MARKET ANALYSIS

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Suckler-cow and sheep farming in global comparison – production systems and economics

Farm-level benchmarking and comparative analysis provide a basis for orientation on national, regional and global level. In the *agri benchmark* global network, we compare beef and sheep farms (as well as other branches) from more than 30 countries. In a partnership approach with researchers, producers and local experts, we collect and validated farm-level data using a standard operating procedure and a farm-level simulation model. In cow-calf farms, winter housing is associated with higher live weight production. Profitability is mainly driven by weaner prices and their variation and to a lesser extent by costs. In the EU, government payments play a crucial role in determining profitability. In sheep farming, performance and economic framework conditions differ across production systems and countries. Sheep profitability shows large variations with higher profits being achieved outside of Europe. The global outlook for beef and sheep production remains positive, with declining numbers in Europe and challenges related to workforce and environmental regulations.

Keywords: modelling, simulation, agri benchmark, animal husbandry, profitability, cow-calf production, sheep production, benchmarking

JEL classification: Q11

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Introduction

The *agri benchmark* Network is a project of the Thünen Institute of Farm Economics. For several branches (crops, horticulture, beef, sheep, pig, poultry and aquaculture), we analyse production systems, their economics, framework conditions and perspectives globally. For the livestock networks, this also includes animal welfare and environmental analysis, especially on greenhouse gas emissions.

Within the network, we apply a partnership approach with research partners in all participating countries who contribute data and expertise, crosscheck and validate results. Some partners (in Australia, Brazil, Canada, Spain) established their own national networks using the *agri benchmark* tools or their own tools which can be easily linked to the global analysis. They also perform their own analysis and reporting for clients in their countries. Figure 1 shows the member countries of the Network as well as the number of farms.

Data and methods

The uniqueness of the network are farm-level data sets of so-called typical production systems and farms which are created jointly with research partners in member countries, producers and local experts following a standard operating procedure developed jointly in the networks. Due to the global character of the exercise, the approach and methods constitute a compromise between the detail required and the feasibility and fundability of data collection. It means that we cannot do extensive surveys but need to collect a few data points to make meaningful and consistent conclusions. For beef and sheep, there is no other comparable system and data available. Our approach makes sure that the results of the benchmarking exercise are comparable between and within countries. The data is updated annually, and results are discussed in an annual conference that rotates through the member states.

2023	Countries	Frams	Year in Network
Beef	28	172*	21
Cow-calf	28	97	19
Beef finishing	28	75	21
Sheep	18	47	11

* 35 farms appear twice duo to complete cycle (cow-calf and beef finishing in one farm)

Figure 1: Countries and farms in the agri benchmark Beef and Sheep Network 2023.
Source: Own data and illustration

There are several steps for data collection and validation (see also Chibanda *et al.,* 2020):

Step 1: Identifying relevant regions. We want to represent high market shares of the product considered. Thus, we first identify the most important regions. This step entails the identification of the most important regions according to the purpose of the analysis. To permit analysis of cost of production and competitiveness, the focus is on regional 'hot spots' in terms of agricultural production in each country. In most of the countries, statistics can be used for this purpose, and the indicators we have employed are livestock numbers and density per region.

Step 2: Identifying Typical (prevailing, most common) Production Systems. The identification of typical production systems is conducted in close collaboration with local experts who are usually farm advisors, producer organisations or research institutions with close contacts to producers. The main reason for adopting this expert-based approach is the general lack of economic statistics about production systems and their prevalence in most agricultural statistics. Characterisation of the farms is made at a whole-farm level (specialised vs. mixed farms, labour organisation, land ownership, capital and equipment etc.) and enterprise level (livestock numbers, breeds used, performance and reproductive indicators, feed basis, feed rations etc.).

Step 3: Data collection: After the identification of typical farms or production systems, the data collection can be done in one of two ways. The first and preferred way involves conducting focus groups consisting of the research partner, at least one local expert (advisor) and four to six producers. The producers' farms should come close to the characteristics of the farm identified in Step 2. A standard questionnaire is used and filled-in jointly with the focus group members, using the farm type and production system identified in Step 2 as a basis. The research partners act as moderators and direct the discussion around the typical farming situation in a typical year. The discussion aims at achieving a consensus for each figure, taking out extreme figures or particularities of the individual producers. Instead of calculating an average of the participating producers' farms, the most frequent or prevailing specification for each variable and indicator is recorded. The second way involves collecting the data from an individual producer that comes very close to the typical farm identified in Step 2 and then 'typify' this data by replacing the farm particularities by more typical information and data available from expert knowledge, surveys and technical handbooks. In both cases, consistent datasets are obtained.

Step 4: Processing and Validation: The Technology Impact Policy Impact Calculations (TIPI-CAL) model is used for data analysis. TIPI-CAL is a production and accounting model that enables the calculation of physical (cropping pattern, yields, inputs, animal performance, land use, labour, machinery, equipment, buildings) and economic parameters (prices, financing, overhead costs, variable costs). In recent years, some environmental indicators have been added, for example to calculate greenhouse gas (GHG) emission. The model produces a whole-farm profit and loss account, a balance sheet and a cash flow. At the enterprise-level, a total cost calculation is produced (including cash costs, depreciation and opportunity costs). In what can be termed an 'interplay' procedure, results are reverted to the data providers. Changes in the data are made until an agreement is achieved that the data set is realistic, accurate and consistent.

Step 5: Updating. The updating of the data takes place annually for all prices. Updates are either done for each farm individually or through national or regional projection data which are applied to the farms in a country. Every three to five years and where relevant, updates of the farm sizes (hectares, animal numbers), performance indicators and their organization (labour, capital) are carried out. All these steps are performed jointly with the research partners and the local experts in the countries.

The result of the farm analysis and other topics are discussed among network members in an annual conference which takes place in June and rotates around the globe. Here the partners can see "their" farms in the national and international comparison and explain differences within their countries and with other countries. Inconsistent data can also be identified within the scope of the benchmarking. Where necessary, data are corrected in a post-conference process. In September/October of each year, the partners receive a comprehensive result data base with numerous tools and options for selection, ranking and analysing data on enterprise and whole-farm level. Additional data and tools on beef and sheep markets, prices, production and trade are available as well. A short summary report with the main findings is published on the *agri benchmark* website. Partners are encouraged to translate this report into their own language and publish locally.

Cow-calf farm results

Explanatory notes on the presentation of the results in the following charts

1. Production system definitions
   Cow-calf: 'Outdoor' (animals stay outside all year round), and 'Winter barn' (animals are kept in barns mainly during winter times).
   Sheep: 'Grazing', 'Grazing and forages', 'Forages', 'Grazing, concentrates and forages'.
   These definitions are based on the dry matter composition of the feed rations.
2. Explanation of the names of the farms on the x-axes:
   Country Number of suckler-cows _Number of finishing cattle sold per year.
   Examples:
   AR_800_630 Argentinian farm with 800 suckler-cows and 630 finished cattle sold per year.
   AT_25_0 Austrian farm with 25 suckler-cows and no finishing cattle.
   AU_1250 An Australian farm with 1250 ewes (mother sheep).

The analysis within the *agri benchmark* has shown that cow-calf systems are pasture-based world-wide. The main difference can be observed in winter, when in some countries and systems the cows remain outside, while in other

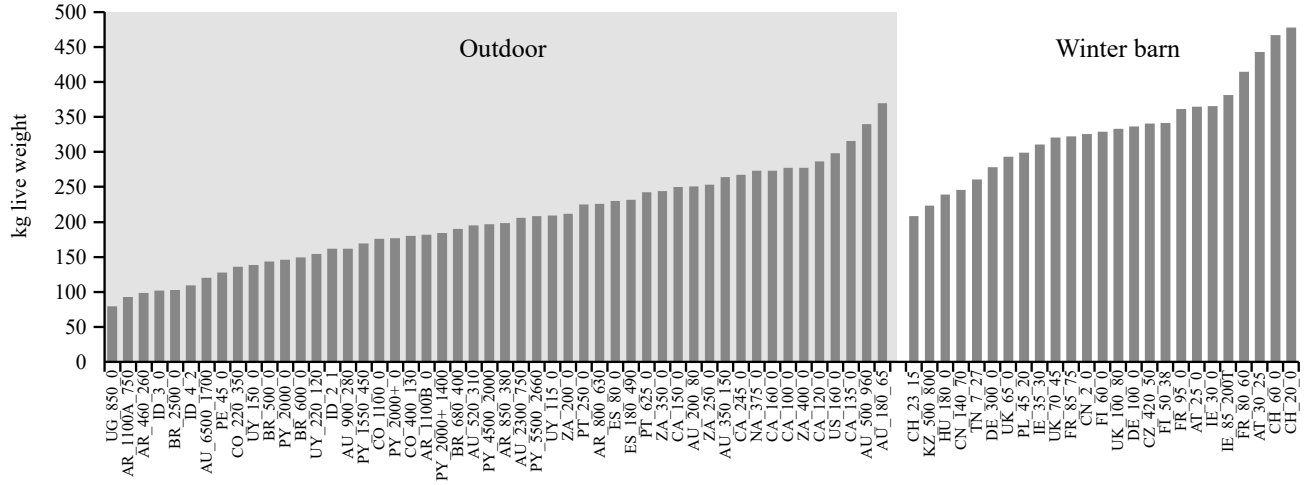

Figure 2: Live weight produced per cow and year by winter housing system (kg live weight).

Countries: AR = Argentina, AU = Australia, AT = Austria, BR = Brazil, CA = Canada, CH = Switzerland, CN = China, CO = Colombia, CZ = Czech Republic, DE = Germany, ES = Spain, FI = Finland, FR = France, HU = Hungary, ID = Indonesia, IE = Ireland, KZ = Kazakhstan, NA = Namibia, PE = Peru, PL = Poland, PT = Portugal, PY = Paraguay, TN = Tunisia, UG = Uganda, UK = United Kingdom, US = USA, UY = Uruguay, ZA = South Africa

Source: Own calculations

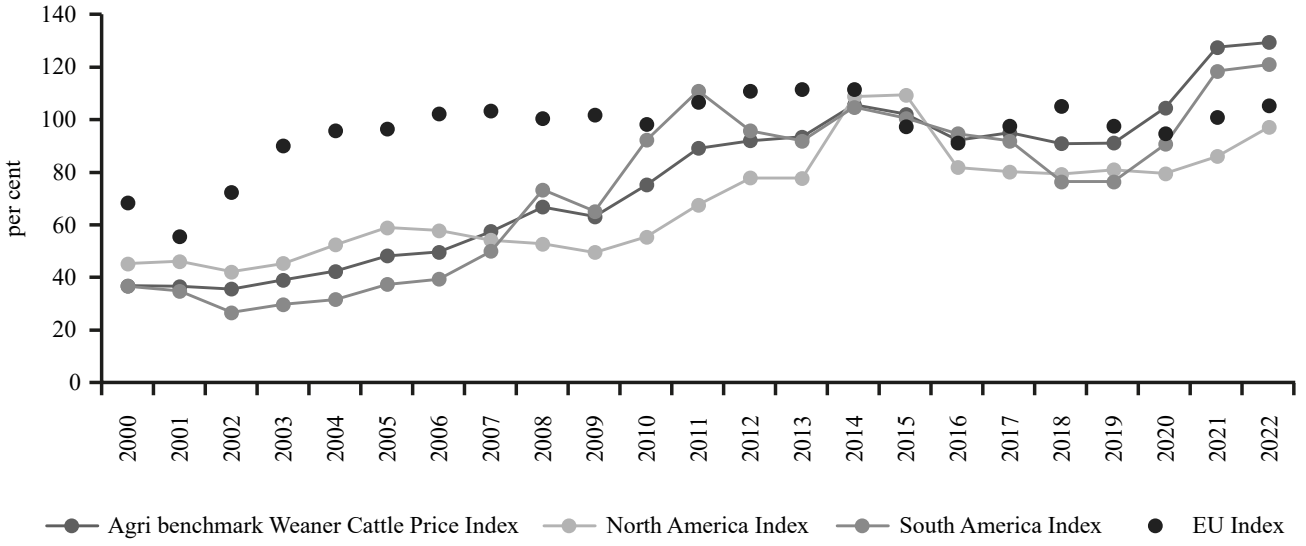

Figure 3: Weaner price developments in selected countries.

Source: Own calculations based on *agri benchmark* Weaner Price Index.

countries they are put into a winter barn. The main reason for housing is usually not low temperatures but the accessibility of (wet) pastures and the need for winter feeding and associated labour requirements.

The number of cows vary significantly and aim at reflecting of full-time farms with suckler-cows. In countries where full-time farms are not common, we try to reflect the typical/average herd size. The number of cows vary from less than 10 cows in Indonesia and some farms in China and Tunisia to more than 1000 cows in South American countries and up to 6500 cows in the Northern Territory of Australia. It should be mentioned that larger farms are not necessarily performing better.

The winter barn systems produce higher weights per cow and year than outdoor systems (Figure 2). The weight includes the weaners, cull cows and breeding bulls as well as surplus heifers not needed for replacement. The figures are also breed-related and driven by cow-performance (number of calves per cow and year), mortality and replacement rates.

Weaner prices have been identified as the main driver of cow-calf profitability. Figure 3 shows the *agri benchmark* Weaner Price Index and a breakdown for selected regions. The *agri benchmark* price indices are farm-level based and weighted by each country's production quantity. The trend in the last 20 years has been upwards for the overall index (all *agri benchmark* countries) as well as the North and South America index. After the record year 2014 with historically low cattle and weaner numbers in the USA, the index decreased to pick up again in the year 2020. The South America and overall index reached a new historic peak in 2022. This was assisted by herd rebuilding after drought and rising import demand for South American beef from China.

The EU index developed less positively and remained almost at a flat level since 2006.

In *agri benchmark*, we perform a total cost analysis. We account for so-called factor costs as well as non-factor costs. Factor costs refer to the production factors labour, land and capital. For all factors, expenses are reflected (wages, land rents, interest payments) but also the opportunity costs for own production factors are accounted for (a wage rate for family labour, a rental price for own land, an interest for equity).

The remaining costs are non-factor costs, consisting of further cash costs and depreciation for machines, buildings and equipment. We do not depreciate livestock. All cost items can be combined in multiple ways, depending on the statement the analyst wants to make. For example, when it comes to profitability, we can express three levels: short-term (total returns less cash costs, including the expenses for production factors), medium-term (short-term less depreciation), long-term (medium-term less opportunity costs).

The total cost of cow-calf production has a wide range with a factor of more than 10 between the lowest and highest levels (Figure 4). Southern African, South American countries, and Australia are the low-cost producers, with grass-based systems. Ireland and France are also at the lower end of the distribution. Switzerland, other European countries (like Hungary) and Tunisia are the high-cost producers. Note that Hungarian data was first available for 2021, in Uganda in 2022.

With the exception of the USA, Tunisia and Peru, cow-calf farming appears to be profitable outside of Europe (Figure 5). In Europe, the average of the farms in the sample are not profitable, with Switzerland, Ireland, France and Poland being the exceptions. In Europe, profitability has worsened in 2022 compared to the previous year except in Ireland and Poland. It should be mentioned that decoupled (area) payments play an important role and contribute to overall profitability on whole-farm level in the EU-farms. Out of Europe, in most cases, profitability has improved or decreased only slightly, the one exception being Argentina, where weaner prices have increased above average inflation.

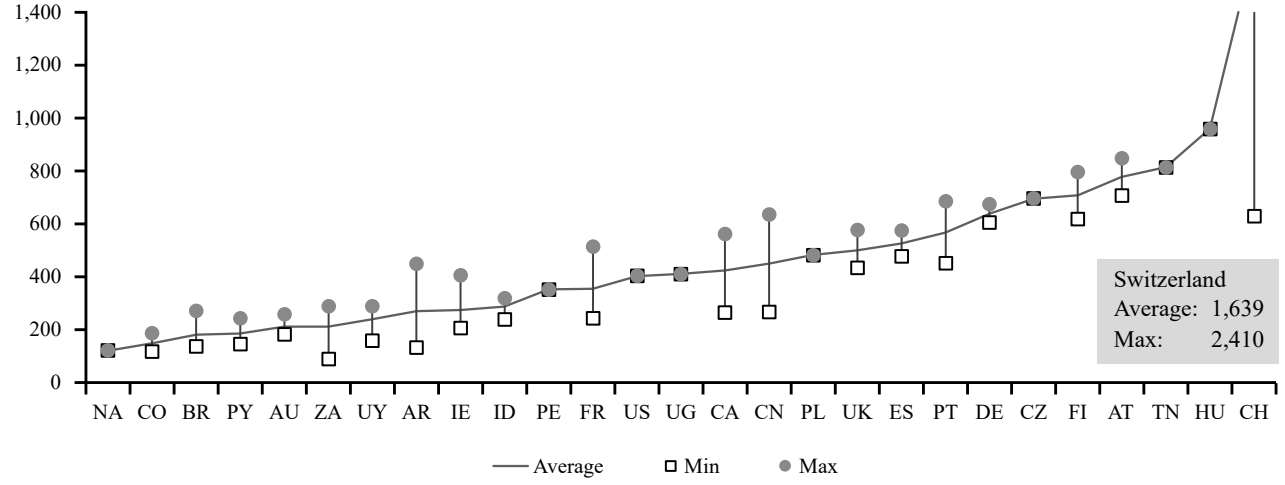

Figure 4: Cow-calf total cost and their variation in 2022 (USD per 100 kg live weight).

Countries: AR = Argentina, AU = Australia, AT = Austria, BR = Brazil, CA = Canada, CH = Switzerland, CN = China, CO = Colombia, CZ = Czech Republic, DE = Germany, ES = Spain, FI = Finland, FR = France, HU = Hungary, ID = Indonesia, IE = Ireland, KZ = Kazakhstan, NA = Namibia, PE = Peru, PL = Poland, PT = Portugal, PY = Paraguay, TN = Tunisia, UG = Uganda, UK = United Kingdom, US = USA, UY = Uruguay, ZA = South Africa
Source: Own calculations

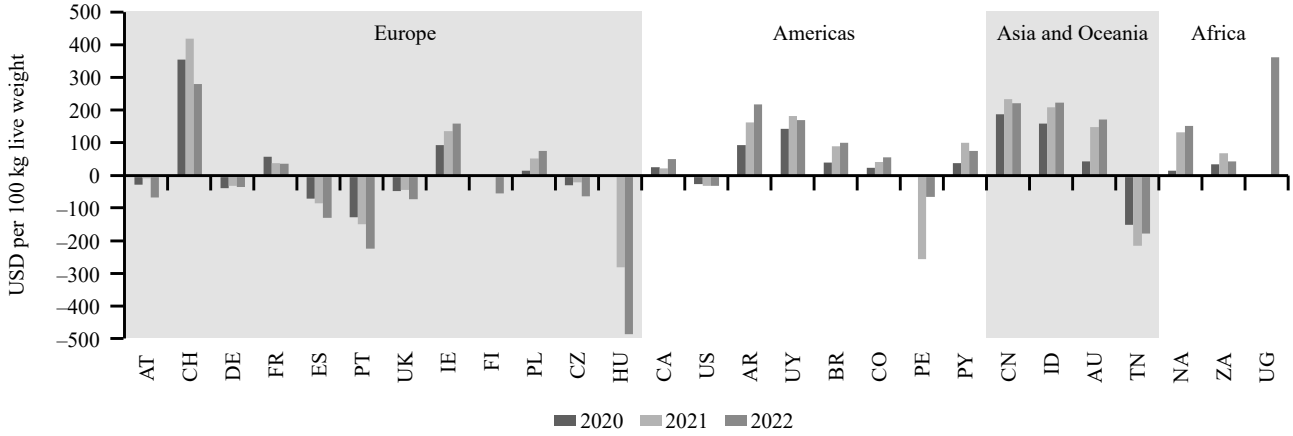

Figure 5: Cow-calf medium-term profitability* for the average of the farms 2020-2022 (USD per 100 kg live weight).

Countries: AR = Argentina, AU = Australia, AT = Austria, BR = Brazil, CA = Canada, CH = Switzerland, CN = China, CO = Colombia, CZ = Czech Republic, DE = Germany, ES = Spain, FI = Finland, FR = France, HU = Hungary, ID = Indonesia, IE = Ireland, KZ = Kazakhstan, NA = Namibia, PE = Peru, PL = Poland, PT = Portugal, PY = Paraguay, TN = Tunisia, UG = Uganda, UK = United Kingdom, US = USA, UY = Uruguay, ZA = South Africa
Source: Own calculations

Sheep farm results

Rather like the cow-calf farms, the sheep farms in the comparison show a significant range in herd sizes and aim at reflecting of full-time farms with sheep. In countries where full-time farms are not common, we try to reflect the typical / average herd size. Herd sizes range from 40-60 ewes in Iran and Tunisia via a few hundred ewes in most of the countries and up to a few thousand in Spain, Australia and Southern Africa.

Two principal performance parameters by production system: 1) Number of lambs per 100 ewes, and 2) Total weight per ewe (Figure 6). All production systems display low and high numbers of lambs weaned. Due to the rate of twin-births they go up to a maximum of 160 lambs. One would expect that the live weight produced coincides with the number of weaned lambs. However, this is clearly not always the case. The reasons are differences in a) market preferences (the high number of lambs can coincide with low sell weights like in Spain), b) replacement rates (higher weight from cull ewes), c) a different focus on meat, milk, or wool (like in Australia), and d) combination of prolific sheep breeds (many lambs) and a low-quality feed base.

When it comes to the market returns of the ewe enterprises, a wide variation can be observed. In addition, some of the European farms receive significant amounts of direct payments (Figure 7). The lowest returns are in Brazil, the medium returns are in China, Australia, Namibia, South Africa, and most of Europe, and the highest returns can be found in North Africa and Jordan. The extremely high returns of the Jordan farms have two sources: 1) the highest meat prices in the comparison (see table above Figure 7) and

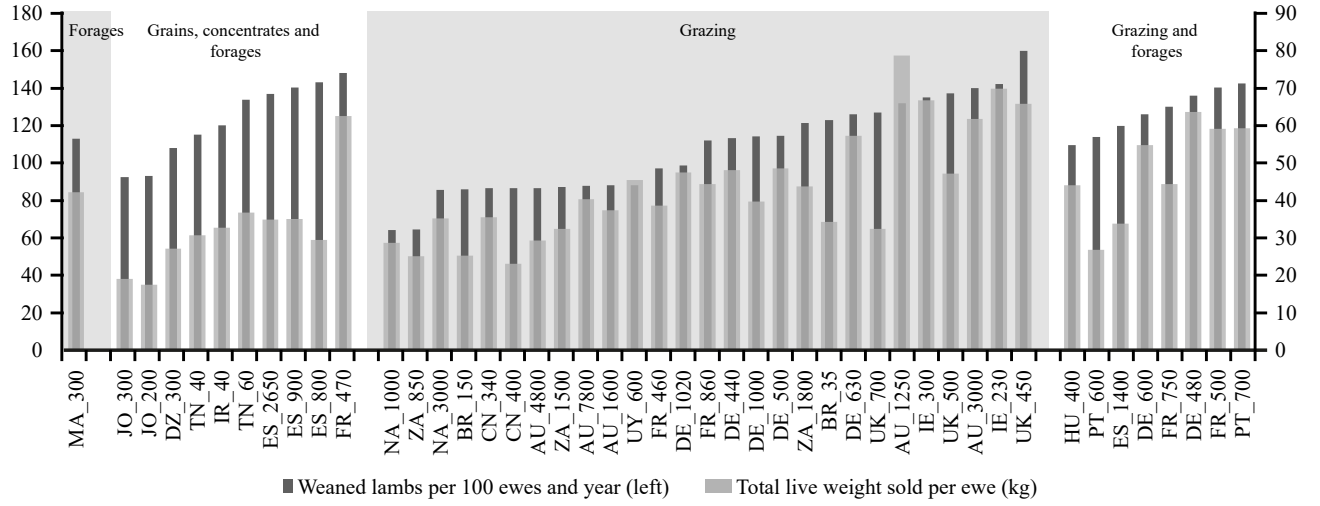

Figure 6: Number of lambs per ewe and total live weight sold per ewe by production system.

Countries: AU = Australia, BR = Brazil, CN = China, DE = Germany, DZ = Algeria, ES = Spain, FR = France, HU = Hungary, IE = Ireland, JO = Jordan, MA = Morocco, NA = Namibia, PT = Portugal, TN = Tunisia, UK = United Kingdom, UY = Uruguay, ZA = South Africa
Source: Own calculations

JO	DZ	CN	TN	MA	DE	ES	PT	FR	IE	UK	NZ	ZA	AU	BR	IR	MX	UY	NA	UA
14.0	13.2	12.3	8.6	8.3	8.2	7.9	7.6	7.4	7.1	6.7	5.2	5.2	5.0	4.5	4.3	4.2	4.1	3.9	1.2

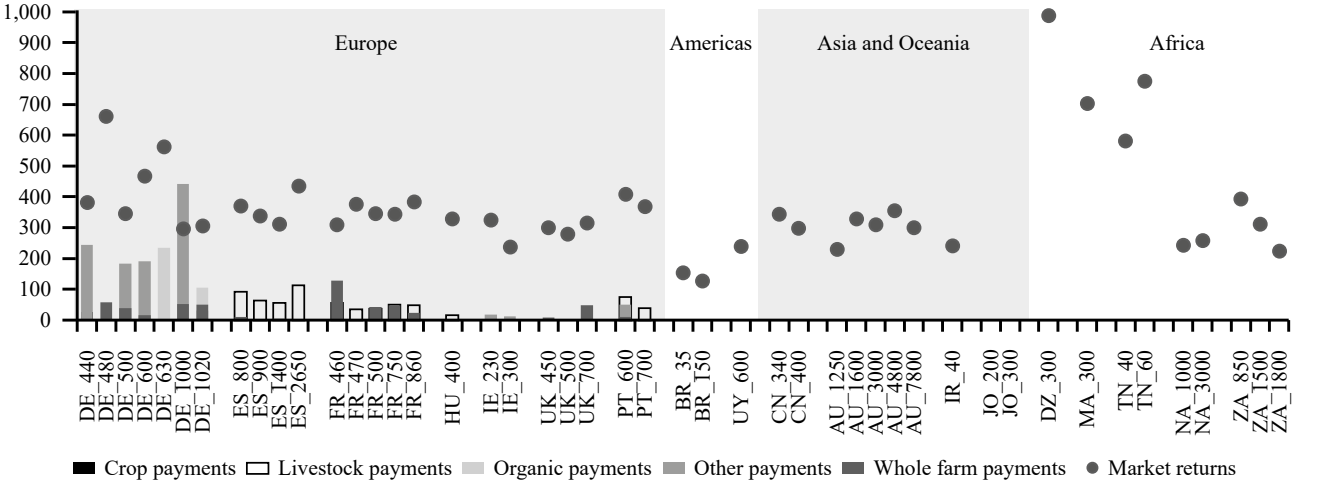

Figure 7: Sheep meat prices (table) and sheep market returns and government payments in 2022 (USD per kg live weight).

Note: Average of lamb and mutton meat price. Countries:AU = Australia, BR = Brazil, CN = China, DE = Germany, DZ = Algeria, ES = Spain, FR = France, HU = Hungary, IE = Ireland, JO = Jordan, MA = Morocco, MX = Mexico, NA = Namibia, NZ = New Zealand, PT = Portugal, TN = Tunisia, UA = Ukraine, UK = United Kingdom, UY = Uruguay, ZA = South Africa. MX, NZ and UA do not have farm data but sheep meat price data.
Source: Own calculations

2) the fact that the Awassi breed they use has a milk-producing focus and that milk income with high milk prices (USD 1.40 per kg milk) factors into total returns. The situation in Algeria and China is similar.

Rather like beef prices, sheep meat prices (the combination of mutton and lamb prices) have developed positively in the last 20 years (Figure 8). Due to the high weight of China's production, we calculate our overall price index with and without China. In the past, the index without China was significantly higher than the index with China. From 2020 onwards, the index including China has been higher than the index without China, indicating high sheep and lamb prices in China. In the years 2023 to 2016 the indices shown here almost identical and remained relatively close to each other after that. In a manner that is also reminiscent of beef price movements, only the Oceania index moved to a higher level. Despite decreasing again in 2022, the indices remained essentially at record levels.

Sheep costs of production vary significantly between countries (Figure 9). However, in each country, production costs have remained at very similar levels in the last three years. The main reason for the little variation is the fact that sheep systems were less affected by price rises in feed and energy in the last three years because they are mainly based on grass. Exceptions are Jordan and Algeria, where purchased feed and concentrates together play a more significant role than in the other countries, and most of the feed is imported at high prices. The Middle East (especially Jordan) and North African countries as well as the German farms have the highest costs. On the other end of the distribution, South American countries, Australia, and Southern African countries have the lowest cost in the comparison.

Consequently, in most countries, the profitability of sheep production was mainly driven by sheep price developments. In general, the non-European countries show a stable and mostly relatively high level of profitability (except

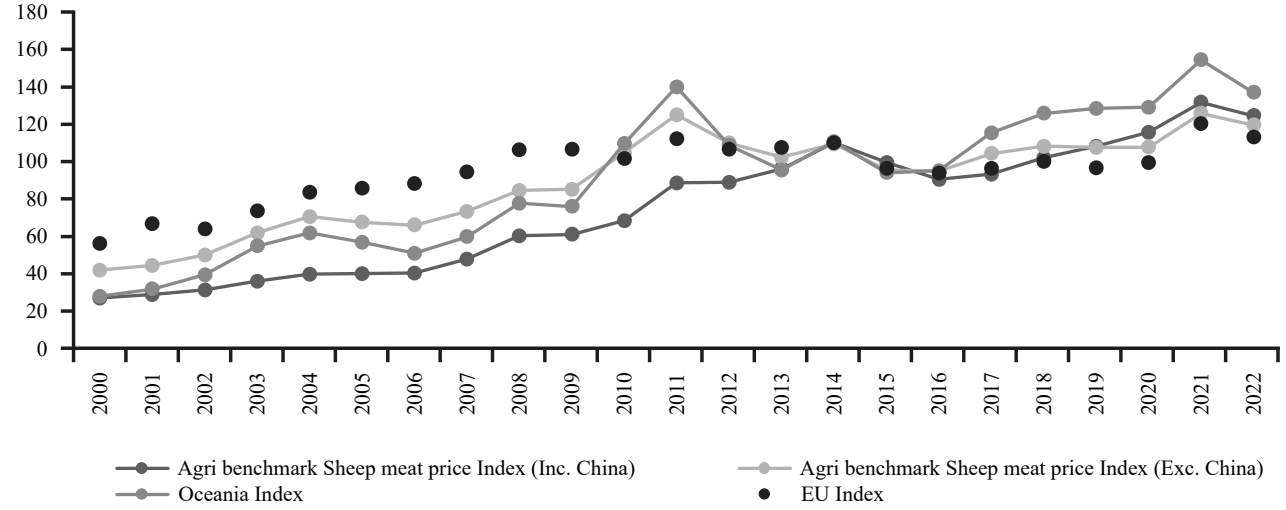

Figure 8: Development of sheep meat price levels in selected countries.
Source: Own calculations based on *agri benchmark* Lamb Price Index.

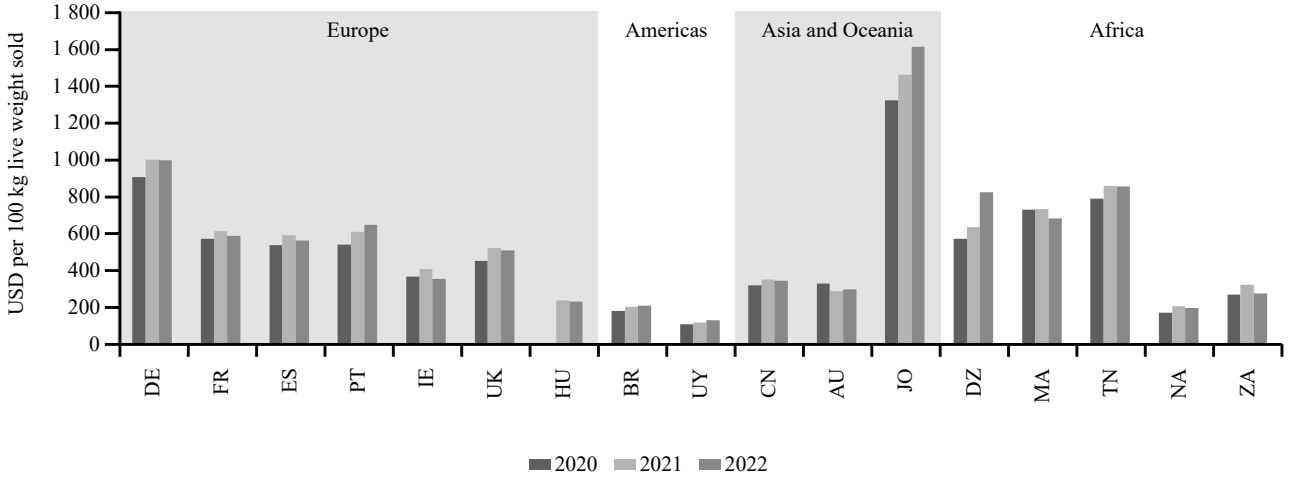

Figure 9 : Sheep cost developments for the average of the farms 2020-2022 (USD per 100 kg live weight sold).
Countries: AU = Australia, BR = Brazil, CN = China, DE = Germany, DZ = Algeria, ES = Spain, FR = France, HU = Hungary, IE = Ireland, JO = Jordan, MA = Morocco, NA = Namibia, PT = Portugal, TN = Tunisia, UK = United Kingdom, UY = Uruguay, ZA = South Africa
Source: Own calculations

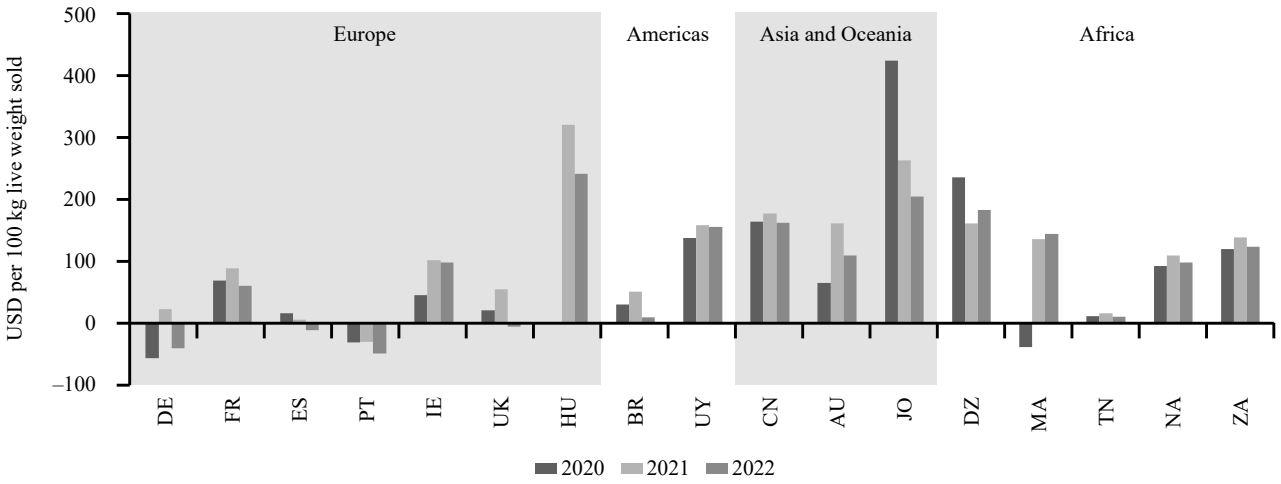

Figure 10: Sheep medium-term profitability for the average of the farms 2020-2022 (USD per 100 kg live weight).

Countries: AU = Australia, BR = Brazil, CN = China, DE = Germany, DZ = Algeria, ES = Spain, FR = France, HU = Hungary, IE = Ireland, JO = Jordan, MA = Morocco, NA = Namibia, PT = Portugal, TN = Tunisia, UK = United Kingdom, UY = Uruguay, ZA = South Africa
Source: Own calculations

Brazil and Tunisia). The situation in Europe varies more, with high profits in the Hungarian farm due to the large increase in the price of lamb, which is a traditional export product. In contrast, the German, Spanish, and Portuguese farms show low profits or even losses (Figure 10).

Outlook

The global outlook for beef demand and production is positive. The OECD/FAO Outlook 2023 projects a slight increase of global per-capita demand by 2031 for meat, mainly driven by poultry, with beef and sheep basically constant. The growing populations of Asia, Africa and South America transform this per-capita demand into a significant increase in total demand quantities. To satisfy this demand, production needs to increase, too, but 91 percent of that increase is expected to take place out of Europe. China, Asia-Pacific (w/o China and India) and Sub-Sahara Africa are supposed to drive this expansion whereas Europe is set to lose production shares.

The EU-Outlook 2023 projects a decline in cow and sheep numbers and an associated drop of production of almost 9 percent for beef and 2 percent for sheep meat, respectively, by 2035. It is likely that with the global demand increase, continued border protection and quota regimes and an increase of imports, the domestic EU-price will remain at a relatively high level, allowing those farms that remain in the sector to be profitable. However, the availability of a sufficient agricultural workforce, the impacts of environmental and animal welfare regulation and uncertainty regarding farm succession will remain issues for European livestock producers.

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