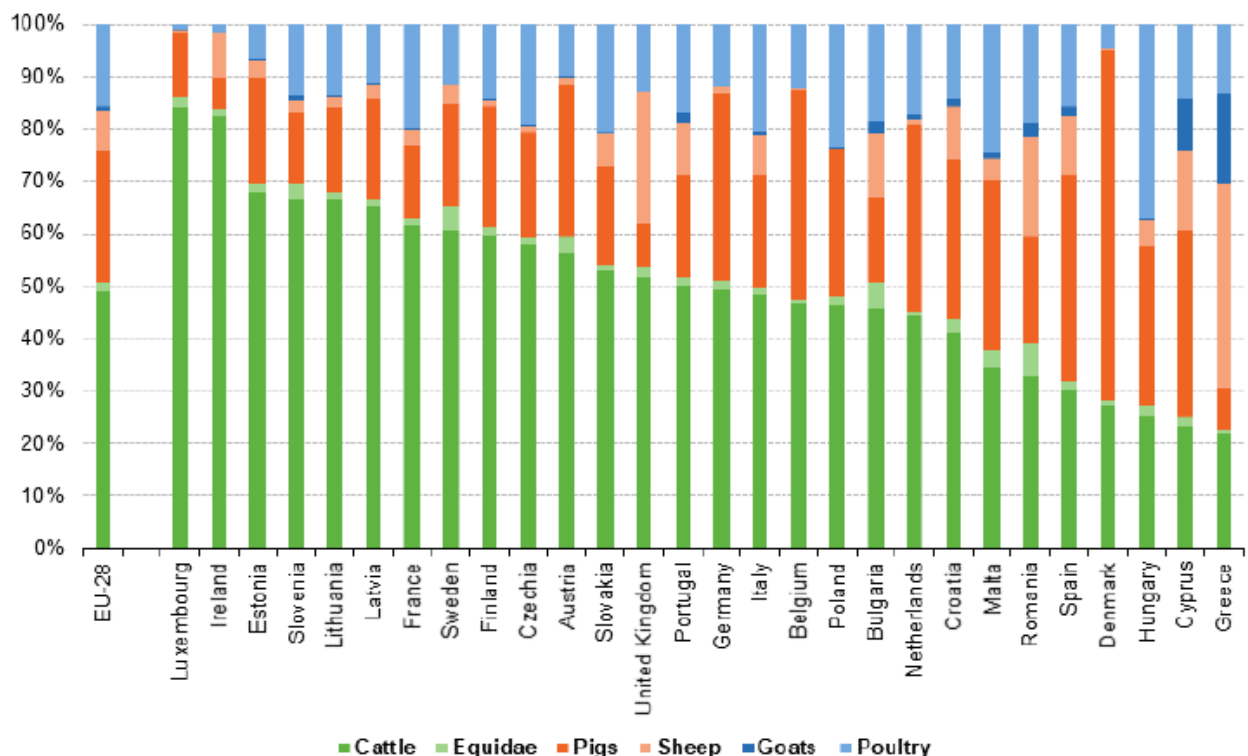


Figure 3: Livestock population in LSU by species in EU-28, 2016 (percentage of total LSU) (Eurostat, 2019b)

On average, the **European livestock density** reached 0.8 LSU per hectare utilised agricultural area (UAA) in 2016 with a high level of variation according to livestock systems, countries and regions. Ranging from 0.2 in Bulgaria to 3.8 in the Netherlands (Eurostat, 2019). A third of all farm animals (especially dairy, pigs, and poultry) are held in Denmark, the Netherlands, northern Germany and western France (ATF, 2017a).

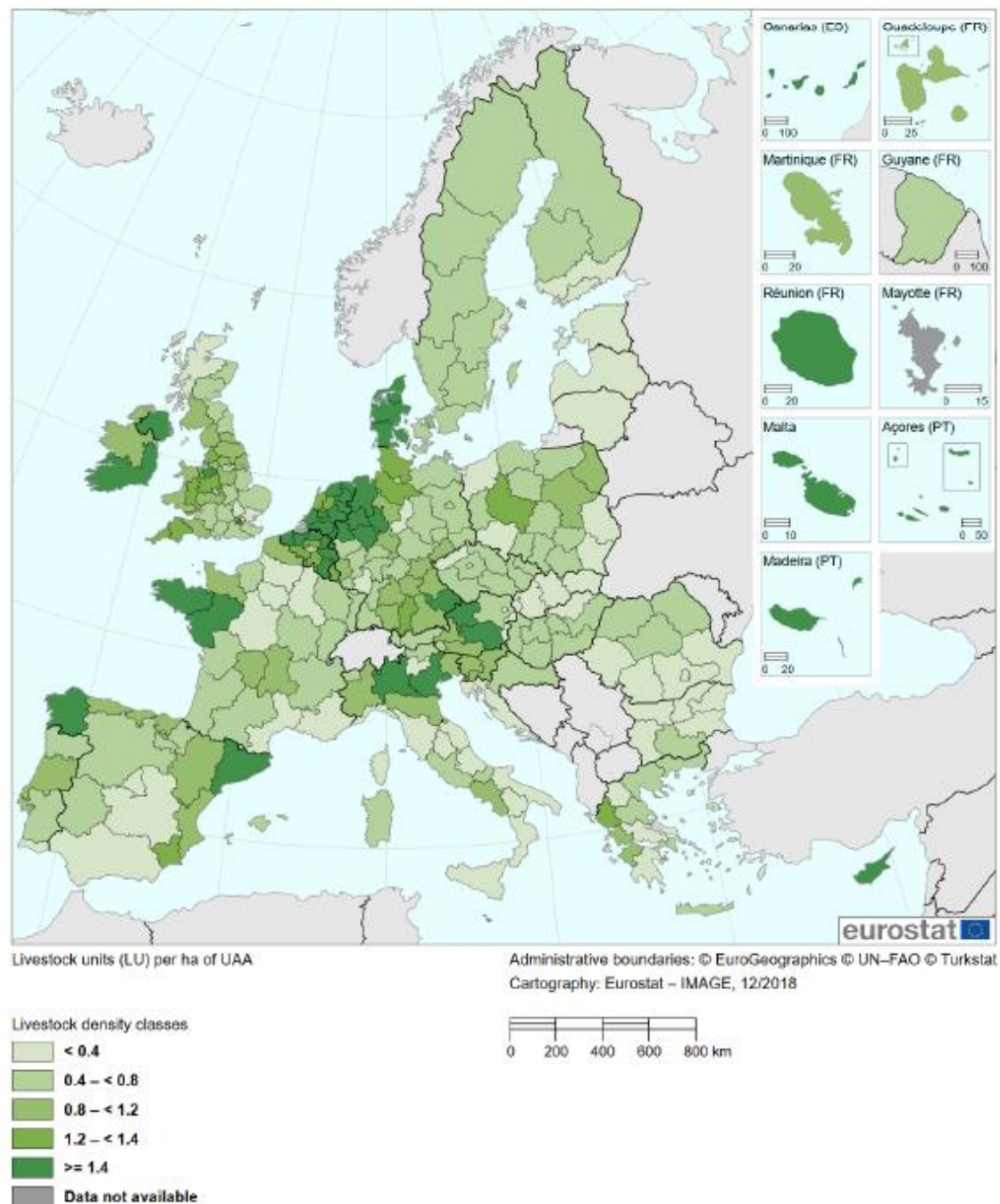


Figure 4: Livestock density by NUTS 2 regions, EU-28 in 2016 (LSU per ha UAA) (Eurostat, 2019b)

Throughout the EU the livestock sector is a major player of the agricultural economy and its land use. The relative importance of different subsectors varies enormously among Member States, influenced at the same time by cultural values and bio-physical conditions (pork in Spain and beef in Ireland), while economic conditions also interfere (small ruminants often playing a larger role in more subsistence production oriented economies). Within each subsector a range of production systems occurs. Even though a trend has been seen in the last decades to increasing intensification and larger farm units in all Member States, diversity of farming systems remains large. This is explained by the biophysical conditions in different regions of Europe, pushing farmers in countries with short vegetation period or insufficient rain to more intensive production (high input/output systems) while

wet lowlands in mild climate or mountainous regions extensify animal raising (low input/output systems). The situation was particularly dynamic in the eight Central Eastern European countries accessing the EU at the 2004 enlargement. On average, productivity in this eight countries is well below EU-15 average and a continuing increase is expected. Nevertheless, the bulk of livestock products are supplied by very large entities, for example in 2004, 39% of milk in EU-15 was produced by 11% of the dairy farms with milk quota over 400,000 kg.” As cited by Leip et al. (2010). The authors state that large pig farms (with more than 2,000 animals) represent only 0.3% of EU fattening pig farms, but they contain 16% of the EU’s pig population. Furthermore, large poultry farms (with more than 40.000 animals) represent only 0.1% of laying hen farms, but contain 59% of the EU’s laying hen population.

Relevant products of animal origin are foodstuffs like eggs, meat, milk and honey as well as other products with importance for human usage like wool and leather. In the following paragraph, details about production and consumption of foodstuff of animal origin in the EU is provided.

Egg production

After China, the EU is the world’s second largest egg producer. A total number of 400 million laying hens are kept in different housing systems among the EU. Half of them (53%) are kept in enriched cages, 27% in barn systems, 15% in free range and 5% are in organic holdings (Eurostat, 2018). European laying hens produce more than 7.5 million tonnes of eggs each year, of which about 10% consists of hatching eggs. Seven EU Member States account for 75% of the overall production. Those major producers are France, Germany, Italy, Spain, the United Kingdom, the Netherlands and Poland (European Commission, 2019a).

For egg and egg products, the EU has a self-sufficiency of about 105%, and therefore is a net exporter of eggs and egg products. Eggs and egg products are exported for an annual value of more than €200 million, mainly to Japan and Switzerland whereas imports of eggs and egg products have increased during last years, with the main sellers being the US and Ukraine (European Commission, 2019a).

Meat production

The EU produces 45.2 million tonnes of meat, of which 23.4 million tonnes are pork, 15.0 million tonnes are poultry meat and 7.8 million tonnes are bovine meat (beef and veal) (referring to the year 2017, Eurostat, 2018). Figure 5 shows European meat production by species over time between 2010 and 2017.

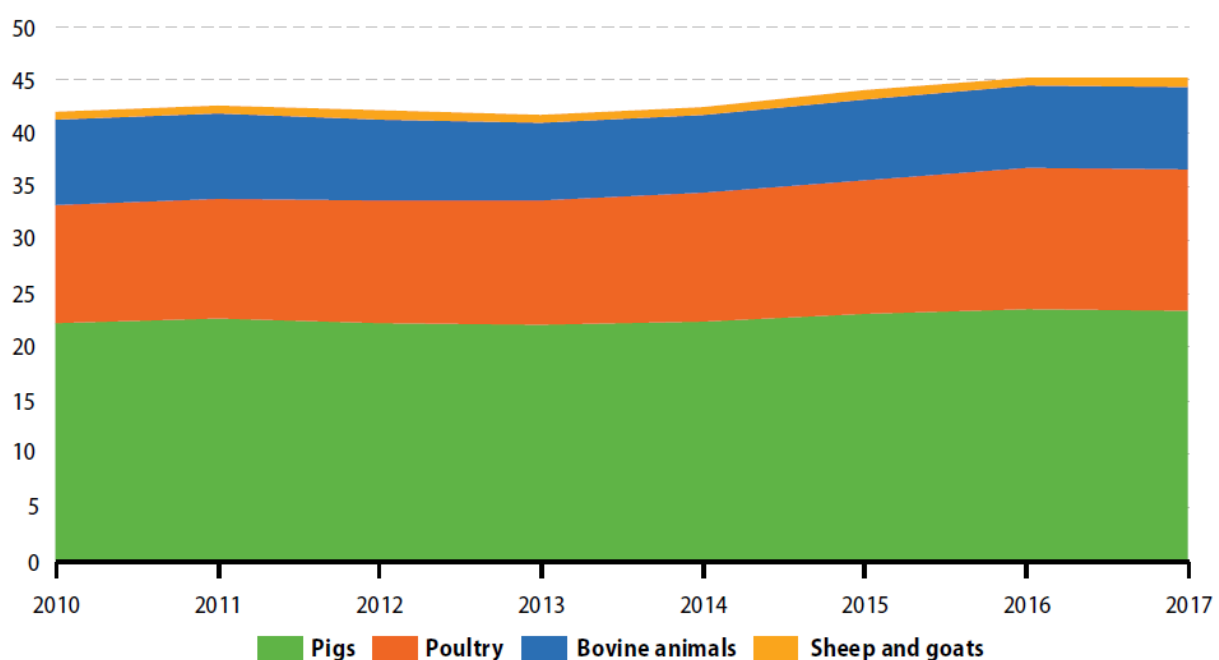


Figure 5: Production of meat, by species, EU-28, 2010-2017 (million tonnes of carcass weight) (Eurostat, 2018)

As mentioned before there is a wide variety of livestock density and main livestock species held among the Member States. In connection to this also the amount and type of meat produced in the different Member States varies. Figure 6 illustrates the country of origin of meat from different livestock species. Europe's self-sufficiency rate differs among the respective products of animal origin and both import and export shapes the European livestock sector also in the global context.

More than half of the EU's **beef** (54%) is produced by the four Member States France, Germany, Italy and the United Kingdom. The EU's self-sufficiency rate of beef is 102%.

Veal is mainly produced in Spain (25.1%), the Netherlands (23.0%) and France (19.3%).

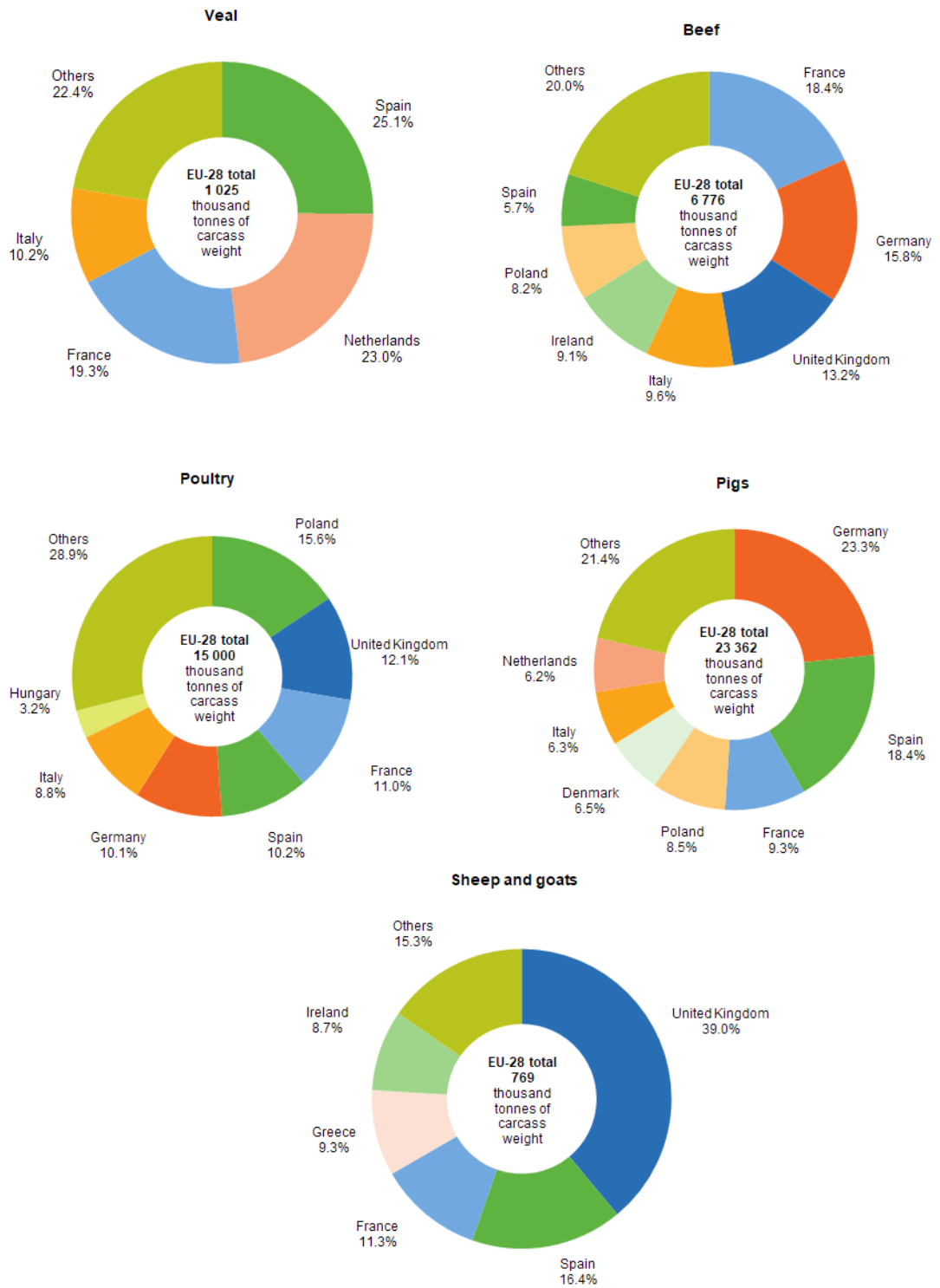
After China, the EU is the world's second biggest producer of **pork**. The EU has a self-sufficiency of about 111% for pork and pork products and exports about 13% of its total production, which represents the world's largest exporter for pork and pork products. Most of the EU's pork exports go to East Asia, in particular China. Within the EU, one quarter of the overall production originates from Germany (23.3%, 5.5 million tonnes). The second largest pork producing Member State is Spain, which provides 18.4% of the total amount (4.3 million tonnes).

In terms of both global **poultry meat** production and exports the EU takes a third position after the USA and Brazil. Mainly products of lower value are exported from the EU, whereas imported goods are high value poultry products, like breast meat and poultry preparations from Brazil, Thailand and Ukraine (European Commission, 2019a).

Beside the meat production from the main species of beef, pig and poultry, **sheep and goat meat** is also of relevance for European citizens. Traditional grazing systems for sheep and goats are part of the landscape and cultural heritage in many countries of the EU. These extensive livestock systems provide a source of employment in disadvantaged agricultural areas and enable the production of high quality, traditional products like cheese varieties, which "are broadly recognised as the result of a sustainable and multifunctional form of agriculture that contributes to preserving the environment and social cohesion in rural areas" (Rossi, 2017). Production of sheep and goat meat accounts for less than 2% of total EU meat production. With a yearly production of about 1 million tonnes carcass weight (85% sheep and 14% goats), the EU livestock sector is not self-sufficient for sheep and goat meat. Around 20% of the EU's sheep and goat meat consumption is imported from New Zealand, Australia and Mercosur countries. Also live sheep are imported from both New Zealand and Australia. Despite the self-sufficiency rate, the EU also exports in this sector. Live sheep are traded mostly to the Middle East and North Africa and sheep meat is shipped to the Far East. In Europe, sheep and goats are often kept in economically vulnerable areas like mountain regions. Different breeds of sheep are kept: heavy lambs are produced in the UK and Ireland, light lambs are reared in southern regions like Greece and Italy, often in combination with sheep milk production. However small the overall production of sheep and goat meat is in the EU, it plays an important role in some individual Member States. In Greece the value of sheep and goat meat production represents almost half of the total livestock production value and in the UK and Ireland sheep meat respectively accounts for almost 8% and 6% of the total meat produced (Rossi, 2017). Detailed information about the sheep and goat sector in the EU is provided by a briefing for the European Parliament by Rossi (2017).

Production of meat, 2017

(% share of EU-28 total, based on tonnes of carcass weight)



Note: The EU-28 aggregates correspond to the sum of the Member States for which data are available.
 Source: Eurostat (online data code: apro_mt_pann)

Figure 6: Production of meat in Europe by species in 2017 (Eurostat, 2019)

Milk production

The production of **milk and dairy products** is of high value for the European livestock sector as they account for approximately 15% of agricultural output. Furthermore, the EU is a major player in the world dairy market as the leading exporter of many dairy products, most notably cheeses (European Commission, 2019a).

Milk is produced in every single EU Member State without exception. European dairy farms have an annual production of 170.1 million tonnes raw milk originating from different dairy species, whereas cow milk represents the most important component (referring to the year 2017, Eurostat 2018). Figure 7 displays the utilisation of milk produced on European dairy farms.

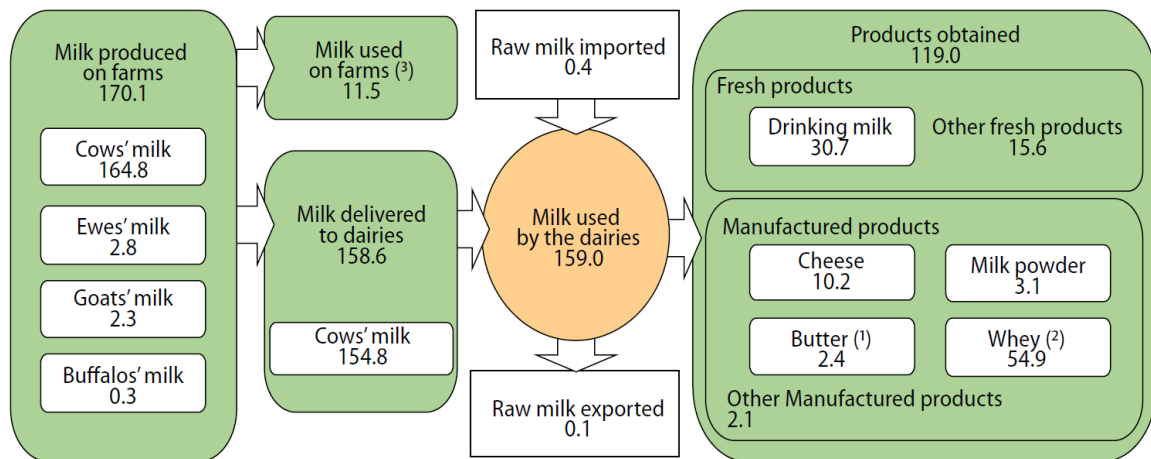


Figure 7: Production and use of milk, EU-28, 2017 (million tonnes) (Eurostat, 2018)

The highest amount of cows' milk is produced on farms in Germany, France and the United Kingdom, accounting for 20.6%, 15.9% and 9.8% of the total collection of cows' milk by dairies (Eurostat, 2018). Clearly, cows' milk dominates the European market of dairy milk, whereas in Greece the majority of milk delivered to dairies (57.1%) originates from ewes and goats. Production of sheep and goat milk is mainly (92%) concentrated in five Member States: Greece (24%), Spain (23%), France (19%), Romania (14%) and Italy (12%) (Rossi, 2017). The largest share of sheep and goat milk is used for manufacturing cheese, whereby cheese products from sheep, goat or mixed milk accounts for 9% of the EU's total cheese production. The highest amount cheese manufactured from ewe's pure milk is produced in Spain, Italy and France, accounting for 93% of the EU's total production.

Due to genetic selection, the production potential of dairy cows has increased rapidly during recent decades. Relating thereto, the overall number of dairy cows in the EU has decreased in recent years. In 2018, the European livestock sector included around 23 million dairy cows with an average yearly milk production of 7,000 kg per cow, whereas production yield differs among breeds and production systems. The Holstein Friesian is the most commonly used dairy cow breed in the EU.

Honey production and beekeeping

Beekeeping is a small but important part of the European livestock sector. Many crops that are essential for the human diet like most fruits, vegetables, nuts and oil crops depend on pollination. Honeybee colonies therefore have a key role in food production and contribute to a functional environment and to the development of rural areas. Beekeeping can be found in all EU countries and is composed of a diversity of production conditions for both hobby and commercial beekeeping. Several Member States have a beekeeping sector that is an important component of their agriculture and rural areas (Romania, Spain, Hungary, Germany, Italy, Greece, France and Poland; in no weighted order). Due to beneficial climate conditions, the highest production rates are in the southern Member States of the European Union (Eurostat, 2018). A total number of 650,000 beekeepers in the EU produce **honey**, which means that bees contribute to their household's income. The average number of hives per beekeeper is 21 and the estimated average honey yield per beehive and year equates 22

kg (European Commission, 2019b). A total of 17.5 million beehives produce 230,000 tons of honey per year, which accounts for 12% of the world production. This makes the EU the world's second biggest honey producer after China where 29% of the world's honey is produced. Besides honey, a variety of apiculture products including **pollen**, **propolis**, **royal jelly** and **beeswax** are also produced in the EU. However, Europe's demand for honey and other apiculture products is very high; the self-sufficiency grade ranks 60%. Therefore, imports are needed to cover the domestic consumption. The main suppliers for imports of honey into the EU are China and Ukraine, accounting for 40% and 20% of EU imports, respectively. Smaller amounts are also imported from countries in Latin America. An overview on how the EU's beekeeping sector is affected by the CAP is provided by (Bee Life Beekeeping European Cooperation, 2019).

The current support for livestock through the Common Agricultural Policy (CAP)

Agricultural production strongly depends on weather and climate conditions and working with natural resources requires cautious production systems that do not overstrain scarce resources, while still being profitable. Despite the importance of food production, farmers' incomes are around 40% lower compared to non-agricultural incomes (European Commission, 2019c). Poorly calculable business uncertainties and the environmental impact of farming justifies the significant role that the public sector plays in supporting European farmers. The common agricultural policy (CAP) supports European farmers by means of three different measures: (1) **income support through direct payments** to ensure income stability, to remunerate farmers for environmentally friendly farming and delivering public goods not normally paid for by the markets, such as taking care of the countryside; (2) **market measures** to deal with difficult market situations such as a sudden drop in demand due to a health scare (like the BSE crisis), or a fall in prices as a result of a temporary oversupply on the market; (3) **rural development measures** with national and regional programs to address the specific needs and challenges facing rural areas (European Commission, 2019c). These measures of the CAP are financed through two funds as part of the EU budget. On the one hand payments are based on the European Agricultural Fund (EAGF), which provides direct support and funds market measures. On the other hand the European Agricultural Fund for Rural Development (EAFRD) serves for financing rural development. Payments are managed at the national level by each European Union country and explicit configuration of the financial support differs among the Member States. Out of a total EU budget of €160.11 billion in 2018 the EU supported farmers with €58.82 billion. The budget distribution is demonstrated in Figure 8.

The EU supports farmers with €58.82 billion in 2018

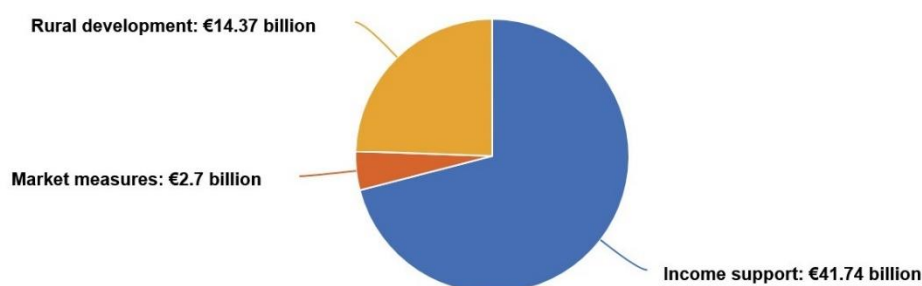


Figure 8: Distribution of the CAP budget in 2018 (European Commission, 2019c).

For **direct payments**, total funding available from 2014 to 2020 is €252 billion, which could theoretically enable a yearly payment of €3,300 for each livestock farmer (Baldock and Mottershead, 2017). Practically there is a wide variation in the actual distribution of direct payments both between different Member States and within individual Member States, depending for example on the respective production system or regional structure. The CAP direct payments can be grouped into three different categories:

1. **Basic direct payments** are paid per hectare so vary according to the amount of land in a farmer's claim. They are not linked to the production level of the farm. In some EU member states these payments are also based on the historical amount of money the farmer used to receive from the CAP in the past. To promote smaller farms, member states can choose to pay a higher rate on the first few hectares or to apply a reduction to larger claims (also called "capping"). Simplification of application for a payment for farms with low value claims can be realised through a Small Farmers' Scheme.
To receive the direct payments farmers do not need to meet production thresholds to qualify for funding, but they must ensure their land is capable of being used for production and also meet the requirements of cross-compliance, for example animal welfare directives.
2. **Greening payments**, which represent 30% of the total CAP budget for direct payments. In most Member States, these are added pro rata to the basic payments, reflecting the historic entitlements of the respective farm. To receive greening payments the farmer has to meet different requirements depending on what type of land is claimed. For arable farmers a certain amount of crop diversification is required, whilst farmers with "permanent grassland" (land which has not been part of a crop rotation for five years or more including most pasture, ploughing is not permitted) must maintain its status (i.e. not convert to arable) to qualify for funding, whereby 5% tolerance are accepted. Grassland areas have to be specified by the relevant Member State. To receive greening funds, arable farmers must in addition offer at least 5% of their hectares as "ecological focus area" to promote biodiversity. On most of these areas (45%) legumes are cultivated, which can serve as a protein source for animal feed.
Certified organic farms receive greening payments without the need to meet special requirements. Greening is likely to have only a small impact on European livestock farmers although it may provide an incentive to owners of arable farms to grow more legumes, with a potential impact on feed prices, by providing regionally produced protein sources for animal feed and possibly reducing soy imports. In contrast to this, in some cases the intensive cultivation of fodder and yield of usable feedstuff per hectare might be constrained by the requirement for crop diversification and crop rotation.
3. **Voluntary coupled payments**, which depend on the volume of production. As a flexible instrument, they can be allocated according to the priorities of each Member State to encourage particular types of farming in particular locations. Up to 8% of the CAP budget for direct payments can be used by the Member States to fund coupled payments, with an additional 2% allowed for protein crops.

The importance of public direct payments differs greatly across the different livestock farming systems as presented in Figure 9. They play a relatively minor role on pig and poultry farms (granivores), accounting for an average 22% of the farms' total income, whereas extensive grazing livestock farms substantially depend on public transfer (Matthews, 2016).

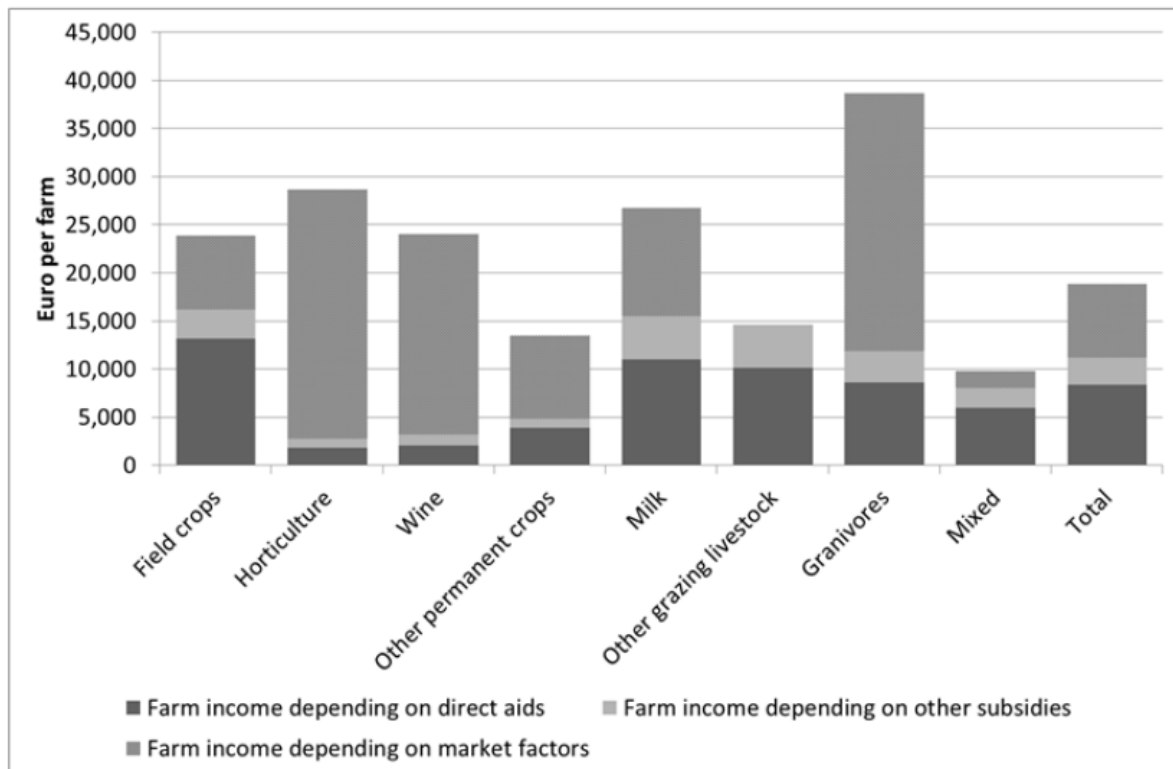


Figure 9: Proportion of direct payments that account for the income of different farming systems (Matthews, 2016).

In addition to direct payments, Member States also receive funding for their **Rural Development Programmes** under the second pillar of the CAP. The available budget for these payments across the different Member States is €95 billion for 2014 to 2020.

According to Baldock and Mottershead (2017), rural development measures that are most relevant to European livestock farmers are:

- » Support for organic farming: In order to motivate farmers to convert to organic and maintain that status, Member States can choose to pay additional funds per hectare. Payments during the conversion period can be higher, to compensate for a period when yields are expected to fall, but produce cannot yet be sold for premium prices;
- » Support to farmers in areas with natural constraints (see below)
- » Support to farmers who adopt practices beneficial to the environment or climate change i.e. agri-environment schemes, which are widespread in many countries, including the UK
- » Support for investment in farm competitiveness and environmental performance; and
- » Support for food processing and production

Another example for EU funds that can support the livestock sector is the **EU's School Milk Scheme**, which represents a combination of a health promotion tool and marketing assistance for the dairy industry. It is optional for Member States and they can apply for a budget of 100 million euros by drawing up a strategy describing the objectives and implementation plan of offering free or subsidized drinking milk to nursery children and schoolchildren.

4. Relevant drivers of EU livestock production

4.1 Overview of drivers of change in EU livestock sector

A driver of change is an influencing variable that catalyzes change and modulation of a complex system, like the European livestock sector. Any natural- or human-induced factor can serve as a driver of change (Hazell and Wood, 2008), whereas there are key drivers that are of highest relevance for

each system. The main categories of drivers of change that influence the sustainability of the European livestock sector and will be considered in the present study are visualised in Figure 10. The utilised classification is modified according to Zanten et al. (2016). However, it should be noted, that a strict assignment of influencing variables to different categories is difficult, due to heavy interdependencies between the respective factors. The presented categories should provide greater clarity, aiming to summarise the most relevant incidents and trends within each driver category that have shaped the history of change in EU's animal production sector during the past 60 years. This subsuming retrospective analysis, sectioned according to the categories, is given in the following Chapter 4.2.

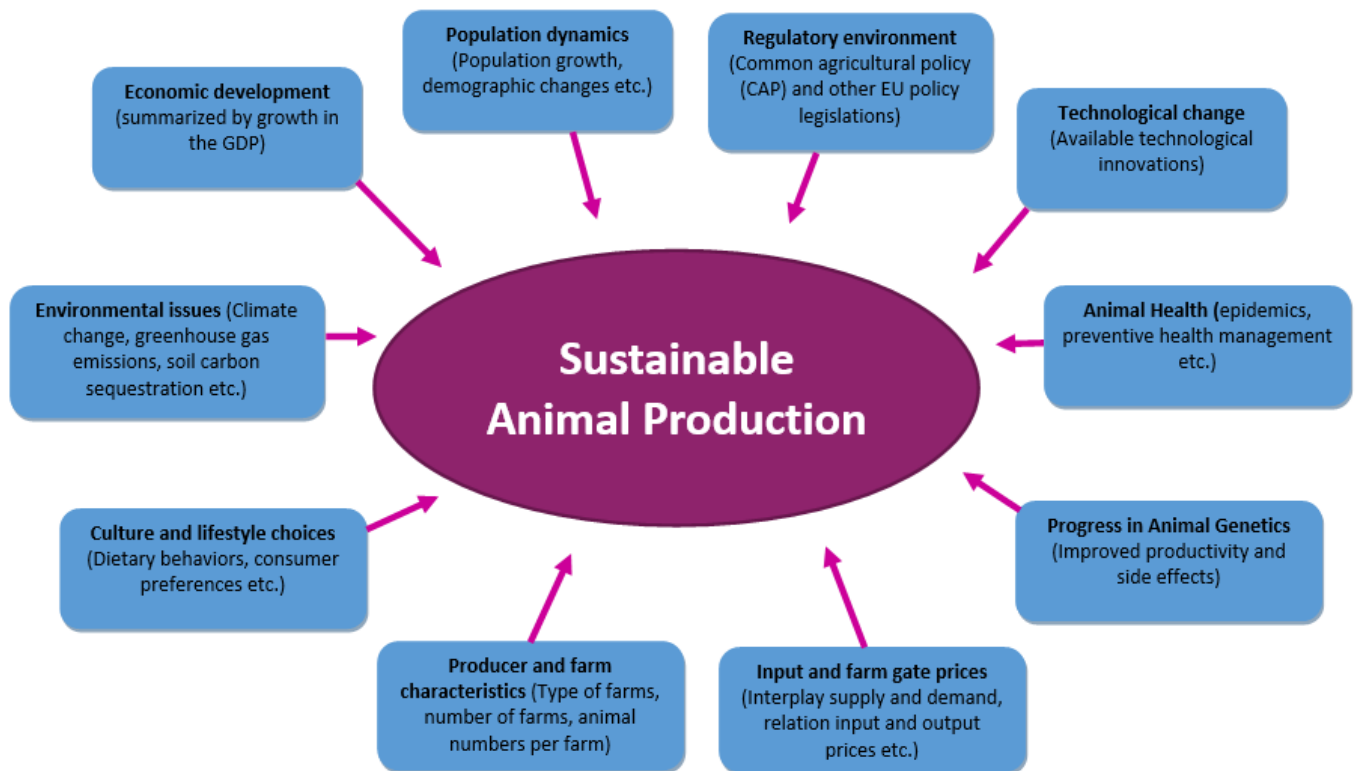


Figure 10: Main drivers of change in European livestock production (modified according to Zanten et al., 2016)

Generally, drivers of change can be classified as direct and indirect catalysts of system change. Direct drivers are those that have a direct measurable effect on different system aspects. Indirect drivers act as key influences on one or many other drivers. For example, globally increased demand for livestock products (a direct driver) is the product of increases in human world population and their income increases (indirect drivers) (Herrero et al., 2012). In the present CWG-SAP CASA study there is no differentiation between direct or indirect influencing variables applied. For each category of the set of drivers shown in Figure 10 there are both direct and indirect aspects shaping the European livestock sector. In addition, drivers can also be distinguished according to their range of influence. Taking into account the nomenclature of Hazell and Wood (2008), the present study aims to analyse the impact range of the driver categories on national, European and global level by expert ranking (see Chapter 5.1).

4.2 Retrospective Analysis

The framework conditions for animal farming have changed dynamically over recent decades. Different influencing factors and drivers of change have shaped the basis of the livestock sector. This chapter gives a brief overview on the main influencing factors and drivers of change that have retrospectively led to the current status quo of the European livestock sector. Categorised according

to the driver set visualised in Figure 10, this retrospective analysis gives an overview of important trends, events and aspects that have shaped the European livestock sector during the past 60 years.

Economic Development, Population Dynamics, Input and Farm Gate Prices

Domestication of animals and evolution of organised harvest and fodder storage techniques enabled the availability of food and feed all year-round. This formed the basis of the growth of the human population. Consequently, livestock production in Europe has a long history, which is strongly connected to the increase in standard of living of the European citizen during recent decades (Hartung, 2013). Historical changes in the demand for livestock products have been largely driven by human population growth, income growth and urbanisation (Thornton, 2010). Over the past 50 years the **European population** has increased rapidly but during more recent years population size has stabilised and is even expected to decrease in future decades, as the yearly growth rate has temporarily been negative as shown in Figure 11. In contrast to this, global population is expected to grow steadily, which will also have an impact on the European food producing sectors, due to possible exports and changes in market price situations (Figure 12).

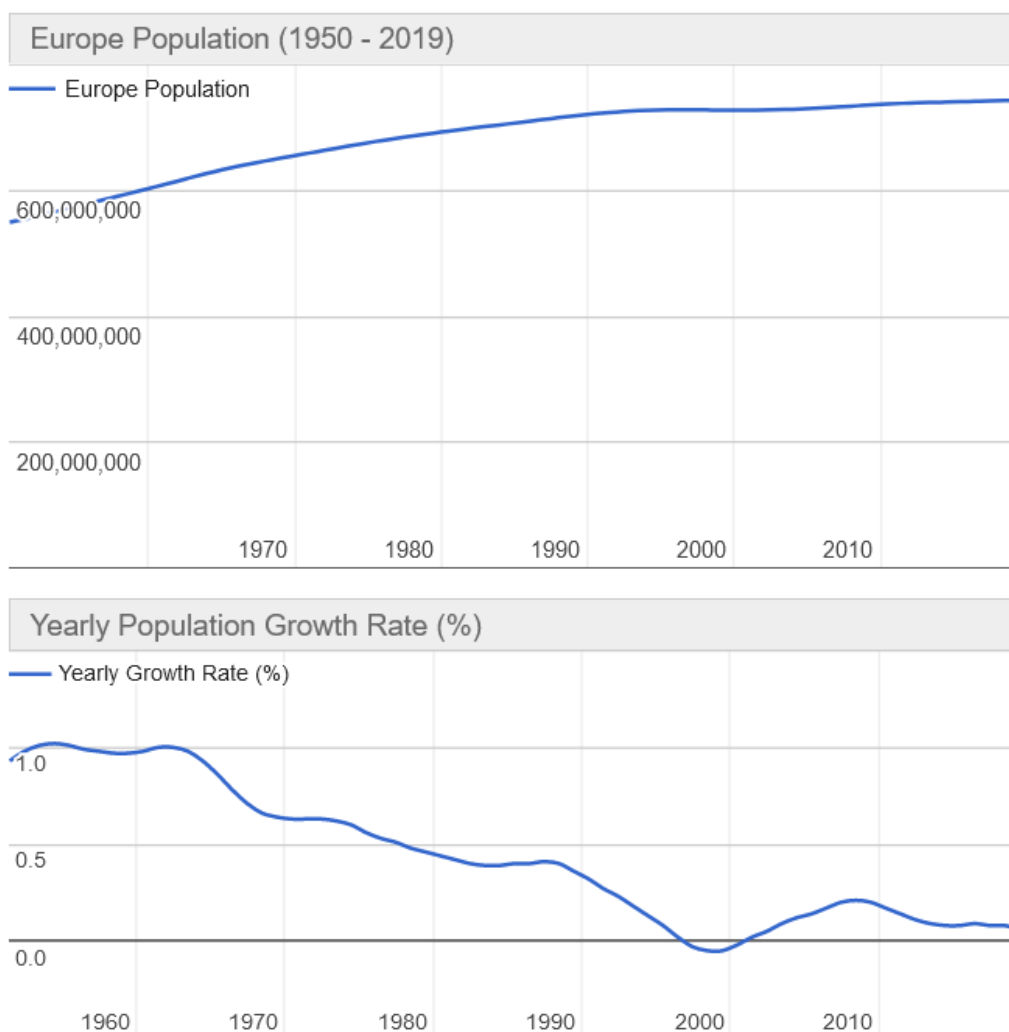


Figure 11: Development of Europe's population size and yearly population growth rate during recent decades (worldometers.info, 2019)

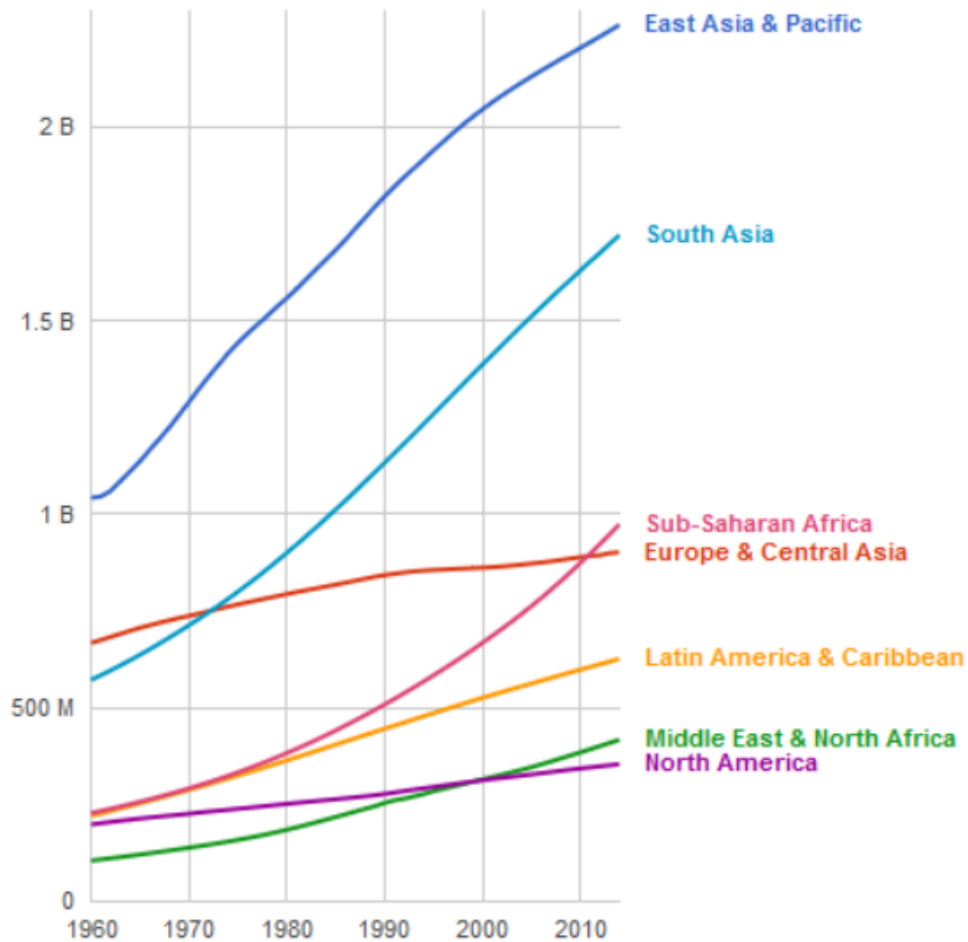


Figure 12: Global population growth between 1960 and 2010 (Wikimedia, 2019)

The intensification of production cut the **prices for animal products** and made them affordable. The cost of nutrition (food and drinks) and tobacco on the total monthly expenditure of an average German household decreased from about 57% in 1900 to about 14% in 2018 (Statista, 2019). With increasing income during the industrialisation, the **consumption of meat** also increased. Generally, the growth of the gross domestic product of a country is considered to strongly promote the consumption of meat and dairy products (Satterthwaite et al., 2010). Figure 13 illustrates the per capita meat consumption in eight EU Member States between 1960 and 2010. Meat consumption (in g/day) strongly increases over all analysed countries until 1990s, since then there is a slightly negative trend in many countries, reducing the total meat consumption.

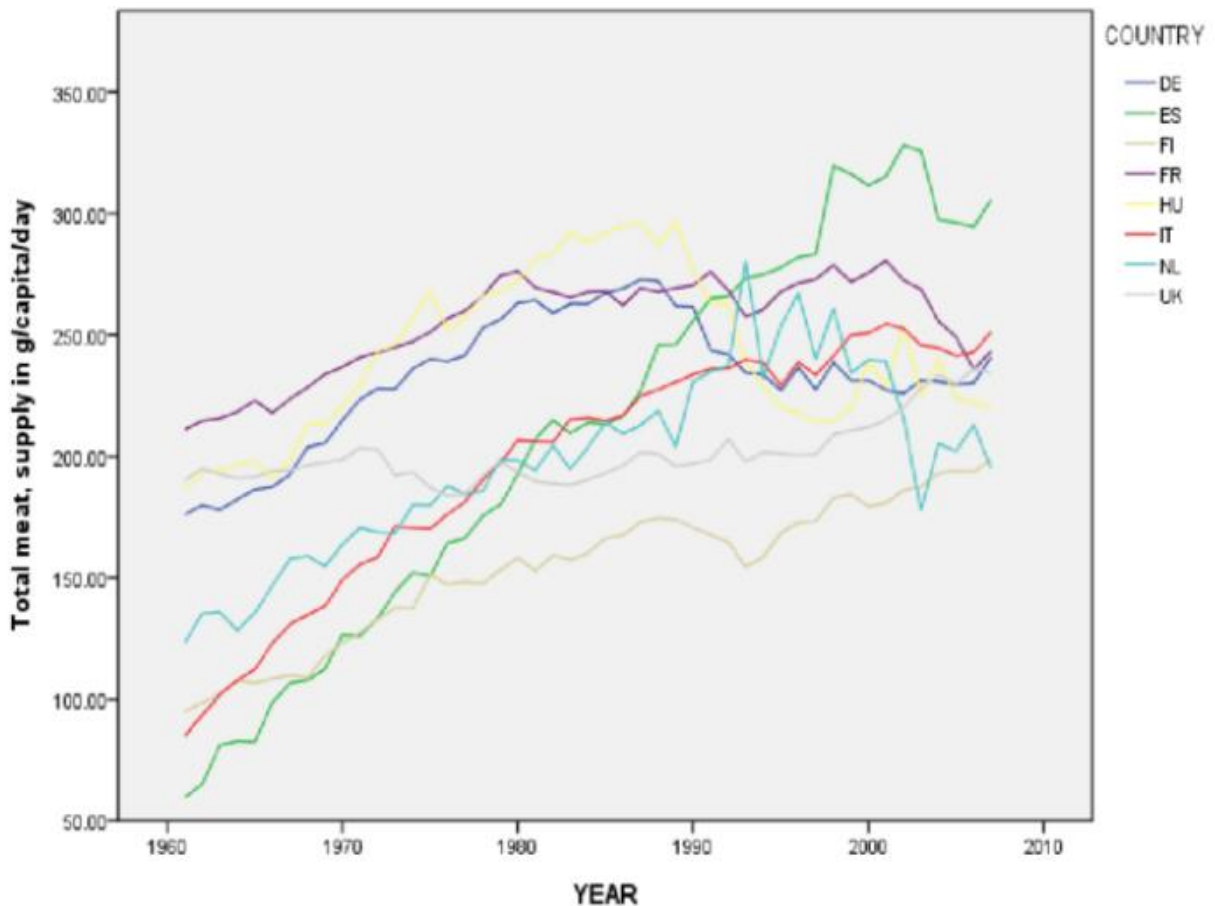


Figure 13: Development of the per capita meat consumption (in g/day) in eight EU Member States between 1960 and 2010 (Kanerva, 2013)

In general, interdependencies between European domestic and external markets have increased with globalisation during the last decades. **Farm gate and market prices** are also influenced by external regulatory structures. This influence is visible in the effects of the milk quota which was in place from 1984 to 2015 to regulate the oversupply of milk after the Second World War and restricted milk production in the different Member States. After the abolishment of the milk quota milk production increased in the EU (+7.8% from 2014 to 2015 in EU-28), but prices and farmers' incomes simultaneously decreased from 2014 onwards (Zanten et al., 2016). A detailed analysis of the impact of the abolition of the milk quota on milk production and milk prices in the Netherlands is provided by Zanten et al., (2016). Figure 14 displays the historic trends of farm gate milk prices, which are clearly differing between the two compared Member States and fluctuating as a consequence of influences like the milk quota or changes in animal feed prices.

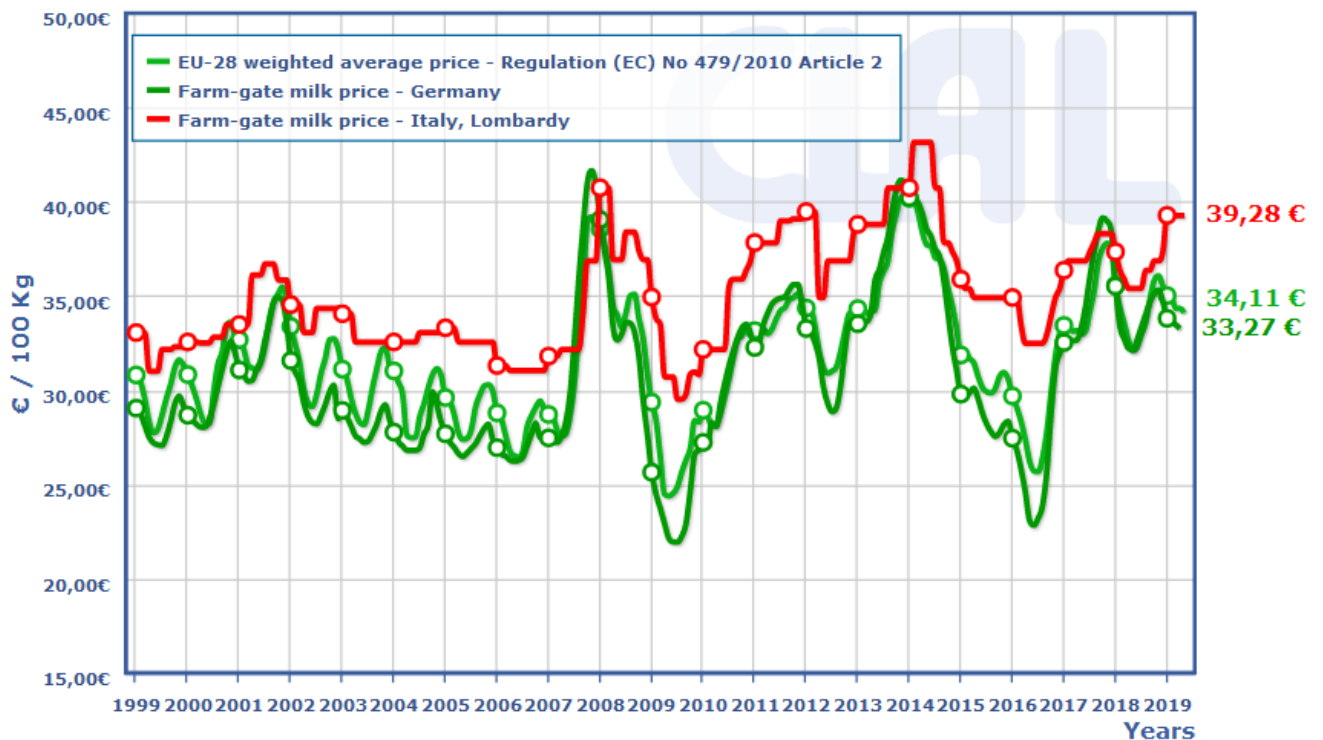


Figure 14: Historical comparative overview of farm gate milk prices (Clal, 2019)

Culture and lifestyle choices

Consumer behaviour has a significant impact on the price structure and the production systems in European livestock farming. Generally, the EU aims to meet the social needs and values of both producers and consumers and provide public goods and cultural services.

After the Second World War, food was mainly perceived as nourishment and products of animal origin were appreciated for their valuable nutrients and calories. Nowadays, a growing ethical concern related to production processes can be identified as a major trend in European food consumers' attitudes (Fox, 1993). The public is increasingly interested in aspects of sustainability of livestock farming. Other trends in consumer demands in Europe were summarised by Zanten et al. (2016). A growing interest in local and organic production, more consumers with a vegetarian or vegan lifestyle or critical questioning of environmental side effects of the animal production sector can be noted.

However, concerns are not always reflected by purchase behaviour. The market share of products which are associated with higher sustainability and animal welfare standards like organic products are still marginal (Harper et al., 2002; Van Loo et al., 2014), even though the demand for organic and local products is rapidly increasing (Kearney, 2010).

Due to intense trade, nearly all food products are available all over Europe. However, there are still clear geographic variations in consumer preferences based on the historical availability of food products. An overview on cultural differences of consumer choices in the different Member States is given in a study by Garcia and Albisu (2001).

During recent decades, purchase behaviour of consumers was increasingly shaped by a demand for more information about how foodstuff of animal origin is produced. This demand for information might partly be caused by declining consumer confidence in Europe over the past four decades due to "food scandals". In the following relevant problem situations of the European livestock sector regarding food safety are listed chronologically:

- » 1980s until 2000 BSE crisis: public health scare that lasted several years as the disease can be transmitted to humans; the European Union orders a worldwide embargo on British beef and its derivatives until 1999 (2002 in France)

- » 1999 dioxin in chicken eggs: the highly carcinogenic substance dioxin is discovered in feed for poultry and livestock in Belgium, contaminating the whole food chain; consumers
- » 2006 dioxin in pork fat (Belgium)
- » 2008 dioxin in mozzarella cheese (Italy) and pork meat (Ireland)
- » 2013 horsemeat scandal: in February 2013 it is exposed that in some convenience products, like burgers or lasagna which were sold all over Europe, beef meat was secretly replaced by horse meat. Enabling them to significantly increase their profits, manufacturers had mixed at least 750 tons of less expensive horsemeat into their products. Even though this scandal did not have any health implications, consumer trust is significantly dented (Kulas, 2014)
- » 2017 Fipronil in chicken eggs: in the summer of 2017 a disinfectant containing the toxic insecticide fipronil, which is banned for use on food-producing animals in the EU was used in pens of laying hens to fight an outbreak of red mites. The toxic substance was found in eggs and processed food products.

According to Fontes et al. (2013), the BSE crisis represents the main historical animal disease related scare in Europe. With this crisis, consumers became more aware of food safety issues and as a reaction adapted their consuming behaviour of beef products. Per capita consumption of veal and beef in EU fell from 22.1 kg in 1995 to 17.9 kg in 2001. More precisely, impacts on consumer buying behaviour in the different Member States (based on data from 2000, during the second wave of the BSE crisis) were studied by Angulo and Gil (2007). In all cases consumption dropped considerably. Consumption of beef decreased about 40% in France, about 60% in Germany, 60%, about 42% in Italy, 42%, and about 30% in Portugal.

As a reaction to the food safety crises, in 2014 the European Commission commenced a REFIT (Regulatory Fitness and Performance Programme) evaluation of the EU General Food Law. As the first step of this procedure a “Fitness Check” of the regulation was launched, whose findings were published in January 2018. In February 2019, the European Parliament and the Council reached a provisional agreement regarding the Commission's proposal for a Regulation on the transparency and sustainability of the EU risk assessment in the food chain. The main aspects of this agreement have the aim to (1) ensure more transparency, (2) increase the independence and standard of scientific studies, (3) strengthen the governance and the scientific cooperation between the Member States, and to (4) develop comprehensive risk communication and open dialogue amongst all interested parties. In the near future, this agreement will be adopted formally, both the European Parliament and the Council.

With the aim to recover consumer trust, different labels for product quality and standard of production systems were introduced across Europe. In addition to various labels from private associations (for example Demeter) or trademarks (for example “Reinert HerzensSACHE” in Germany), an official EU-label became obligatory for pre-packaged foodstuff from organic production. This label was supposed to create a homogenous organic production standard and a coherent visual identity to European Union produced organic products, making it easier for the consumers to identify products that were produced with an organic standard and helping farmers to market them across the EU.

European consumers' attitudes have also been influenced by scientific statements regarding healthy diets. As demonstrated in Figure 15, consumption patterns of meat significantly changed between 1980 and 2010, with a clear increase of poultry meat consumption, whereas consumption of red meat (like beef, sheep or goat) has declined. This substitution of red meats by white meats might be caused by scientific recommendations to lower the amount of red meats in a healthy diet and preferences of consumers to products lower in fat, due to reduced calorie amount.

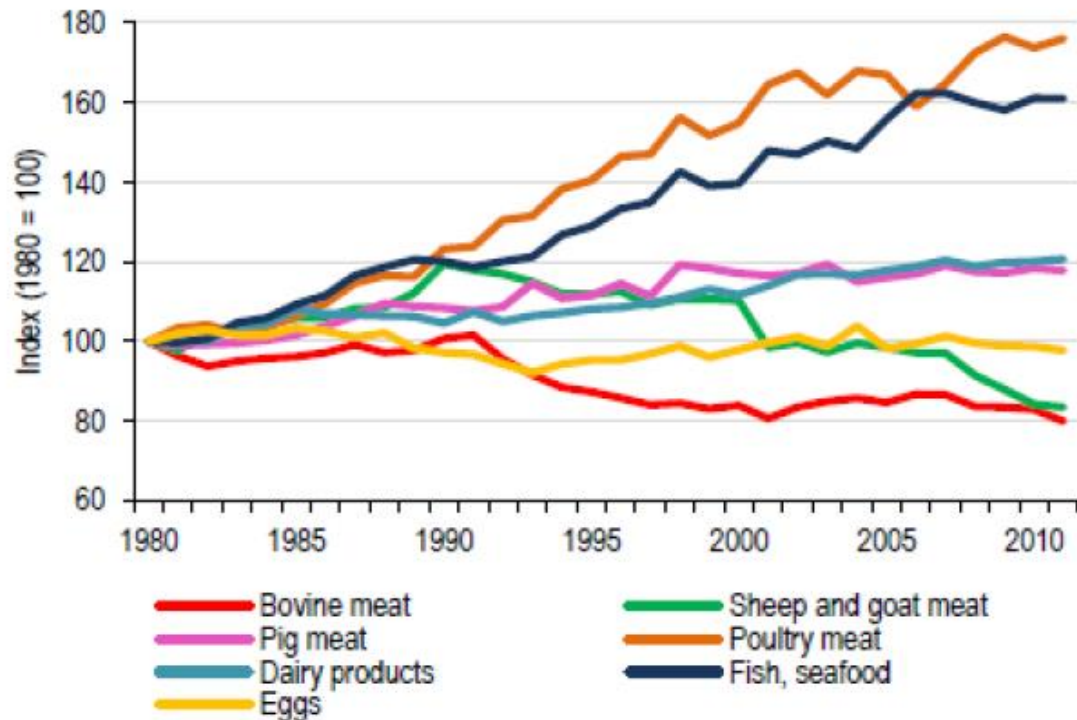


Figure 15: Changes in animal protein consumption per person in the EU-28 from 1980 to 2010 (FAOSTAT, ATF, 2017b)

Regulatory environment

Currently receiving 38% of the EU budget, the CAP generally aims to provide affordable, safe food for EU citizens, ensure a fair standard of living for farmers and preserve natural resources and respecting the environment (European Council, 2019). The CAP is a dynamic policy and has undergone several reforms, in order to adapt to changing conditions and new challenges of the agricultural sector and in turn, the CAP has also shaped European livestock production.

The CAP was created in **1962** by the six founding Member States of the European Communities (Belgium, France, Italy, Luxembourg, Netherlands and West Germany) and is the longest-serving policy of the European Union. As the economy and standard of living was sharply weakened by the implications of the Second World War, the CAP was initially founded to increase the food supply for the European citizens. Food rationing until 1950 and the memorable experience of food shortage and starvation after the First World War were the strong motivation to never let this happen again. Therefore, the first political instrument that was utilised by the CAP was direct production support. Guaranteed market prices, border protection, export support and subsidised cost of feed brought financial solidarity and agricultural tariffs as well as national subsidies were abolished. Progress in technology, breeding, feeding and other husbandry techniques led to intensification and specialisation of European farming systems which highly improved the productivity of the livestock sector (Hartung, 2000). Therefore, the efforts of the CAP to increase production were very successful. Farms became so productive that they grew more food than needed in the EU. Food surpluses of some livestock products (especially milk and butter) were stocked and also sold on the world market for very low prices, impairing the income of the local farmers in developing countries. Obviously, the CAP needed a reform to adapt to these increased production capabilities of European livestock farms. Therefore, in the 1990s several measures were introduced to bring production levels and prices closer to market needs. Exemplarily, the milk quota can be named as an important measure that shaped the EU dairy sector after its implementation in **1984**.

The CAP shifted from market support to producer support and an upper stocking rate limit per farm and extensification premiums should support extensive livestock farming. Adding environmental concerns to the agenda of the CAP, the reform coincided with the **1992** Rio Earth Summit, which

launched the principle of sustainable development. Later in the 1990s, the CAP was increasingly focused on food quality and supported investment in farms, training and better processing and marketing. Measures to protect traditional and regional food were taken, and also the first European legislation for organic farming was implemented.

The CAP reform in **2000** focused on rural development to support the economic, social and cultural development of rural areas. Furthermore, the focus was laid on sound management of natural resources, spatial planning and respect for animal welfare. Due to globalisation, in **2003** farmers were increasingly oriented on market structures and prices, as international imports progressively entered the EU market for animal-sourced products. The CAP now provided income support, cutting the link between subsidies and production (decoupling). Farmers received this income support on condition of fulfilling various standards of food safety, environmental protection and animal health and welfare. Measures such as extensification payments, less favourable areas compensatory payments and agri-environmental scheme (AES) aimed to maintain diversity of livestock production systems to support small farms and specialized production models like dairy production in the mountain region in the EU (Giannoccaro et al., 2015).

In December 2004, the Council Regulation (EC) No 1/2005 on the protection of animals during transport was signed. The Council Regulation (EC) No 834/2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91 was decided in 28 June 2007. Detailed rules for the implementation of this regulation were laid down in September 2008 (Commission Regulation (EC) No 889/2008). The **2008** Health Check Reform aimed to reinforce the 2003 reform. In particular, the simplifications of subsidy payments were taken into account in this reform. Concerning the market intervention the commission evaluated and analysed the political instruments of the former 2003 CAP reform. The milk politics should have received specific support mechanisms. EU farmers and the CAP needed to work more closely together concerning topics like climate change, water protection and protecting biodiversity (Commission of the European Communities, 2007; Farmer and Swales, 2007).

In **2013**, the CAP was reformed and the current reform is scheduled from 2014 to 2020. The revision builds on previous structures and takes into account new challenges that generate new objectives. The focus is to support the producer rather than the product and to work on aspects of sustainability especially concerning resource use. Funds are channelled towards genuine farmers, especially support small farms and young farmers and requires farmers to respect the environment. These are long-term objectives and in order to achieve them the various political instruments of the CAP need to be adapted as shown in Figure 16. The current support of the CAP for the EU livestock sector is presented in Chapter 3.

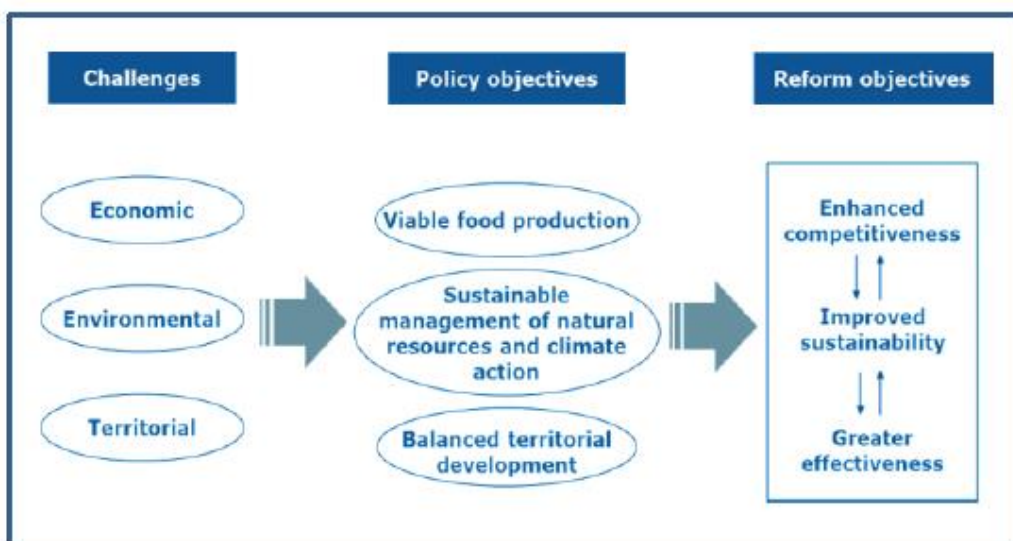


Figure 16: From challenges to objectives - CAP reform 2014-2020 (European Commission, 2013)

As studied by Viscecchia and Giannoccaro (2014) the CAP also has an influence on the livestock number reared. Political impacts on agricultural landscapes by the CAP was reviewed by Lefebvre et al. (2012). As presented, the regulatory environment has clearly shaped the dynamics of the livestock sector in the EU. Decision making of farmers is largely shaped by the legal circumstances and financial support opportunities in the different Member States.

Technological change

As defined by Brewster et al. (2018) “The first modern agricultural revolution arrived with the beginnings of the automation of agriculture during the 18th century. Since then, the primary sector has evolved slowly at first, then more rapidly, with the introduction of many different innovative processes and technologies, especially after World War II with the “Green Revolution”. The relatively recent innovations in telecommunication and information technologies have led to a far more connected world, which is now affecting the agricultural sector more and more. In the 2000s, the terms “e-agriculture” or “ICT (Information and communication technologies)” were used for the first time in official documents concerning agriculture, and the potential of applying these new technologies in agriculture began to be recognised. Concurrently there has been a growing awareness of issues concerning sustainability and the agri-food sector, in terms of environmental, social and economic dimensions.”

Scientific and technical progress in animal farming have brought many changes to the European livestock sector. Management strategies for breeding and feeding have been modified as well as housing systems and production processes.

Feeding strategies for livestock have changed during recent decades. Research in the field of animal nutrition has enabled the exact calculation of rations, optimised for each age stage and production sector. A transition from mainly low energy roughages, agricultural co-products or food waste towards optimised rations containing high quality industrial by-products and concentrates was achieved (Zanten et al., 2016). Therefore, the feed efficiency (e.g. feed conversion ratio - the amount of feed that is needed per kg of animal product) has significantly improved during recent decades. On the other hand, the increased use of concentrate food also raises concerns regarding the ecological efficiency of feeding grains that are suitable for human consumption to livestock. Automatic feeding systems ensure a balanced supplementation for example with the optimal amount of mineral micronutrients and simplify the management of farms with large livestock numbers.

Human labour has been substituted by mechanical technologies in many more aspects than just in the management of feed and water supply. For example automatic milking systems/milking robots or automatic manure management are commonly used techniques. Precision Livestock farming facilitates the management of large herds with the help of data processing, which is enabled by automatic animal identification and data collection through sensors (for example pedometers for automatic heat detection).

The role of ICT has gained increased importance for the European livestock sector during recent decades but great variations in the range of uptake of these new available technologies can be seen among and within the different Member States and production systems (Brewster et al., 2018).

Animal Health

The health and welfare of livestock is indispensable for a profitable and economically viable production system. A good health status enables high productivity e.g. increased growth rates, milk yields or egg production from each unit of input and therefore supports resource efficiency. Fertility and economically productive life span are also strongly affected by livestock health. Products of animal origin can only be produced in a high quality standard if both health and welfare of livestock are ensured. In addition, ensuring high standards of health and welfare of farm animals is fundamental for social acceptability of livestock production systems. These aspects significantly affect consumer trust and perception of animal-based diets. The terminology *animal welfare* is based on the concept of Five Freedoms (FAWC, 1979):

1. Freedom from hunger or thirst by ready access to fresh water and a diet to maintain full health and vigour
2. Freedom from discomfort by providing an appropriate environment including shelter and a comfortable resting area
3. Freedom from pain, injury or disease by prevention or rapid diagnosis and treatment
4. Freedom to express (most) normal behaviour by providing sufficient space, proper facilities and company of the animal's own kind
5. Freedom from fear and distress by ensuring conditions and treatment which avoid mental suffering.

The awareness of animal welfare in livestock production systems has strongly increased during the last 60 years in the EU, from consumer and farmer perspective, as well as from the political structure. In 1979, the first European Conference on Farm Animal Welfare was held. Based on the concept of Five Freedoms the EU passed the Council Directive 98/58/EC concerning the protection of animals kept for farming purposes in 1998. A comprehensive review of animal welfare legislation in the beef, pork, and poultry industries is provided by Stevenson et al. (2014). Moynagh (2000) describes in detail how EU regulation and consumer demand for animal welfare have evolved during the last years. In a study by Dalla Villa et al. (2014) the drivers for animal welfare policies in Europe are analysed. The scientific interest in the topic of animal welfare has strongly intensified during the past 30 years, visible in the growing number of publications related to the field of animal welfare (Zanten et al., 2016).

Examples of animal welfare related topics which had significant importance for consumer attitudes towards livestock production and stimulated a process of internal auditing and solution search of livestock producers are listed in the following:

- » behavioural disorders like tail-biting or feather picking (and related procedures like tail or break trimming),
- » killing of male chicks from laying breeds,
- » castration of male piglets,
- » dehorning of calves,
- » housing elements like farrowing crates and gestation crates for sows or battery cages for laying hens.

Some of these discussions led to reactions of the regulatory instances (for example the EU ban on gestation crates in 2013). Gradually, the recommendations of the Council of Europe and EU Directives became increasingly stringent. For instance, whereas a minimum standard for the size of individual calves' crates was formulated in 1991, such crates were actually prohibited for calves over two months of age six years later (EC Directive 91/629 and 97/2). A similar trend was seen in the Directives on laying hens, e.g., the most recent EU Directive (1999/74/EC) banning the conventional battery cage as from 2012 (Butterworth, 2005).

Ensuring a sufficient standard of health and welfare is not only important for a proper product quality (for example implications of distress on meat quality) and animal welfare, but also can have sharp implications for human health. Between animals and humans zoonotic infections are transmissible either directly through contact with infected animals, through vectors (non-food borne zoonotic diseases) or indirectly by consuming food or drinking water contaminated by pathogenic microorganisms such as bacteria and their toxins, viruses and parasites (food-borne zoonotic diseases). The severity of zoonotic diseases both in humans and livestock varies from subclinical infections over mild symptoms to life-threatening conditions. Food-borne zoonotic diseases are a significant and widespread global public health threat. In the EU, over 320,000 human cases are reported each year, but many cases might not be recorded (EFSA, 2019).

To protect consumers from zoonotic diseases the EU has adopted an integrated approach to food safety from the farm to the fork. The first EU food hygiene rules were introduced in 1964. Since then, they have evolved into a pro-active, coherent and comprehensive tool to protect human, animal and plant health as well as the environment (European Commission, 2014). In 2002, the European

Parliament and the Council adopted Regulation (EC) No 178/2002 laying down the general principles and requirements of food law (General Food Law Regulation). In addition, an independent agency responsible for scientific advice and support, the European Food Safety Authority (EFSA) was founded.

Risk assessment (e.g. data collection, analysis, recommendations) and risk management (e.g. legislative measures like the Directive 2002/99/EC laying down the animal health rules governing the production, processing, distribution and introduction of products of animal origin for human consumption, 16 December 2002 or targets for reduction) are the key measures of the EU food safety approach. As one effective element, the coordinated approach by the EU and Member States to reduce human salmonella cases can be quoted as an example: human salmonella cases were reduced by almost one-half over a five-year period from 196,000 cases in 2004 to 108,000 cases in 2009 (EFSA, 2019).

Table 3 gives an overview of how animal food products can become contaminated with zoonotic microorganisms at different stages of the food chain.

Table 3: Source of contamination of animal source food with zoonotic microorganisms at different stages of the food chain (EFSA, 2019)

Stage of the food chain	How food products become contaminated
Farm level	<ul style="list-style-type: none"> » Animal feed can be contaminated with bacteria such as Salmonella which can cause infection in animals and potentially lead to human infection from derived food products » Parasites may infect food producing animals » Milk can be contaminated by coming into contact with for example faeces or environmental dust » Animal skin and fur can be contaminated by faeces and environment » Eggs and different vegetables can also be contaminated at the farm
Slaughterhouse	<ul style="list-style-type: none"> » Meat can be contaminated by coming into contact with intestinal contents or animal skin
Industrial food processing	<ul style="list-style-type: none"> » Micro-organisms present in another raw agricultural product or on food contact surfaces may contaminate food » Infected humans handling food may contaminate food
Consumer (food processing in the kitchen)	<ul style="list-style-type: none"> » Microbes can be transferred from one food to another by improper use of kitchen utensils or by infected humans handling the food

Table 4 summarizes the most important microorganisms that cause food-borne diseases.

Table 4 Microorganisms that cause zoonotic food-borne diseases (EFSA, 2019)

Bacteria	<i>Campylobacter</i> (causing campylobacteriosis), <i>Salmonella</i> (causing salmonellosis), <i>Listeria</i> (causing listeriosis), Pathogenic <i>Escherichia coli</i> (E. coli), <i>Yersinia</i>
Bacterial toxins	Toxins of <i>Staphylococcus aureus</i> , <i>Clostridium perfringens</i> , <i>Clostridium botulinum</i> and <i>Bacillus cereus</i>
Viruses	Calicivirus (including norovirus), rotavirus, hepatitis A virus, hepatitis E virus Infected humans handling food may contaminate food
Parasites	Trichinella, Toxoplasma, Cryptosporidium, Giardia

History shows that infectious livestock diseases can have a devastating impact on the European livestock sector. Epidemic infectious diseases have especially temporarily and heavily weakened the economic situation for livestock farmers. Hereinafter the implications of the Bovine Spongiform Encephalopathy (BSE) crisis in the 1990s will be described as an example of the importance of animal health aspects for the European livestock sector.

The infectious agent which causes BSE in cattle can be transmitted to humans through consumption of contaminated meat causing variant Creutzfeldt-Jakob Disease (vCJD). Unlike other food-borne diseases which are spread by micro-organisms, BSE is caused by a prion, which is an abnormal form of a protein (known as PrP^c; EFSA, 2019). First cases of BSE were officially reported in November 1986 in the UK. First measures were taken by an export ban on British beef and live cattle, as well as preventive slaughtering of bovine animals over 30 months. The epidemic evolved quickly and numbered almost 185,000 diagnosed cases in total in the UK and a further 5,500 elsewhere in the EU, with some 2 million infected bovines estimated to have entered the human food chain in the UK (Budka, 2011). The emergence of BSE was clearly linked to the practice of feeding meat and bone meal to cattle, which contained ruminant protein of scrapie infected sheep (WHO, 2002). Therefore, regulations of feeding practices regarding protein sources were changed in 2001. Feeding of animal proteins to farmed animals was totally banned in the whole EU. Rules for destroying specified risk materials after slaughter (nervous tissue) represented an additional measure to protect against human exposure included in the EU transmissible spongiform encephalopathies regulations of 2001 (Regulation (EC) No 999/2001 of the European Parliament and of the Council of 22 May 2001 laying down rules for the prevention, control and eradication of certain transmissible spongiform encephalopathies. OJ L 147, 31.05.2001, p. 1-40). Figure 17 shows that the specific measures led to a significant decrease of reported BSE and vCJD cases in both UK and total EU. The EU's animal disease eradication policy has helped to reduce the annual number of BSE (bovine spongiform encephalopathy) cases from 2,124 to 18 in the last decade (European Commission, 2014). However, finding a good solution for alternative protein sources in livestock feed is still challenging.

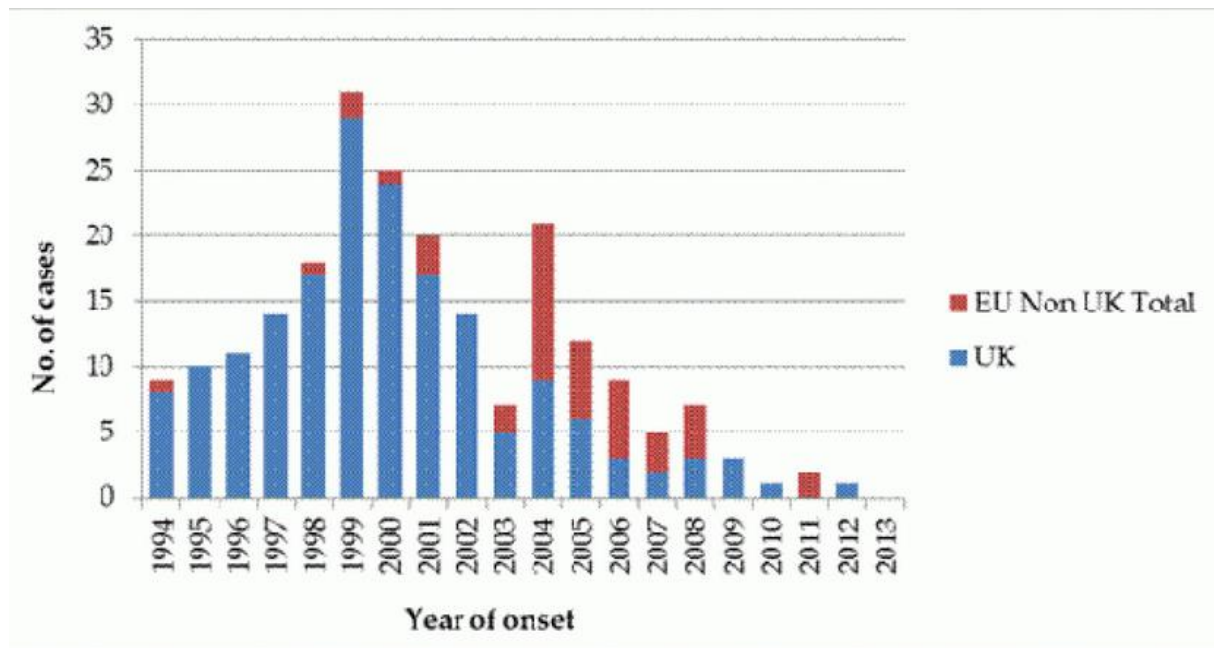


Figure 17: Number of reported vCJD cases (probable and definite) by year of onset in the EU by reporting country, 1994-2014 (ECDC, 2019)

The effective control of zoonotic diseases is crucial for agronomic health, for safeguarding and securing national and international food supplies as well as for building and maintaining consumer trust in the production of animal source food. Preventive animal health management strategies including for example effective vaccination schemes and well thought out hygiene measures are equally important as the effective treatment of existing infections to ensure a high biosecurity standard, which affects the wellbeing of the farm animal, the product quality as well as human health in Europe.

The EU follows a holistic approach to control animal diseases. This approach is based on different aspects (European Commission, 2019d):

- » specific control measures in place for each disease
- » surveillance
- » the EU financial contribution
- » the notification system
- » the EU emergency team
- » the traceability system
- » the EU reference laboratories for selected diseases.

Besides the BSE crisis there were several infectious diseases that affected the European livestock sector during recent decades. For example avian influenza, bluetongue, swine vesicular disease, swine fever (for examples in 2006, led to prophylactic culling of 50,000 pigs in Germany after a diagnosis on a single pig farm), schmallenberg virus, scrapie or the 2009/2010 spread of the pandemic A (H1N1) influenza virus ('swine flu').

Taking into account the complex relationships between the health of humans and animals as well as environmental effects, the concept of "One Health" has achieved increasing importance and represents a holistic and interdisciplinary approach, which requires close cooperation of the different disciplines. Especially the emergence of antibiotic resistant microorganisms can be named as a current hot topic, caused by the overuse of antibiotics. Non-curative application of antibiotics as e.g. growth promoter or preventative measure is the main reason for over intensive antibiotic usage in the livestock sector. Antibiotic use per kilogramme of meat production varies widely across the different Member States and is especially low in the Scandinavian countries (Ritchie, 2017). Rates in Scandinavian countries (Norway, Finland, Sweden and Denmark) are 50 to 100 times lower than in

other EU countries such as Cyprus, Spain and Italy. In the Scandinavian nations the use of antibiotics for growth promotion was admitted in the 1990s and early 2000s. This led to a more prudent use of antibiotic substances and a significant decline in application rates for both growth and therapeutic uses. Low levels of antibiotic use in the Scandinavian countries are maintained partly through a combination of good practices for livestock health (reducing the demand for treatment) and regulatory restrictions (Ritchie, 2017). In 2006, the use of antibiotics for non-medical purposes was banned overall in the European Union. This legal change had varying success in the different Member States. In some EU countries (Germany, France, UK) a significant decline could be observed after this ban. Whereas antibiotic use in Cyprus, Spain and Italy is still very high. Figure 18 shows, that in most Member States of the EU the globally set cap of 50 mg per population corrected livestock unit (PCU) is not met. Due to the current relevance of this topic, on-farm measures like selective dry cow therapy are gaining increasing importance for livestock farmers in the EU. The blanket application of antibiotic substances in udders of dairy cows after cessation of milking was banned in 1994 in Denmark and 2012 in the Netherlands. On a voluntary basis the management practice of selective dry cow therapy is currently adopted in many farms all over the EU.

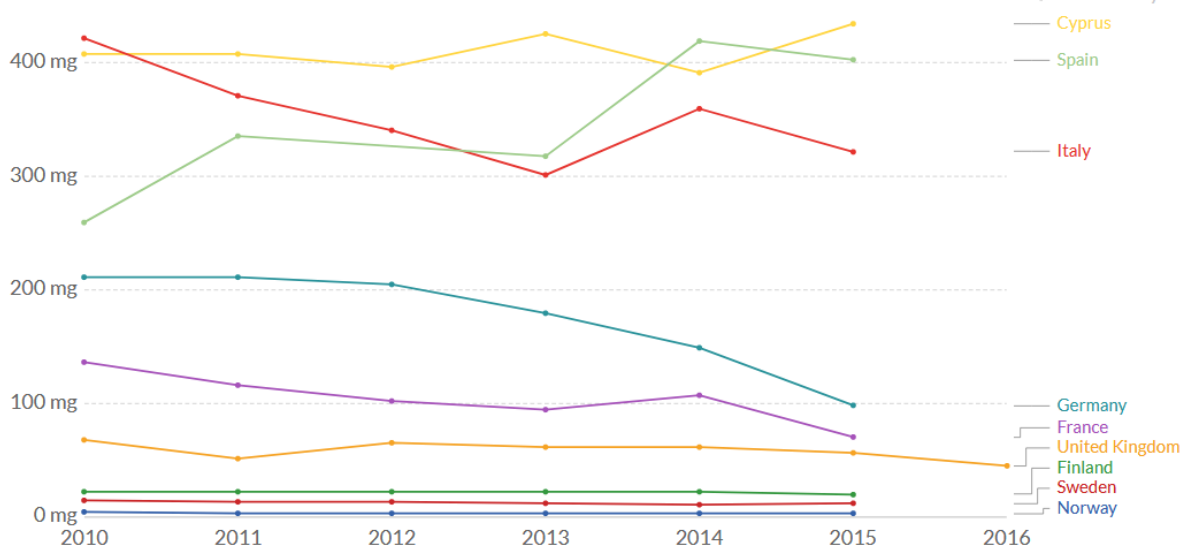


Figure 18: Antibiotic use in livestock in Europe. Data is measured as the milligrams of total antibiotic use per kilogram of meat production. This is corrected for differences in livestock numbers and types, normalising to a population-corrected unit (PCU). A suggested global cap of antibiotic use in livestock is set at 50 mg/PCU (Ritchie, 2017)

Progress in Animal Genetics

Effective genetic selection has led to increased productivity among all commonly used livestock species during recent decades as presented in Figure 19. The illustrated improved productivity surely does not only result from breeding technologies but also depends on enhanced feeding strategies and updated housing systems, technologies and health management.



Figure 10 Animal productivity in Europe between 1961 & 2011 (FAOSTAT)

Figure 19: Animal productivity in Europe between 1961 and 2011 (FAOSTAT, Zanten et al., 2016)

Genetic advances could be realised with increased speed by means of artificial insemination, which was first applied on cattle in the 1940s in the United States (Foote et al., 2002). Artificial insemination intensified the selection intensity, due to the fact that excellent males were chosen to produce a high number of offspring, spreading the favourable genetic material in the following generation. This effect is especially high in animals with a short generation interval. In vitro fertilisation and embryo transfer are more modern techniques that help with improving the genetic base of livestock animals. Progress in animal genetics led to highly specialised livestock breeds, only used for one purpose. Local breeds were replaced by specialised high producing breeds like the Holstein-Friesian dairy cow, which lead to discussion about possible loss of genetic resources.

Genetic improvements related to consumer demands were also of relevance during the last decades. For example lowering the fat content of meat was partly seen as a breeding goal for both pigs and poultry. Recently, breeding goals are more and more focused on resilience and economic useful lifespan.

Producer and farm characteristics

The European livestock sector underwent considerable structural changes concerning producer and farm characteristics. The most evident and policy-relevant structural developments in EU agriculture are reflected in the declining number of farms, farm size growth and production re-specialisation over time (Neuenfeldt et al., 2018). During recent decades, farming systems have increasingly specialised their production. Small farms with mixed production (crop-livestock systems) models were more and more replaced by larger-scale intensive livestock farming systems. More than half (55%) of agricultural holdings in the EU kept livestock in 2016, which represents a decrease of one third compared to the situation in 2005 (Eurostat, 2019). In contrast to this, the average number of housed animals per farm grew rapidly with the industrialisation and the total number of livestock in Europe had its highest increase between 1950s and 1980s. Globalisation enabled livestock production to develop independently of the surrounding land (particularly pig and poultry production) due to feed imports from other parts of the world. Figure 20 illustrates the relationship between productivity of dairy cows and farm size as well as the relationship between number of dairy farms and dairy cows in the EU.

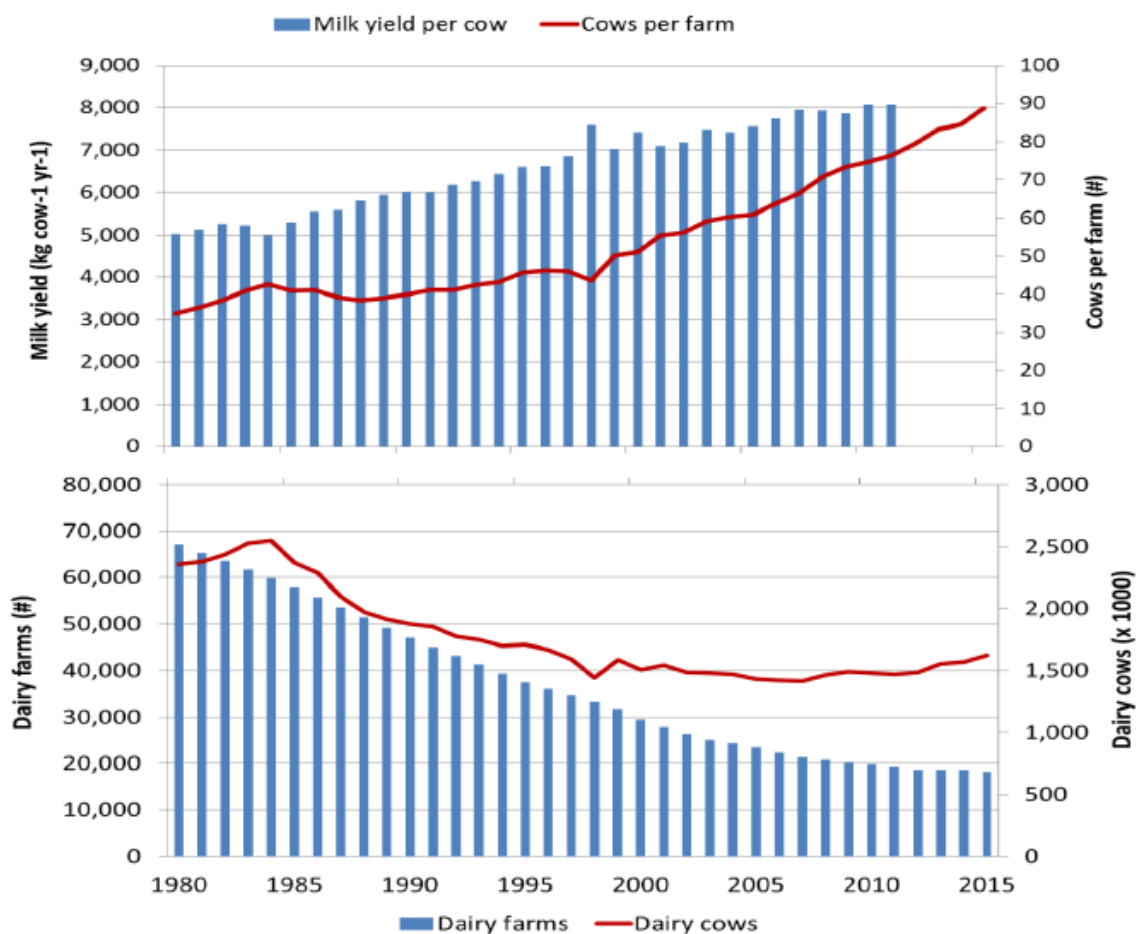


Figure 20: Relationship between productivity and farm size (upper figure) and number of dairy farms and dairy cows (lower figure) in the EU between 1980 and 2015 (Zanten et al., 2016)

Analysing the drivers of structural change in EU agriculture Neuenfeldt et al. (2018; using data from the period 1989–2013) indicate that the past farm structure explains approximately 36% of the EU farm structure variation across regions and time, followed by natural conditions (16%), agricultural prices (14%), macroeconomic variables (9%), subsidies (7%), population (6% represented by age of holder and population density) and agricultural income (6%).

Environmental issues

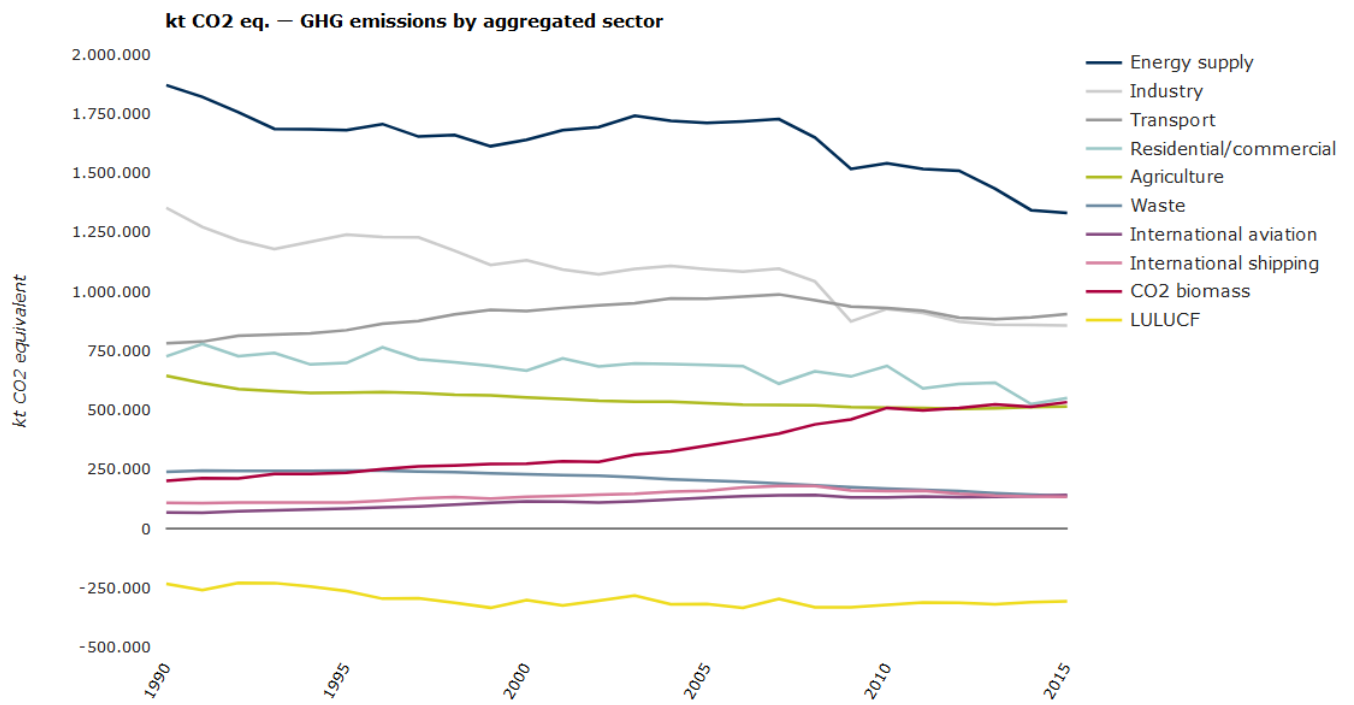
In the history of livestock production, natural resources that are of significant importance for humanity like land, water, nitrogen and phosphorus have declined. The use of these natural and non-

or poorly renewable resources should be employed prudently and efficiently. In addition, emissions to soils, water and to the atmosphere should be minimised to ensure future productivity of the world.

On a global scale the livestock sector is the largest user of agricultural land, 70% of the land used for agriculture is used for livestock production for example for grazing and feed production (Steinfeld et al., 2006). Side effects of livestock production like greenhouse gas (GHG) emissions have recently gained stronger consideration from both political and consumer sides. A detailed analysis of the impacts of European livestock production on nitrogen, sulphur, phosphorus and GHG emissions, land-use, water eutrophication and biodiversity is provided by Leip et al. (2010). Regarding the effects of the livestock sector on biodiversity the authors state: “The intensification of agriculture in the second half of the 20th century has contributed to biodiversity decline and loss throughout Europe, major factors being pollution and habitat fragmentation and loss. Major impacts from animal production are linked to excess of reactive nitrogen. On the other hand, many habitats important for biodiversity conservation are inherently linked to livestock production. Grazing is critical for maintaining many of Europe’s cultural landscapes and sustaining rural communities”.

Aiming to regulate environmental effects, the EU introduced legislation to reduce both environmental and climate impacts (i.e. the Industrial Emissions Directive 2010/75/EU) in 2010. In 2016 the Paris Agreement, an agreement within the United Nations Framework Convention on Climate Change (UNFCCC) with the long-term goal of limiting the increase in global average temperature to well below 2 °C above pre-industrial levels to contain global warming. Total GHG emissions in the EU decreased about 22% from 1990 to 2017 (European Environment Agency, 2019). Due to effective regulation measures the largest emission reductions were related to energy use in sectors such as manufacturing industries and construction, electricity and heat production, and residential combustion (demonstrated in the obvious decrease of CO₂ eq. GHG emissions from for energy supply and industry which is illustrated in Figure 21). Despite a third consecutive increase in fossil fuel consumption, the energy sector was able to reduce its emissions due to the increasing replacement of coal by oil, gas and renewable energy sources for production of electricity and heat in the EU. In relative terms, the largest decrease in emissions since 1990 was obvious in waste management, through reduced and better controlled landfilling.

However, not all sectors were able to effectively reduce their environmental impact on the atmosphere. GHG emissions from the agricultural sector have remained mainly unchanged during the last decades. As they account for approximately 9.8% of the total GHG emissions in the EU (European Environment Agency, 2019) for example due to ruminant fermentation processes which result in methane emissions, or caused by emissions from manure storage and distribution, the livestock sector plays a significant role in the GHG emissions of the EU and an effective reduction strategy is needed.



Note:

LULUCF: Land use/land use change and forestry

Figure 21: Development of GHG emissions (kt CO2 eq.) by aggregated sector between 1990 and 2015 (European Environment Agency, 2019)

Another topic related to environmental effects of animal production is the use of products suitable for human consumption for livestock feed. This feed/food competition brings up questions regarding resource use efficiency and also moral concerns in the view of world hunger.

Protein feed components – import situation

During recent decades, a heavy dependency of EU’s granivores and intensive cattle producers on imported protein feed evolved (Baldock and Mottershead, 2017) since the EU ban on feeding meat and bone meal to farmed animals in 2001, after the incidences of the BSE crisis. Table 5 shows this level of dependency (referring to the year 2014), with the EU producing only 31% of its own protein feed, and only 2% of soya, which is generally regarded as an essential component of pig diets. As presented in the chapter of the regulatory environment, the EU and some Member States “are trying to reduce this dependency, by strengthening the incentives to farmers to grow legume crops for the domestic feed market. Farmers have been increasing production of feed crops in response but not on a very large scale. Although soya bean production has been growing in Europe by nearly six percent per annum for the last decade, Table 5 shows that import dependence remains high. This is in spite of the recent policy changes (coupled payments, greening) to encourage this and other protein crops. Changes to coupled payments rules, in particular, which mean that they cannot, in principle, drive increases in production mean that it is unlikely that the CAP can drive a change in Europe’s dependency on protein feed imports” (Baldock and Mottershead, 2017).

Table 5: Production, consumption and self-sufficiency of protein feed components in the EU (Baldock and Mottershead, 2017)

	EU Production	EU Consumption	Self-Sufficiency
Soya beans/ meal	344	14,280	2%
Rapeseed/ sunflower seeds/meal	5,022	6,795	74%
Pulses	424	450	94%
Dried forage	623	589	106%
Miscellaneous	743	1,336	56%
Sub-total	7,156	23,450	31%
Fish meal	235	350	67%
Total	7,391	23,800	31%

Obviously all presented driving forces have shaped the livestock sector in the EU significantly. Figure 22 serves as an illustrative overview of some of the most important influencing factors that caused change and adaptation of the livestock sector during the last decades and are responsible for how the current status quo evolved.

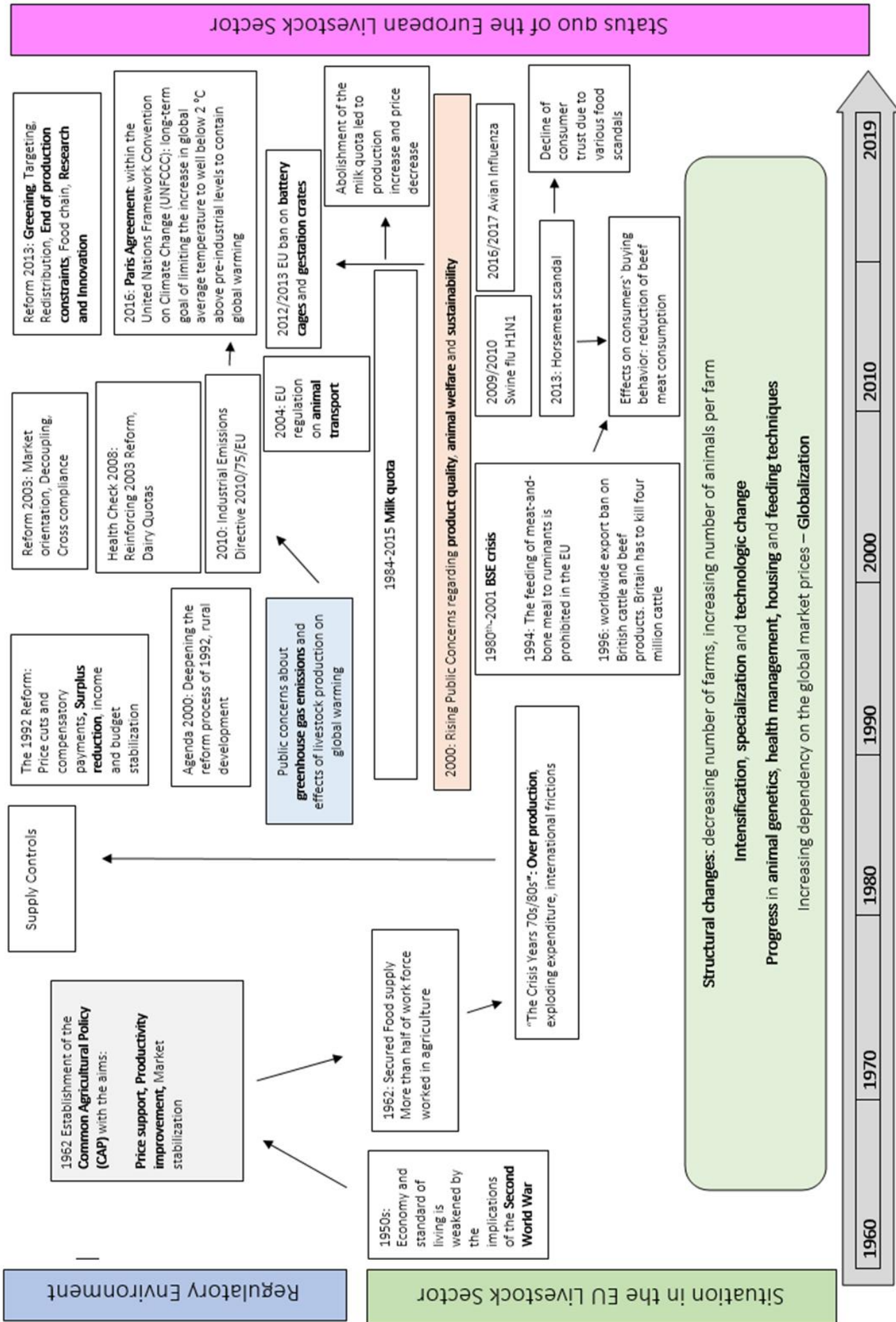


Figure 22: History of the EU livestock sector, shaped by different influencing factors

5. Results from the questionnaire based on expert consultations

In the following sections, the results from the questionnaire are presented. The statements refer solely to the opinions of the surveyed experts. Further details and analyses of the results are given in the discussion in Chapter 6.

5.1 Questionnaire part 1: The impact of drivers of change on National, European and Global levels

The first question of the survey deals with the **drivers of change** that have influenced the livestock sector during recent decades. The experts were asked to indicate the impact of the different driving forces on the current status quo of the livestock sector. The specification was obtained using a point rating scale from zero to five, where zero means no influence and five outstanding significant influence. The following Figure 23 shows the evaluation results of the individual drivers in relation to the National level, which reflects the respective country of origin of the participant, the European level and the Global level.

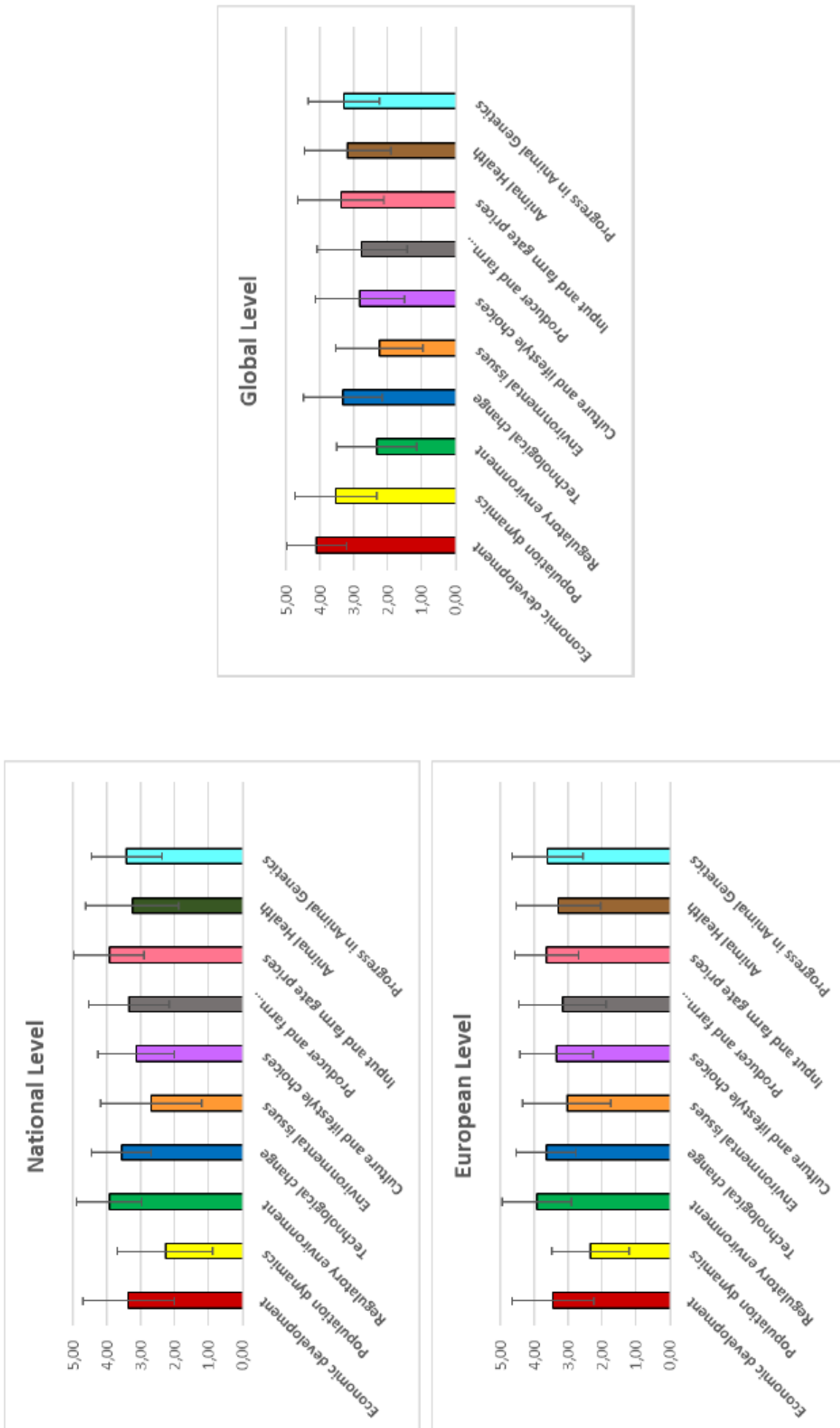


Figure 23: Overview of the experts' evaluation of the drivers of change which influenced the livestock sector during the last decades regarding the impact of the drivers on the current status quo of the livestock sector on National level (own country), European level and Global level; n=51 participants; scale range: 0= no influence to 5= outstanding significant influence

5.2 Questionnaire part 2: The concept of Sustainability in livestock production

The second part of the questionnaire deals with sustainability in livestock production in particular, which has already been defined from the perspective of the CWG-SAP in the Introduction.

Question two of the survey deals with the **sustainability triangle** consisting of the three pillars of sustainability economy, ecology and society (Figure 24). The experts were asked to rate the three pillars to their weighting on the National, European and Global level with a total of 9 points for each level. Three points for all pillars in each level would therefore represent a sustainable system, in which all pillars are weighted equally. Figure 25 shows the evaluation of the experts rating regarding the three pillars of sustainability on the different levels.

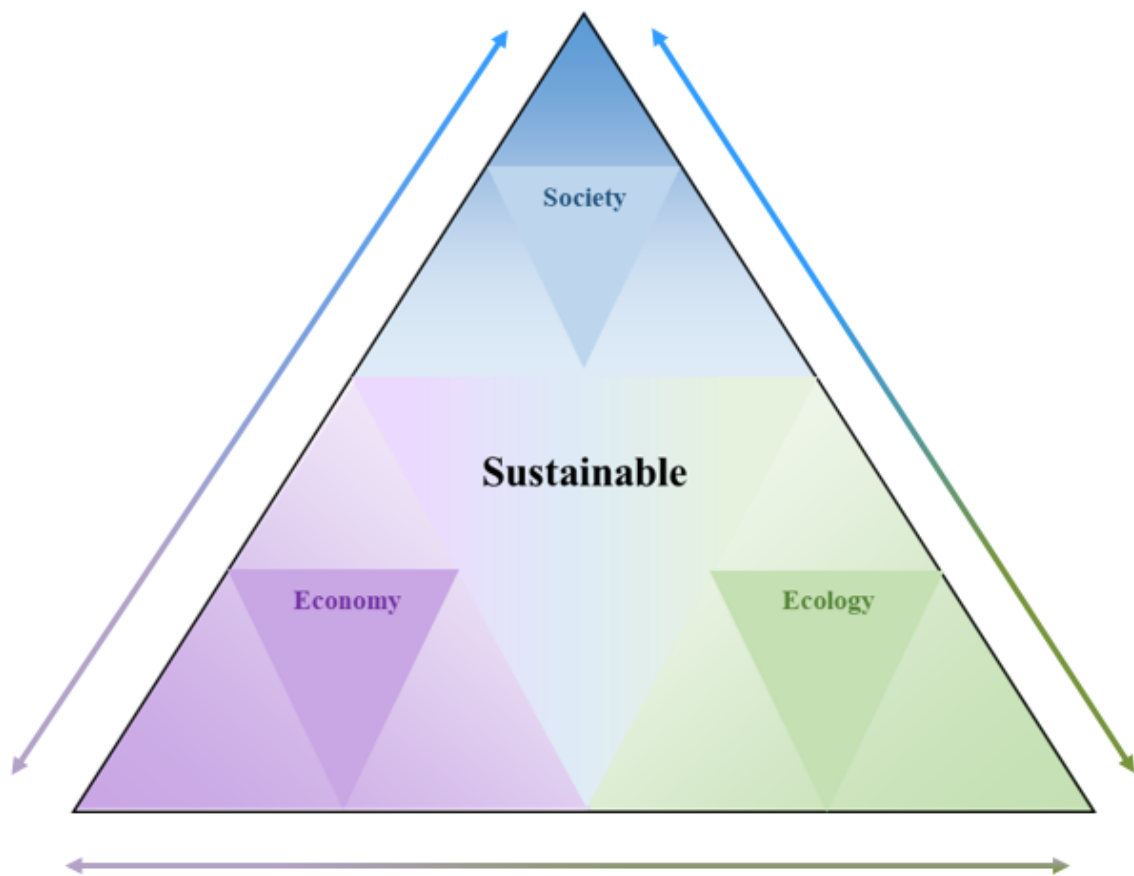


Figure 22: Sustainability triangle with the three pillars: economy, ecology and society

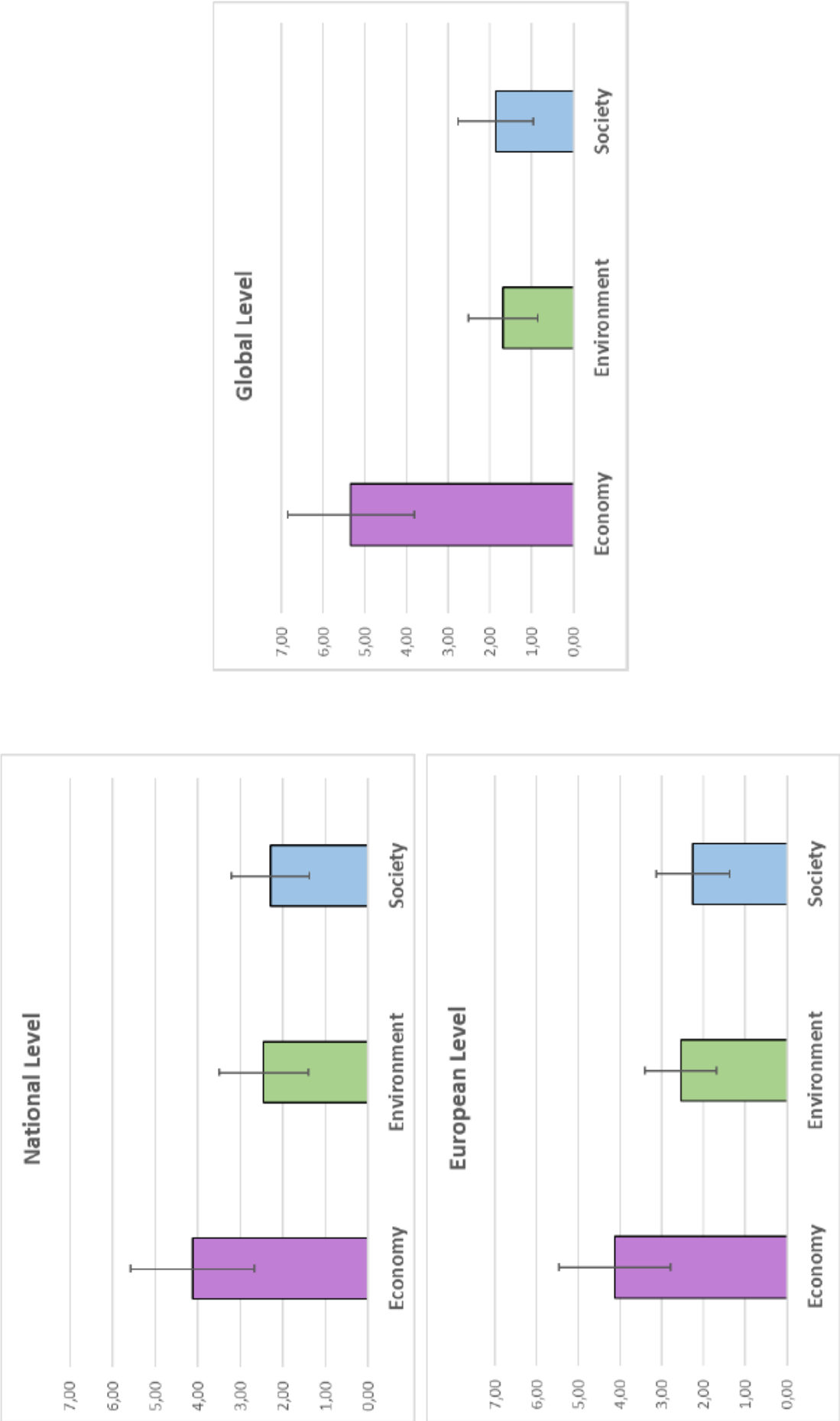


Figure 25: Overview of the experts' rating regarding the weighting of the three pillars of sustainability in the current livestock sector on National level (own country), European level and Global level; n= 51; scale range: total of 9 points divided among the three pillars of sustainability for each level

The questions 3 - 5 of the survey are dealing with the **main economic, ecological and social reasons** why the European livestock sector is currently not as sustainable as desired.

The main **economic reasons** mentioned by the participants are as follows:

The reason most frequently cited by the experts dealt with the current price situation in the livestock sector related to the entire value chain. Here in particular the production costs, price of labour, product prices and investments costs for farmers were mentioned.

Most experts indicated that the production costs are too high and subsequently the price of food is artificially too low as well as the farm gate prices to ensure a reasonable income for the farmers and a good profitability. Farmers often already have high investment costs but even more so if seeking to reduce climate effects, for example. Furthermore, wholesalers or retailers are not willing to pay extra for societal needs (e.g. animal welfare) and environment (e.g. carbon food print). Added to this fact most consumers are not aware that societal and environmental needs like animal welfare and carbon/water food print also cost money, they expect steadily low product prices. In summary it can be said, that the downward pressure on farm gate prices by powerful retailers continues to shrink producer margins and is eroding the economic, environmental and societal sustainability of the livestock sector.

Furthermore, there is a pressure for high productivity in the livestock sector and at the same time high quality, "clean" and sustainably produced products are in demand. However, at the same time the food industry is more or less in a monopoly position which has an impact on pricing, and an imbalance of resource distribution (subsidies) in favour of biggest actors. The farmer has no trading power, the power is concentrated at a few big feed and food companies. At the same time, sustainable economic development is lacking and there is unfair/incorrect support and tax policy for large and small food processing enterprises. Differences in EU support between countries also distort a healthy competition.

In addition, there is also a significant dependence on imported feed, in particular soya imports as the main source of low-priced protein for poultry, pig and milk production in the EU, which is subject to market fluctuations.

The increased use of innovative technology in the livestock sector could contribute to better productivity and to counteract the above-mentioned problems. However, the economic benefits of new technologies are not yet fully proven and depend on too many factors to be easily predicted.

The main **ecologic reasons** cited by the participants are as follows:

On this issue, the most frequently reason cited by the experts dealt with statements directly related to the animal, the housing of animals and the farming conditions.

Intensive production in particular was identified by the experts as one of the main reasons why the European livestock sector is currently not as sustainable as desired. As a result of the intensive production in livestock farming the stocking density increases as well as the number of animals per farm generally. In general, nowadays there are more big farms and smaller family farms, because the small farms can no longer survive from an economic point of view. With increasing numbers of animals, the use of antibiotics does not decrease, which is considered negative from the perspective of the increasing antibiotic resistances of many bacterial species. At the same time, stocking density also means that too many animals are farmed per ha and that therefore too much animal waste products heavily pollute the environment. For this reason the manure management becomes more and more a challenge, also justified in the lack of agricultural land. The application of increased manure amounts can lead to over fertilisation and at the same time to environmental pollution (e.g. water and air pollution, loss of biodiversity). The sensitive natural Nitrogen (N) and Phosphorus (P) Cycle is disturbed by for example the application of increased amounts of manure and other fertilisers. A further consequence of intensive livestock production is the increase in greenhouse gas (GHG) emissions, which often leads to problems and reduced consumer acceptance, especially in

conurbations. In addition, the political regulation of restrictions concerning environmentally relevant emissions varies worldwide.

One possibility of counteracting intensive animal production is through alternative forms of farming, e.g. organic livestock production. This is also an increasing production branch and is gaining consumer acceptance. However, the market chances are worse for farmers of this form of production and political support, e.g. through subsidies for certain forms of animal housing, does not cover all costs arising for the farmer. Furthermore, the political improvements on the environmental aspects, for example “Greenwashing” by the greening of the CAP, are often too marginal. From the political perspective, there is a lack of regulations or lack of control on environmental regulations.

Furthermore, the experts mentioned in the survey the non-sustainable use of natural resources and its overuse/underuse region by region at EU level.

In summary it can be said, that the current monoculture-based livestock systems (e.g. rye grasses, rapeseed meal, wheat) and intensive livestock farming, which impair biodiversity and pollute ecosystems with harmful emissions, impact heavily on the environment, including marine ecosystems, and therefore the European livestock sector is not as sustainable as desired.

The main **social reasons** mentioned by the participants are as follows:

The most frequently cited reason by the experts deals with the status of information of consumers regarding the current situation in the European livestock sector as well as the consumer’s acceptance. The experts were particularly in agreement on this question.

Society has become more and more critical of the current intensive farming systems during recent decades. This is especially due to the lack of consumer information and communication between consumers, farmers and politicians as well as the lack of transparency in the livestock sector in general. The mass media often presents an inaccurate picture of agriculture and animal husbandry, which does not comply with the consumer’s expectation. Furthermore, the buying force of the consumers should not be neglected, especially because consumers are often not aware of the fact, that societal needs (e.g. animal welfare, sustainable and ecologic production) also incur costs. This is often linked with a low social status and education level of the consumer and that urban people are not having direct contact with livestock production. On the other side consumers have high expectations regarding the food quality. Thereby the food should be healthy, produced sustainably and the animals should be granted a high level of welfare.

This also means that in order to be competitive in the context of the global economy and to maximise income, farmers are forced to disregard less profitable but more virtuous choices for animal welfare and to protect the environment. However, there is not enough support, regulation and control on the part of the EU. In addition, there is the generational turnover in agriculture that is accompanied by a lack of attractiveness for young people to become a livestock farmer (low profitability, high labour demand, etc.) and high capital investment is required to start a business. This demonstrates a weakness of the EU livestock sector in providing worthy livelihoods for current and future generations of animal farmers and farm workers. This is an aspect that should be improved to improve attractiveness to the young generation.

Finally, it can be said that a number of social reasons are reflected in the demographic situation and have had a negative impact on the livestock sector. The worsening demographic situation is a consequence of the economic situation in the respective country.

The questions 6 and 7 of the survey are dealing with the EU policy instruments that affect the sustainability of the EU livestock sector either in a positive or negative way.

With regard to policy instruments that have a **positive impact on sustainability** in the livestock sector, the experts surveyed expressed the following opinions:

The majority of the participants consider the European environmental policy as well as guidelines and regulations with regard to rural development to be positive. The agri-environmental measures (AEM)

were many times identified. “Agri-environment measures are a key element for the integration of environmental concerns into the Common Agricultural Policy. They are designed to encourage farmers to protect and enhance the environment on their farmland by paying them for the provision of environmental services” (European Commission, 2019e).

The second most frequently cited policy instrument in the survey was the Less-Favoured Areas (LFA) scheme. This means that areas declared as less favoured have restrictions regarding agricultural production or activity is more difficult (e.g. due to geographical conditions like mountain areas or extreme climatic conditions etc.). Due to more difficult farming conditions in these areas, farmers are granted specific payments to counteract a lower production output. In relation to the agricultural area in the EU as a whole, 57% of them are referred to as LFA. (European Commission, 2019f). Figure 26 shows the LFA areas in relation to the EU with 27 Member States.

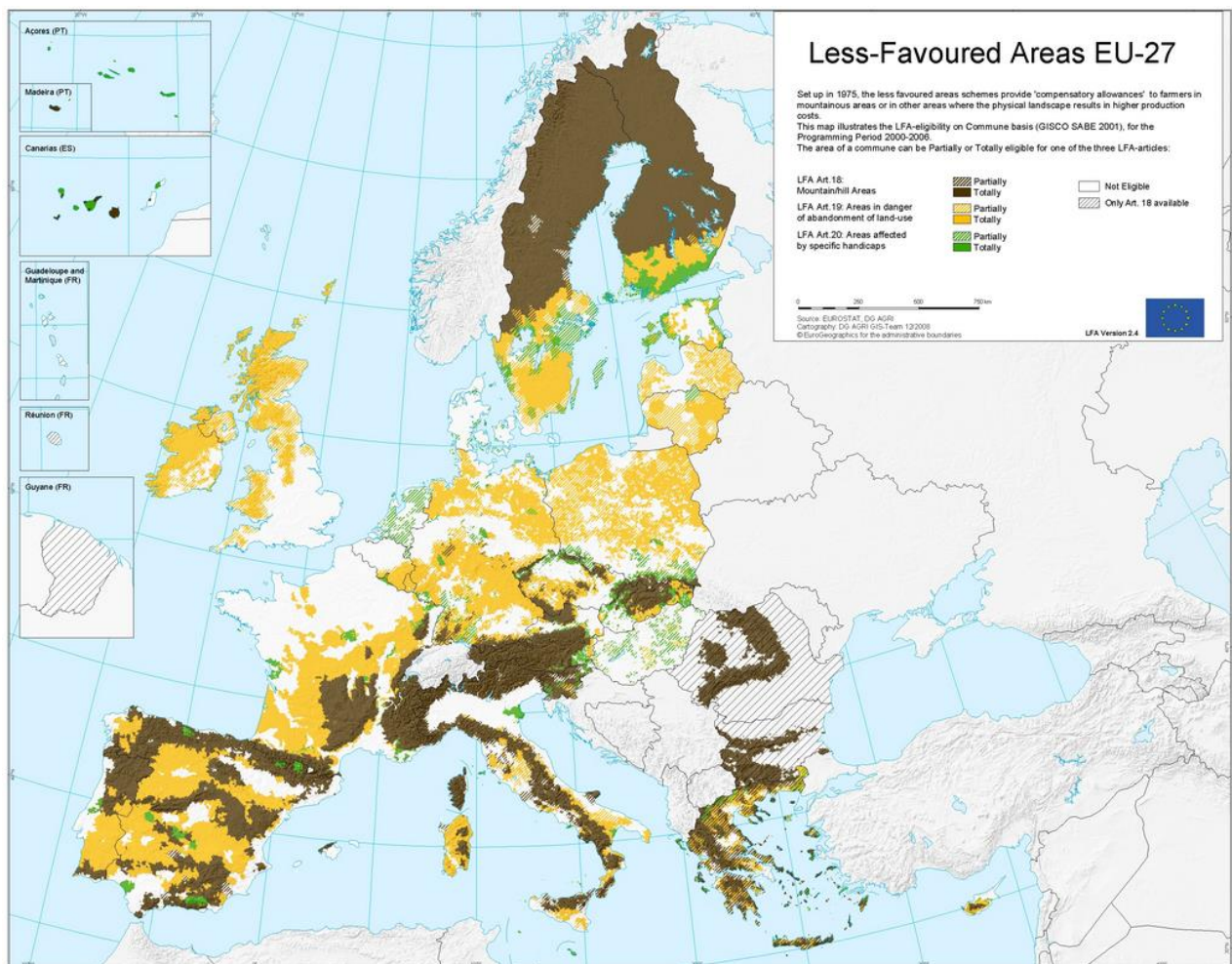


Figure 23: Map of the EU considering 27 Member States with the Less-Favoured Areas grouped into three categories (European Commission 2019f)

The following table lists the other policy instruments, specifically mentioned by the participants, which affect the sustainability of the EU livestock in a positive way, with regard to environmental policy by frequency of quotation.

Table 6: Overview of the specifically cited political instruments with regard to environmental policy (grouped by frequency)

prevalence	political instrument	Description*	Comments of the experts
1	AEM	Agri-Environmental Measures	» subsidies for specific investments (pro animal welfare for example), control of permanent pastures
2	LFA	Less-Favoured Areas	» reducing the concentration pressure to hot spot regions » protection of geographical indications
3	RDP EAFRD	Rural Development Policy: “second pillar” of the CAP → supports rural areas in meeting economic, environmental and social challenges European Agricultural Fund for Rural Development: Rural development programmes are financed by this fund	» investment support is provided for modernization of farming and food processing » support in use of local resources » support of rural population » investment subsidies, animal welfare programs
4	IPPC	International Plant Protection Convention: unification of protective measures	» best available techniques, Nitrogen Directive
5	LIFE program	Sustainable and innovative improvements in environmental quality and climate change should be implemented with the help of this program.	

*European Commission (2019e,f,g,h,i,j)

Furthermore, the second most frequent statements regarding the positive political instruments that have been made are referring to the current pricing policy and the market situation in the livestock sector.

The experts emphasised the direct payments to farmers, which help in shifting production optimum to a more sustainable direction, as well as subsidies to specific farmer groups (e.g. smaller farms).

The participants highlighted the concepts of animal welfare regulation and that there is a greater sensitivity in Europe to the importance of livestock production, to produce with animal welfare standards as well as a reduction of contaminating factors occurring which have implications for animal health and human health.

With regard to the issue of emissions, the experts were positive about the polluter-pays principle, e.g. cross-compliance, as well as the communication of emissions and measures to reduce them. Furthermore, the obligation of nations to reduce emissions (e.g. ammonia) is per se a positive instrument (it can become negative if improperly transferred into national regulations).

With regard to policy instruments that have a **negative impact on sustainability** in the livestock sector, the experts surveyed expressed the following opinions:

In contrast to the previous question, Pillar 1 (direct payments to farmers) of the current CAP reform was mentioned most frequently here (Pillar 2, on the other hand, is rated positively). It is noted that the payments are not sufficiently elaborated, e.g. in many cases the plant production is promoted which influences the livestock sector in a negative way. An example scenario is that wheat exports increase but the livestock sector is shrinking at the same time. That means there is not enough manure available to restore soil fertility, more mineral fertilisers are used and soils are degrading.

The participants also commented on the topics of pricing policy and competitiveness. In particular, producer subsidies, which artificially promote economic sustainability instead of promoting and rewarding environmental sustainability, are negatively valued.

With regard to competitiveness, the participants of the present CWG-SAP CASA study note that, with regard to the liberalisation of agricultural policy, regulations ensuring fair competition and high-level objectives for sustainability in livestock farming should have been adopted. Furthermore, the instruments used to achieve the objectives of EU production should not favour increased competition with products from third countries with different rules.

The implications of the free trade agreements and trade regulations in particular for animal products with countries that have less environmental and animal welfare restriction were rated as negative.

Moreover, according to the experts, there is a lack of solid policy instruments to improve current social standards on farms as well as of robust policy instruments to significantly reduce and regulate the use of antibiotics in the livestock sector.

Question 8 of the survey is about the main drivers of innovation in the EU livestock sector. The participants were asked to list the main drivers of innovation based on their personal opinions and expertise.

The drivers most frequently mentioned here were the current farming situation, including farm management, animal housing, animal genetics and the animal health and welfare situation.

In recent decades, there was an increasing interest in animal health and welfare on the part of consumers. This includes all aspects of animal welfare, such as better knowledge of the negative effects of certain technologies and logistics, such as long transport journeys of living animals, etc. At the same time, the experts demanded research support for objective animal welfare evaluation and labelling.

The conservation of genetic resources or autochthonous breeds was also frequently mentioned. In general, attention should be paid in future to animal breeding, also in the sense of breeding schemes for more efficient and low emitting animals.

For improved sustainability in the livestock sector, it is generally necessary to work on improved animal management. The focus lies on the precision livestock farming systems. Besides the focus on technological aspects (e.g. use of sensor technology, automatic milking systems etc.) in terms of precision livestock farming, it is also necessary to focus on global sustainability issues (the focus should not be put solely on climate but also include welfare issues, biodiversity, etc.).

Often drivers were mentioned with regard to the economic situation in the livestock sector. In particular, the price of sustainability was pointed out. This means that regulations must be found that enable the farmer to earn a reasonable income while at the same time responsible for protecting resources and a sustainable production, which usually goes hand in hand with lower effectiveness and productivity. These regulations can for example provide support for extensification, better prices in trade or even promotion of local production systems. In the current situation, the cost-benefit ratio forces the producer to produce more efficiently. The producer is conscious, however, that agriculture must change, must become "greener". At the same time, farmers are facing problems with workloads due to personnel management, as there is an extreme lack of labour and

skilled workers. Supporting measures must also be taken into account to guarantee farmers and workers in the sector a better quality of life.

With regard to the current environmental situation, some drivers were also listed. These related in particular to finding regulations regarding the climate change. The experts listed topics for the reduction of climate gases, a more careful handling of resources as well as the conservation of biodiversity.

Special attention was also paid to the topics of research and digitisation. In particular, research should help to generate knowledge on the above-mentioned drivers in the areas of animal health and welfare, sustainability in animal production systems, the economic situation and environmental policy. Technological progress can support the required goals in many areas as well, such as improving the quality of life of farmers, etc.

Question 9 of the survey is about the types of innovations, which could improve the sustainability of the EU livestock sector.

The most frequent innovations refer to on-farm solutions, including animal genetics, farm management, animal housing, and the animal health and welfare situation. In particular, an improved genetic selection or genetic improvement, e.g. to achieve better feed efficiency of the animals, was pointed out. The reduction of antibiotic use was often also mentioned in relation to an improved animal health. The use of antibiotic substitutes, which are already available as feed additives, can help to reduce the use of antibiotics and also prevent resistances. In general, changes in animal diets or a perfectly adapted diet can have a positive effect on animal health, well-being and farm management as well and should be consistently pursued. In addition, new raw materials, valorisation of residues and innovations in animal nutrition can help to reduce the current dependency on soy and also production costs.

The focus should in general be more on precision livestock farming, especially with regard to the animal welfare and health situation. In general, it can be said that any innovation that allows small farmers to survive on the current world market and offers them a better quality of life would be useful. More small farms will disappear in the future because there are no successors and young people, respectively the next generation, do not want to adopt the current way of agricultural life.

With regard to the current environmental situation, the participants also considered some innovations to be beneficial in improving sustainability in the livestock sector. The handling of waste products from animal production was mentioned several times, as well as carbon footprint reduction and improvement of water recycling systems. In terms of climate protection, emissions, especially from agriculture, play a major role. A reduction in emissions is to be targeted at all sources of emissions from animal production. For example, more fertiliser reactors can be used for manure treatment to produce CH₄ that can be used locally or sold instead of being released. All innovations in this field that are used contribute to an improved biodiversity in the sense of sustainability.

Digitisation and the use of innovative technologies and sensors can be seen as positive in terms of sustainability, as the use of these tools often leads to improvements in the various stages of animal production, particularly with regard to the innovations and topics mentioned above. For example, there are the use of ICT sensors to have better control of animals on farms and surrounding, apps to follow the welfare situation of animals and the productivity at animal level as well as technologies for saving and manage water, fertilizers, pesticides, antibiotics etc.

In question 10 of the survey the participants were asked for their opinion on which research priorities need to be set to improve sustainability in the livestock sector.

In this question on research priorities most of the answers again referred to the current farming situation including also the animals' perspective. In particular, the experts attached importance to prioritising research with regard to animal health and animal welfare. Here, too, the reduction of the use of antibiotics is pointed out, which should be accompanied by a long-term improvement in animal

health. In this context, a research focus in animal genetics can also help to increase efficiency on one hand and at the same time improve the animals' ability to resist and thus improve their health.

In order to ensure good animal health and welfare, best farming situations must be guaranteed. This means that research is also required in the topics of animal housing systems and farm management in general. Animal welfare and animal health are of crucial importance because “healthy livestock for healthy diets implies healthy people and healthy planet”.

Harmonised standards of animal welfare across countries and objective measurements and labelling of animal products for animal welfare are key issues to be addressed in order to improve the current situation.

Another important research focus named by the experts, is the current environmental situation. The main topics are climate change, conservation of resources, reduction of emissions from agriculture, conservation of biodiversity, but also biosecurity. One approach may be the search for balanced farming systems with animals that are environmentally friendly, maintain soil quality and are profitable at the same time. With regard to the reduction of greenhouse gas emissions from livestock and the reduction of global warming, in addition to animal breeding strategies and an improved manure management, environmentally friendly management practices such as dietary supplements and feed alternatives, pasture improvement, stocking density, biological control, grassland management, manure management, etc. can also be applied. In summary, it can be said that understanding of the broader impacts of animal production on terrestrial and marine ecosystems needs to be developed and mitigation strategies for any adverse impacts on ecosystems need to be developed.

In addition, it is essential to adopt a holistic approach. Research is still focused on individual areas, but individually each of them cannot achieve the ultimate goal of sustainable agriculture. The challenge is to merge them in a cross-system approach. This will include the development of holistic decision support systems that limit uncertainty and help producers to monitor and manage physical, financial and environmental performance, animal health and welfare in real time to improve the sustainability of animal production systems, as well as the multi-disciplinary analysis of the impacts of “modern” livestock systems.

6. General discussion

In the following sections, the results of the survey are linked with the past developments which led to the present situation. Furthermore it will be discussed which drivers had the main influence regarding the current status quo of the livestock sector.

The impact of drivers of change on national, European and Global level

Looking at Figure 23 regarding the influence of drivers of change on the livestock sector, it is remarkable that at European and national level the bar chart give a very similar picture. The experts describe the driver "regulatory environment" as the largest influencer with 3.94 ± 0.97 points at national level and 3.93 ± 1.02 points at European level of a possible maximum of 5 points. Furthermore the drivers “technological change” (National level: 3.57 ± 0.89 points; European level: 3.64 ± 0.88 points), “input and farm gate prices” (National level: 3.94 ± 1.04 points; European level: 3.64 ± 0.94 points) and “progress in animal genetics” (National level: 3.43 ± 1.04 points; European level: 3.61 ± 1.04 points) have been highly rated by the experts. The driver “regulatory environment” was rated as the greatest influence, as the livestock sector in the EU has been strongly shaped by the introduction of CAP and other EU regulations over the last decades. A large number of regulations and environmental regulations influence the entire livestock sector in the EU, which can generally be assessed as target-oriented, also according to the experts' evaluations. The driver "technological change" is the fastest developing driver at all levels (Brewster et al., 2018), and technology and digitisation is also a rapidly growing field outside agriculture. The increasing use of technology in agriculture has resulted in many changes (Zanten et al. 2016; Brewster et al., 2018), but also challenges, especially in countries with a strong economy. This is also reflected in the comments of the experts. Regarding the driver “input and

farm gate prices the ranking was very high too. That is because there were many fluctuations in the input and farm gate prices recognised in recent years in Europe. Farm gate and market prices are strongly influenced by regulatory structures. According to the experts' opinion, the abolition of quotas in Europe led to additional price and cost fluctuations for dairy farmers in Europe, but also worldwide. Added to this were higher costs for energy, animal feed and labour. For this reason, milk prices, for example, have fluctuated very strongly over the past 10 years. "Progress in animal genetics" is also a driver which ranked with a strong impact by the experts. This is particularly related to the introduction of genomic selection and most European countries follow the fast development in animal genetics. With the help of genetic selection, productivity has increased considerably in recent decades and thus exerts a strong influence on the livestock sector. Based on the expert's assessment, the driver "population dynamics" shows the lowest impact on the livestock sector at the National level (2.29 ± 1.41 points) and European level (2.35 ± 1.14 points). This is due to the fact that population growth has been stable for years and is likely to decline in future years.

In contrast, the bar chart of Figure 23 on global level differs in some points significantly from the bar charts on national and European levels. This reveals that the driver "population dynamics" with 3.53 ± 1.22 points is one of the most influential on a global level in contrast to the other levels. This can be explained by the fact that the world population is constantly growing and that the demand for animal products is therefore increasing. Furthermore the driver "regulatory environment" with 2.33 ± 1.18 points is rated by the experts as one of the lowest influencing factors on Global level in contrast to the other levels. According to the experts' opinions, this is due to the fact that fewer regulations and environmental rules apply outside Europe, which means that costs associated with environmental issues and administration are lower and at the same time livestock production has much more competition power.

The concept of sustainability in livestock production

With regard to the development of sustainability in the livestock sector in relation to the three pillars of sustainability, Figure 25 shows the experts rating. The bar charts show that for all levels (National, European and Global) the "economy" pillar is assigned the strongest weighting. Sustainable animal production implies that, for example, the handling of resources is improved, the number of animals is reduced, etc. and at the same time has a significant impact on working hours and process workflows and thus increases the price on the market and impacts the "economy" pillar. Looking at the three purple coloured bar charts in Figure 25, it can be noticed that the influence of the "economy" pillar on the Global level with 5.43 ± 1.52 points was rated slightly higher by the experts than the "economy" pillar on the national level with 4.13 ± 1.45 points and the European level with 4.13 ± 1.34 points. As a consequence, the competitiveness of the livestock sector at the global level is considerably higher, which also affects the "economy" pillar. Another effect regarding this finding can be seen in the import and export market situation. The use of local products and resources is often not possible in many regions of the world, especially in developing countries, because imported goods are often more economical due to the price situation.

The strong weighting on the "economy" pillar at the Global level is simultaneously reflected in a lower rating of the other two pillars "environment" and "society". According to the experts this is because food and financial security seems strongly favoured over environmental concerns in developing countries and there is nearly no improvement in environment. On the other hand, at European and national level, the pillars "environment" and "society" become one which constitutes a step towards a sustainable production. This is mainly due to the fact, that stronger rules and regulations in the EU affect the livestock sector, in contrast to global regulations, with the aim of increasing sustainability in the entire agricultural sector.

The retrospective literature analysis demonstrates that the political instruments used, the constant adaptation of the regulations in the EU and the evolution of the various driving forces have resulted in today's objectives of the sustainability goals which are in line with the CWG-SAP and that these can be implemented with all the necessary measures in a united Europe. In addition, the survey shows that experts in the fields of agricultural sciences and economics from all over Europe confirm these

statements and also mention some points of criticism that can help to achieve the ultimate goal of a sustainable animal production throughout Europe in the future.

Impact on and challenges for the current EU livestock sector

As presented in the status quo of animal source foodstuff production (Chapter 3), the livestock sector is a very important component of the agricultural economy of the European Union. Beside this economic relevance of livestock, the importance, however, goes beyond food production towards a variety of ecosystem services. Ruminant livestock species like cattle, sheep and goats consume cellulosic materials such as grasses, which the human body is unable to digest. This potential facilitates the exploitation of large land areas that are not suitable for crop cultivation. Thus, pasture, green fodder as well as crop residues and cellulosic by-products of the food industry can be utilised and by producing manure nutrients and organic matter are cycled back to crop production. Livestock farming can therefore promote the circularity of nutrient flows. The preservation of cultural landscapes is shaped by traditional animal grazing systems and fodder production. The European livestock sector is closely linked to the social and cultural lives of European farmers and citizens in general, as agriculture and animal farming represent essential parts of the European cultural heritage.

By using scarce natural resources, these important functions affect the global common goods which leads to a variety of challenges the European livestock sector currently has to face. Soil degradation, water pollution, loss of biodiversity and greenhouse gas emissions are just some examples of hot topics that are of relevance for the ecological implications of intense livestock farming. These current challenges are reflected in the future goals of sustainable animal production systems, defined by the CWG-SAP (Terms of References, 2019; see Introduction). Besides the important contribution to a healthy nutrition of Europe's citizens by providing high quality proteins and foodstuff with high nutritional value the consumption of animal-sourced food is partly questioned at the moment. The development of antimicrobial resistant microorganisms represents a threat for public health, which is caused by overusing antimicrobials amongst others in livestock production systems. European livestock farmers have to meet increasingly tougher quality and hygiene targets to protect the consumer and ethical aspects like animal welfare continue to attain growing importance in Europe. The competition on the global market not only opens possibilities for trade opportunities but also opens up problematic issues like the import situation of protein feed components (Baldock and Mottershead, 2017).

Recent key publications have indicated strong evidence that the livestock sector is out of sustainable limits for aspects like nutrient flows, greenhouse gas emissions as a cause for global warming and the preservation of genetic biodiversity (Steinfeld et al., 2006; Rockström, 2009; Sutton et al., 2011; van Dijk et al. 2015; Buckwell and Nadeu, 2018). There is a significant need to find future solutions towards a more sustainable livestock sector in the European Union that are able to meet the ecological, economic and social demands whilst minimizing the negative side effects of livestock production.

7. Conclusions and recommendations

7.1 Conclusions

The following conclusions are drawn from the CWG-SAP CASA study results:

A variety of driving forces have shaped the livestock sector of the EU during recent decades. Structural changes and direct decision making of farmers largely depend on internal and external influencing factors. Evaluation of the expert consultation showed that on national and European levels regulatory environment, technological change and progress in animal genetics during the last decades, as well as input and farm gate prices were assessed as having the largest influence. In contrast to this on the global scale, economic development and population dynamics were rated as the major driving forces that have led to the current status quo of the livestock sector. Additional drivers of change that were rated by the experts are listed in the following: environmental issues, culture and lifestyle choices, producer and farm characteristics and animal health.

Due to the complexity and momentous changes in recent years of the situation in the entire European livestock sector, the current CWG-SAP CASA study can only give a general overview and does not guarantee completeness. The literature analysis showed that there is a wide range of documents that deal with the analysis of specific influencing factors on a Regional, National, European or even on a Global level. Most studies focus on one specific topic or historical event on a defined scale, that brought changes for livestock farmers (for example the effects of a new manure policy on Dutch dairy farmers after the abolition of the milk quota; Klootwijk et al., 2015).

Analysis of past developments can help to approach new challenges in the future in a more constructive and well prepared way. However, general “lessons learned from the past” are hard to outline, since every historic or future problematic situation in the livestock sector occurs in a diverse interplay of influencing factors, which have to be taken into account to work out a constructive solution. Overall it is clear, that the regulatory environment is committed to supporting the development of the European livestock sector towards a more resilient and social accepted future, built on balancing the three pillars of sustainability.

To enable a more holistic approach and profound analysis of the available literature, in future comparable studies a stronger involvement of experts from the various scientific fields might deliver specific input (e.g. literature reviews) and open up the change to draw a more comprehensive overview of the historical evolvement of the European livestock sector.

7.2 Recommendations

In line with the objectives of the CWG-SAP as per Terms of Reference (2019), the following recommendation for a roadmap for further proceedings to use the results and conclusions from this CWG-SAP CASA study are given:

July 2019	» present CWG-SAP CASA study for further discussion to CWG-SAP members	BLE
	» CWG-SAP meeting	
Sept - Oct 2019	› present and discuss results of CWG-SAP CASA study	
	» 5 th SCAR Foresight	CWG-SAP & Head Office
	› deliver final “CWG-SAP fact and figures report” to Foresight experts	
Jan - March 2020	» draft CWG-SAP report incl. updated national reports and draft “CWG-SAP CASA study reflection paper”, national research priorities from SusAn Common Strategic Research and Innovation Agenda and future scenarios considering the 5 th SCAR Foresight transitions	CWG-SAP & Head Office

March 2020	» Analysis of national reports	Head Office
March - May 2020	» CWG-SAP meeting › presentation of CWG-SAP report	CWG SAP & Head Office
Summer 2020	» publication of CWG-SAP Country Report incl. CWG-SAP CASA study “reflection paper”, with the aim to develop “future scenarios”	CWG SAP & Head Office
	» Stakeholder involvement	CWG-SAP & Head Office
2020/2021	» use of policy/refelction papers and development of recommendations for SCAR, EU & Member States	CWG-SAP & Head Office

7.2.1 CWG-SAP Country Report

One of the deliverables of the 2019-2021 mandate for CWG-SAP is to update the 2015 CWG-SAP Country Report “Survey & Analysis” which

- » gave an overview of the different livestock systems in CWG-SAP member countries and the status of national animal production;
- » showed national research and research priorities of 16 countries or regions;
- » identified and discussed priority topics in the field of sustainable animal production;
- » summarised and evaluated relevant research areas in order to find a balance between the sustainability approach, the different research questions and national research priorities
- » built the foundation for the ERA-NET SusAn research framework.

The CWG-SAP CASA study gave a general overview on the situation of the European livestock sector. It is recommended to include the findings of the CWG-SAP CASA study highlighting the most important developments which lead from the past to the present situation in order to set the scene for future research and innovation projections.

The situation within countries and even at a regional level with regard to the complex system of drivers and historic developments could not be presented here. In order to revise common goals and priorities that benefit from a joint European research and innovation approach for more sustainable animal production and thus deliver more impact on European level, CWG-SAP members should be asked to provide additional input from the national perspective along the same lines as the CWG-SAP CASA study. Starting with the CWG-SAP sustainability goals and the assumption that European livestock production is not sustainable yet, what have been the main drivers and past developments that impacted sustainability nationally. National reporting should also outline progress since the last CWG-SAP Country Report 2015 and cover achievements that can be linked to joint efforts, e.g. ERA-NET SusAn, CWG-SAP or other European or international initiatives. With a view to future scenarios, country-specific reform priorities should be included as well.

The aim of the exercise is to have an evidence based status quo report of the situation of livestock in Europe and the CWG-SAP member countries that can serve as a starting point for future deliberations and communications of CWG-SAP as outlined in 7.2.2-7.2.4.

According to the CWG-SAP Terms of Reference (2019), the results of the CWG-SAP CASA study shall be used for the development of a CWG-SAP reflection paper, which identifies the common CWG-SAP perceptions and goals, constructive future projections, realistic pathways and solutions to initiate necessary changes for a more sustainable animal production sector. For the development of the reflection paper, a couple of considerations / decisions should be taken into account:

- » With regard to the CWG-SAP’s mission statement, the focus of the reflection paper should be on recommendations for research and innovation needs.
- » The desk-top research for the CWG-SAP CASA study showed numerous publications on the topic from many different actors. The reflection paper should consider CWG-SAP’s role in the (global)

player context and how it aligns with their policies and strategies: e.g. seek discussion in case of different attitudes, ally in case of similar perceptions to increase impact.

- » CWG-SAP needs to decide from which angle to approach the topic:
 - › livestock sector in the EU political context: the study showcased the dynamics of the sector over the past 60 years and that solutions cannot simply be drawn by learning from the past, however, are there major influencing regulations, indications what worked what did not and why
 - › livestock sector in the EU past 60 years: major drivers
 - › major challenges with clear link to past (political) failures
- » “Future Scenarios” shall be developed on the basis of the CWG-SAP CASA study findings taking into consideration the 5th SCAR Foresight transitions.

7.2.2 CWG-SAP Policy & Reflection Papers

According to the Terms of Reference (2019), CWG-SAP aims to produce sector specific policy briefs. Based on the findings of the CWG-SAP CASA study, additional scientific evidence and country specific information provided in the updated CWG-SAP Country Report (7.2.1), the CWG-SAP policy briefs can provide advice for policy makers in Member States and the European Commission to promote exchange and discussion for the development of a more sustainable livestock production in Europe.

Given the complex nature of sustainability, a number of policy briefs could be published for different target groups on different topics also outlining instruments and strategies towards sustainable and robust solutions for the future configuration of the European livestock sector, for example:

- » a holistic approach for cross-national guidelines to reduce emissions throughout the entire process chain;
- » innovations to conserve resources including animal genetics and feed utilisation;
- » biodiversity conservation and restauration, e.g. by reducing emissions, better manure management
- » improvement of animal health and welfare in the system incl. One Health
- » political regulations and market failure
- » need for systems approach in research.

7.2.3 CWG-SAP stakeholder involvement

One of CWG-SAP’s objectives is to facilitate and stimulate collaboration and networking. The information gathered in the desktop research can be used to identify relevant stakeholders and (international) initiatives. Based on the results of the CWG-SAP CASA study and the CWG-SAP Reflection Papers, CWG-SAP can then seek dialogue on common topics to either increase impact or least avoid duplication of efforts.

7.2.4 CWG SAP input for the 5th SCAR Foresight exercise

One of the deliverables of the new three year mandate for the CWG-SAP is to provide input for the running 5th SCAR Foresight exercise and to support the entire SCAR Foresight process. Since the CWG-SAP CASA study builds the basis for CWG-SAP’s future scenarios in the livestock sector, the results of this study are particularly suitable as input for the SCAR Foresight to present future scenarios of the sector for the coming years and decades.

When the Standing Committee on Agricultural Research (SCAR) began rebuilding its position as a European advisory body on research policies for Member States and the Commission, Foresights were identified as a principle instrument to develop research agendas and to support SCAR in its advisory function. Since 2006, four Foresight exercises have been carried out to identify possible future scenarios for European agriculture and - starting from 2012 - for the wider Bioeconomy. The SCAR Foresight process continuously adapts to new challenges, takes up cross-cutting issues, feeds the strategic process of research policy-making and gives advice to policy decision makers. Currently, a 5th SCAR Foresight under the headline “Natural resources and Food Systems: Transitions towards a “safe and just” operating space” is ongoing. The 5th SCAR Foresight exercise will be developed in accordance with the objectives agreed by all EU Member States to protect the world from hazards of further changes of the world climate (COP21 Paris Agreement) and to guarantee a suitable

development for humanity (Sustainable Development Goals (SDGs) and the UN Agenda 2030). By June 2020, a SCAR Foresight Expert Group shall deliver a report – the 5th SCAR Foresight exercise. This shall be realized through a series of workshops and based on “Facts and figures reports” delivered by the groups under SCAR, the Strategic and Collaborative Working Groups (SWGs & CWGs).

As in recent years livestock production has come under pressure in terms of greenhouse gas emissions and social acceptance, the CWG-SAP’s input is extremely important in order to identify and develop possible future scenarios within the sector.

Therefore, the CWG-SAP will follow the Foresight experts’ request to contribute to the 5th SCAR Foresight with a “Facts and figures report” in order to cover the main relevant aspects of the livestock sector. The related request refers, on the one hand, to the presentation of group work and the results achieved so far and, on the other hand, to aspects of future changes and required adaptations and transitions.

The contribution shall address the following three goals of the future:

1. Healthy and sustainable food for all
2. Safe and just circularity of food systems
3. Substantial increase of biological, social and economic diversity

The “CWG-SAP facts and figures report” is expected to be available by the end of September 2019/mid of October 2019.

8. Executive Summary

Livestock production plays an important role all over Europe. Although production systems and farm structures differ among the Member States, economic relevance (e.g. export of products of animal origin), different ecosystem services (e.g. ruminant exploitation of cellulosic materials), and social/cultural importance (e.g. preservation of cultural landscapes by grazing livestock) are given all over Europe.

The current status quo of the European livestock sector has largely been shaped by the **historic influences of various driving forces** and influencing factors during the past 60 years. Important influences were given for example by the increased economic growth after the Second World War, the population dynamics in Europe and due to increasing globalisation, also the steady increase of the world population (growing international trade). Changes in consumer demands and lifestyle choices towards greater requirements of animal welfare standards as well as requirements for increased information flow and product security, while still allowing for affordable prices also shaped the history of the EU's livestock sector. Scientific and technological progress since the 1950s led to increased productivity, specialisation and structural changes of farms and production systems in the whole European livestock sector. Implications also arose by means of animal health issues like foodborne diseases that caused significant economic losses and implications of consumer trust as observed during the BSE crisis in the 1980s. Increasing awareness for environmental side effects of livestock production like emissions to soil, water and the atmosphere or effects on biodiversity of European ecosystems, shaped the steadily modified political framework conditions during the last decades. Decision making of livestock farmers for adaptation of production systems is directly influenced in particular by market price structure and the regulatory environment.

In order to fulfil its mission to provide advice on the coordination of research and innovation for the development of more sustainable animal production systems in Europe, the **CWG-SAP study consulted international experts** from the field of livestock science. The opinions of 51 experts about the importance of driving forces and aspects of sustainability in livestock production were evaluated, aiming to **draw conclusions on the defined future development needs for more sustainable production systems that have been agreed on within the CWG-SAP**.

Some of the most relevant expert opinions that were mentioned in line with the CWG-SAP future sustainable development goals of the European livestock production sector are listed below:

- » Reducing emissions throughout the entire process chain - holistic approach, cross-national guidelines
- » Conserving resources, sustainable management, developing new methods to conserve resources - research is necessary (perhaps) with regard to animal genetics: higher production rate, better feed utilisation etc.)
- » Maintaining and improving biodiversity, e.g. by reducing emissions, better manure management
- » Reducing the use of antibiotics - finding alternative substances, such as specific feed additives with similar effects (research), or generally improved animal health and thus less use of antibiotics
- » Improvement of animal welfare - improved farm management, precision livestock farming, use of sensor technology
- » Improvement of animal health: "healthy animals, healthy diets, healthy people, healthy planet"

In contrast to these supportive aspects, the experts also indicated some critical aspects that were not explicitly taken into account by the future sustainable development goals defined by the CWG-SAP so far. Exemplarily, the most frequently stated remarks are listed:

- » Political regulations regarding farm gate prices, import/export limitations and cross-country guidelines are too marginal
- » Lobby situation in the animal feed industry should be taken into account
- » Critical situation of protein supply for animal feed like the European and international implications caused by soy imports

- » Research from a holistic point of view which combines different disciplines is necessary which represents the biggest challenge in optimising scientific progress; even though the CWG-SAP states, that the interactions of the different disciplines related to the livestock sector are regarded in a holistic way the experts explicitly stress this importance regarding the European research situation; scientific papers including data from one separate research field are still easier to publish, therefore interdisciplinary projects should be strongly supported

The outlining of the current status quo of the European livestock sector, the retrospective analysis of the drivers of change as well as the evaluation of the expert survey demonstrated that the CWG-SAP is on a right path by defining concrete goals and requirements to move towards a more sustainable animal production. Additionally mentioned critical points can serve to further optimise the objectives of the CWG-SAP. The present study serves as a base to fulfil the targeted future scenario building by the CWG-SAP, enabling the working out of constructive future projections, realistic pathways and solutions to initiate necessary changes to strengthen the aspects of sustainability in the European livestock sector.

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Annex: Questionnaire

Questionnaire for the CASA Study

Time requirement about 20 minutes.

“Drivers of change and development in the EU livestock sector – Meta Analysis as basis for future scenario building”

Background and Objective

Founded by CASA, the study “Drivers of change and development in the EU livestock sector” is prepared to serve as a basis for the Collaborative Working Group on Sustainable Animal Production (CWG-SAP) to work out pathways and solutions towards a more sustainable animal production sector in future. The study will be based on a literature review, supported by the results of the present questionnaire. The study aims to:

- Understand the dynamics which led to the present situation of the European livestock sector – How did today's status quo come about, what were the relevant drivers?
- Which future changes could lead to a more sustainable EU livestock sector?

General Information

- Please fill in the questionnaire as completely as possible
- The answers should **reflect your personal opinion**, based on your expertise (do not need to reflect the official national strategy)

Please provide us some information about you.

Your personal data will not be linked to the evaluation outcome and will be used only to put the answers in perspective to your professional background and country.

Deadline: Please send us the filled in questionnaire until **31th of May** via Email

Return answers to and contact in case of questions on the content of the questionnaire:

Maren Wierig and Lisett Martin, Federal Office for Agriculture and Food (BLE)

Maren.Wierig@ble.de, Tel. +49-228-6845 3828

Lisett.Martin@ble.de, Tel. +49-228-6845 3639

Country: _____

Please choose your expertise:

- Researcher from the field of: _____
- Governmental Agency
- NGO
- Other: _____

Name/Contact (optional, only for possible inquiries): _____





1. Below you find examples for drivers of change that have influenced the livestock sector during the last decades. Please evaluate the different drivers regarding to what extend they had an impact on the current status quo of the livestock sector.

Scale ranging from 0 (no influence) to 5 (outstanding significant influence)

Driver of Change	National Level	European Level	Global Level	Please explain your rating (key points), for example reason for deviation between the levels
Economic development (summarized by growth in the GDP)				
Population dynamics (Population growth, demographic changes etc.)				
Regulatory environment (Common agricultural policy (CAP) and other EU policy legislations)				
Technological change (Available technological innovations)				
Environmental issues (Climate change, greenhouse gas emissions, soil carbon sequestration etc.)				
Culture and lifestyle choices (Dietary behaviors, consumer preferences etc.)				
Producer and farm characteristics (Type of farms, number of farms, animal numbers per farm)				



Input and farm gate prices (Interplay supply and demand, relation input and output prices etc.)				
Animal Health (epidemics, preventive health management etc.)				
Progress in Animal Genetics (Improved productivity and side effects)				
Other relevant Drivers?				

Any additional comments?



CWG-SAP defines Sustainable Animal Production as “economically viable, socially acceptable, with minimal impact on the environment”

→ Sustainability triangle of economic competitiveness, social acceptability and environmental protection



2. To your personal opinion, how are the three pillars of sustainability weighted in the current livestock sector?

Please rate the three pillars according to their weighting on the different levels on the matrix below with a total of 9 points in each row.

→ 3 points for all pillars would represent a sustainable system, in which all pillars are weighted equally

Level	Economy	Environment	Society
National Level			
European Level			
Global Level			
Please explain your rating (key points), for example reason for deviation between the levels			

Any additional comments?

3. What do you think are the main **economic reasons** for the European livestock sector to be currently not as sustainable as desired? *(max. 3 replies)*

- Xx
- Xx
- Xx

4. What do you think are the main **ecologic reasons** for the European livestock sector to be currently not as sustainable as desired? *(max. 3 replies)*

- Xx
- Xx
- Xx

5. What do you think are the main **social reasons** for the European livestock sector to be currently not as sustainable as desired? *(max. 3 replies)*

- Xx
- Xx
- Xx

6. Which of the current **EU policy instruments** do you think affect the **sustainability** of the EU livestock sector in a **positive** way? *(max. 3 replies)*

- Xx
- Xx
- Xx

7. Which of the current **EU policy instruments** do you think affect the sustainability of the EU livestock sector in a **negative** way? *(max. 3 replies)*

- Xx
- Xx
- Xx

8. What do you think are the **main drivers of innovation** in the EU livestock sector for **ensuring sustainability**? (*max. 5 replies*)

- Xx
- Xx
- Xx
- Xx
- Xx

9. Which kind of **innovations** could improve the sustainability of the EU livestock sector? (*max. 3 replies*)

- Xx
- Xx
- Xx

10. Which **research priorities** do you think need to be set in order to improve sustainability in the livestock sector? (*max. 3 replies*)

- Xx
- Xx
- Xx

Any additional comments on the questionnaire?

Thank you for your support!



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