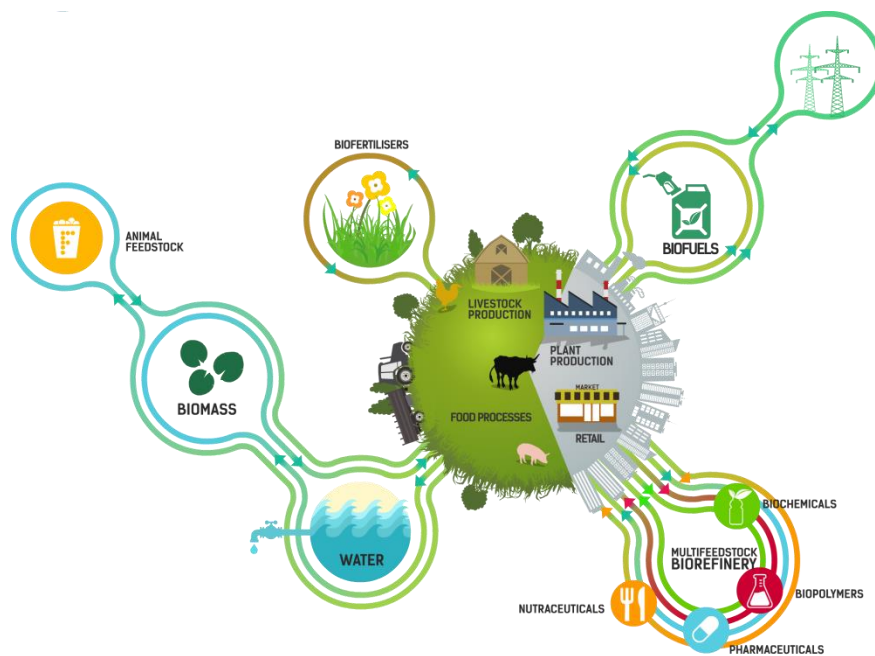


Database/Inventory of the CEREALS AWCB value chain



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Table of contents

Table of contents	I
List of figures	II
List of tables	V
1 Introduction	1
1.1 Project background	2
1.2 Scope of the report	3
2 Methods and commodities	6
2.1 Barley	11
2.2 Maize	26
2.3 Triticale	43
2.4 Oats	56
2.5 Rice	71
2.6 Rye	90
2.7 Wheat and spelt	103
3 Total quantity of AWCB	116
4 Current practices of commodity AWCB valorisation	117
5 References	121
6 ANNEX - Consumption per capita	128

List of figures

Figure 1 Conceptual model on the food losses generated all along the food chain (1).....	3
Figure 2 Steps in AWCB value chain	4
Figure 3 Cereals (2)	4
Figure 4 Winter barley (31).....	11
Figure 5 Barley AWCB value chain	12
Figure 6 Tonnes of harvested barley per country, 2010-2015	15
Figure 7 Tonnes of barley straw per country, 2010-2015	17
Figure 8 Tonnes of processed barley per country, 2010-2013.....	21
Figure 9 Tonnes of barley bran per country, 2010-2013.....	23
Figure 10 Tonnes of barley hull per country, 2010-2013	25
Figure 11 Corn stover (35)	26
Figure 12 Maize bran (36).....	26
Figure 13 Maize AWCB value chain	27
Figure 14 Tonnes of harvested maize per country, 2010-2015.....	30
Figure 15 Tonnes of maize stalks per country, 2010-2015.....	32
Figure 16 Tonnes of maize husks per country, 2010-2015.....	34
Figure 17 Tonnes of maize cobs per country, 2010-2015	36
Figure 18 Tonnes of processed maize per country, 2010-2013	40
Figure 19 Tonnes of maize bran per country, 2010-2013	42
Figure 20 Grains of wheat, rye and triticale	43
Figure 21 Triticale AWCB value chain	44
Figure 22 Tonnes of harvested triticale per country, 2010-2015.....	47
Figure 23 Tonnes of triticale straw per country, 2010-2015.....	49

Figure 24 Tonnes of processed triticale per country, 2010-2013.....	53
Figure 25 Tonnes of triticale bran per country, 2010-2013.....	55
Figure 26 Oats field (39).....	56
Figure 27 Oats AWCB value chain.....	57
Figure 28 Tonnes of harvested oats per country, 2010-2015	60
Figure 29 Tonnes of oats straw per country, 2010-2015	62
Figure 30 Tonnes of processed oats per country, 2010-2013	66
Figure 31 Tonnes of oat bran per country, 2010-2013.....	68
Figure 32 Tonnes of oat hull per country, 2010-2013	70
Figure 33 Rice field in Romania (41)	71
Figure 34 Rice AWCB value chain	72
Figure 35 Tonnes of harvested rice per country, 2010-2015	75
Figure 36 Tonnes of rice straw per country, 2010-2015	77
Figure 37 Tonnes of processed rice per country, 2010-2013	81
Figure 38 Tonnes of rice bran per country, 2010-2013.....	83
Figure 39 Tonnes of rice husks per country, 2010-2015	85
Figure 40 Consumption of rice (tonnes) per country, 2010-2015.....	87
Figure 41 Tonnes of rotten rice per country, 2010-2015	89
Figure 42 Harvesting of rye (43)	90
Figure 43 Rye AWCB value chain	91
Figure 44 Tonnes of harvested rye per country, 2010-2015	94
Figure 45 Tonnes of rye straw per country, 2010-2015	96
Figure 46 Tonnes of processed rye per country, 2010-2013.....	100
Figure 47 Tonnes of rye bran per country, 2010-2013.....	102
Figure 48 Wheat grains (46).....	103

Figure 49 Wheat AWCB value chain	104
Figure 50 Tonnes of harvested wheat and spelt per country, 2010-2015	107
Figure 51 Tonnes of wheat and spelt straw per country, 2010-2015	109
Figure 52 Tonnes of processed wheat per country, 2010-2013.....	113
Figure 53 Tonnes of wheat bran per country, 2010-2013.....	115
Figure 54 Total quantity of cereal AWCB in the period 2010-2013	116
Figure 55 Use of straw bales for building walls (48).....	117
Figure 56 Maize stalks in anaerobic composting (50)	118
Figure 57 Use of fibres in corn husk (52).....	118
Figure 58 Bioethanol production from rice straw (55).....	119

List of tables

Table 1 Population of EU-28 countries (4).....	7
Table 2 Main AWCB produced from cereals sector.....	9
Table 3 Tonnes of harvested barley per country, 2010-2015 (32)	14
Table 4 Tonnes of barley straw per country, 2010-2015.....	16
Table 5 Tonnes of imported and exported barley per country, 2010-2013 (5)	18
Table 6 Tonnes of processed barley per country, 2010-2013	20
Table 7 Tonnes of barley bran per country, 2010-2013	22
Table 8 Tonnes of barley hull per country, 2010-2013.....	24
Table 9 Tonnes of harvested maize per country, 2010-2015 (32).....	29
Table 10 Tonnes of maize stalks per country, 2010-2015	31
Table 11 Tonnes of maize husks per country, 2010-2015	33
Table 12 Tonnes of maize cobs per country, 2010-2015.....	35
Table 13 Tonnes of imported and exported maize per country, 2010-2013 (5).....	37
Table 14 Tonnes of processed maize per country, 2010-2013.....	39
Table 15 Tonnes of maize bran per country, 2010-2013.....	41
Table 16 Tonnes of harvested triticale per country, 2010-2015 (32).....	46
Table 17 Tonnes of triticale straw per country, 2010-2015	48
Table 18 Tonnes of imported and exported triticale per country, 2010-2013 (5)	50
Table 19 Tonnes of processed triticale per country, 2010-2013.....	52
Table 20 Tonnes of triticale bran per country, 2010-2013.....	54
Table 21 Tonnes of harvested oats per country, 2010-2015 (32)	59
Table 22 Tonnes of oats straw per country, 2010-2015.....	61
Table 23 Tonnes of imported and exported oats per country, 2010-2013 (5).....	63

Table 24 Tonnes of processed oats per country, 2010-2013	65
Table 25 Tonnes of oat bran per country, 2010-2013	67
Table 26 Tonnes of oat hull per country, 2010-2013	69
Table 27 Tonnes of harvested rice per country, 2010-2015 (32)	74
Table 28 Tonnes of rice straw per country, 2010-2015.....	76
Table 29 Tonnes of imported and exported rice per country, 2010-2013 (5).....	78
Table 30 Tonnes of processed rice per country, 2010-2013	80
Table 31 Tonnes of rice bran per country, 2010-2013	82
Table 32 Tonnes of rice husks per country, 2010-2015.....	84
Table 33 Consumption of rice (tonnes) per country, 2010-2015	86
Table 34 Tonnes of rotten rice per country, 2010-2015	88
Table 35 Tonnes of harvested rye per country, 2010-2015 (32).....	93
Table 36 Tonnes of rye straw per country, 2010-2015	95
Table 37 Tonnes of imported and exported rye per country, 2010-2013 (5)	97
Table 38 Tonnes of processed rye per country, 2010-2013	99
Table 39 Tonnes of rye bran per country, 2010-2013	101
Table 40 Tonnes of harvested wheat and spelt per country, 2010-2015 (32)	106
Table 41 Tonnes of wheat and spelt straw per country, 2010-2015.....	108
Table 42 Tonnes of imported and exported wheat per country, 2010-2013 (5)	110
Table 43 Tonnes of processed wheat per country, 2010-2013	112
Table 44 Tonnes of wheat bran per country, 2010-2013	114
Table 45 Characteristics, potential use and developed patents of cereal AWCB	120
Table 46 Rice consumption per capita in kg/year	128

1 Introduction

The purpose of this report is to provide a database/inventory of agricultural value chains and the various agricultural wastes, co-products and by-products (AWCB) that are produced along it, including their regional distribution and their current valorisation pathways in EU countries. This is the critical first step to achieving an understanding of the current situation for AWCBs in Europe. The quantities of AWCBs that are produced in the value chain of cereal crops will be determined from three main stages: cultivation, processing and consumption.

This report also contains information regarding current practices of waste-valorisation for analysed commodities as well as consumption data for different commodities per capita. Import and export of different commodities are also included in the report in order to better showcase regional distribution of different commodities consumption and processing.

This study constitutes Deliverable 1.1 of the **Work package 1: Agricultural Waste Value Chain Assessment; Task 1.1 Agricultural value chain mapping** of the European Union's Horizon 2020 research and innovation programme "AGROCYCLE" under grant agreement N° 690142.

Task 1.1 is viewed as a 'first step' to map AWCB streams in the agricultural production and supply chains across Europe. This first task is vast, encompassing four animal, seven cereal, five fruit, and ten vegetable value chains. In order to complete the task for the 26 value chains in 28 countries, a wide range of data sources is employed.

The methodologies developed for this task acts as a template, to not only illustrate but, to best estimate the quantities of AWCB that are being generated across the various value chains in Europe. This first attempt uses the best available data at the time of writing (December 2016). The ultimate success and value of this database depend on the data quality and the continuous revising with more up to date data as it becomes available.

1.1 Project background

Continuing population and consumption growth is driving the demand for food globally, with agricultural activities having to increase to meet this demand. Europe has a major AWCB problem, generating some 700 million tonnes of AWCB annually.

There is an urgent need and huge opportunity to address the efficient use of AWCB towards delivering sustainable value chains in the farming and processing sectors. As such, AgroCycle will convert low value AWCBs into highly valuable products, achieving a 10% increase in waste recycling and valorisation by 2020. This will be achieved by developing a detailed and holistic understanding of the AWCB streams and piloting a key number of AWCB utilisation/valorisation pathways. It will bring technologies and systems from ~TRL4 to ~TRL7 within the 3 years of the project. A post-project commercialisation plan will bring commercially promising technologies/systems to TRL8 and TRL9, ensuring AgroCycle will have an enduring impact by achieving sustainable use of AWCB both inside and outside the agricultural sector, leading to the realisation of a Circular Economy.

AgroCycle addresses AWCBs from several agricultural sectors: wine, olive oil, horticulture, fruit, grassland, swine, dairy and poultry. The AgroCycle consortium is a large (26) multi-national group (including China) comprising the necessary and relevant multi-actors (i.e. researchers; companies in the technical, manufacturing, advisory, retail sectors (Large and SMEs); lead users; end users; and trade/producer associations) for achieving the project's ambitious goals. Farming's unique regional (rural) location means that AgroCycle will help reduce the EU's Innovation Divide and address the Regional Smart Specialisation Strategies for each partner country: impact will be Regional with National and International dimensions. The presence of three partners from China ensures international synergies and a global impact.

1.2 Scope of the report

Agrifood value chains generate a significant amount of different AWCB types that occur during the three major stages of the complex path, from farm to fork. Figure 1 presents a conceptual model where AWCB is produced in the agrifood chain.

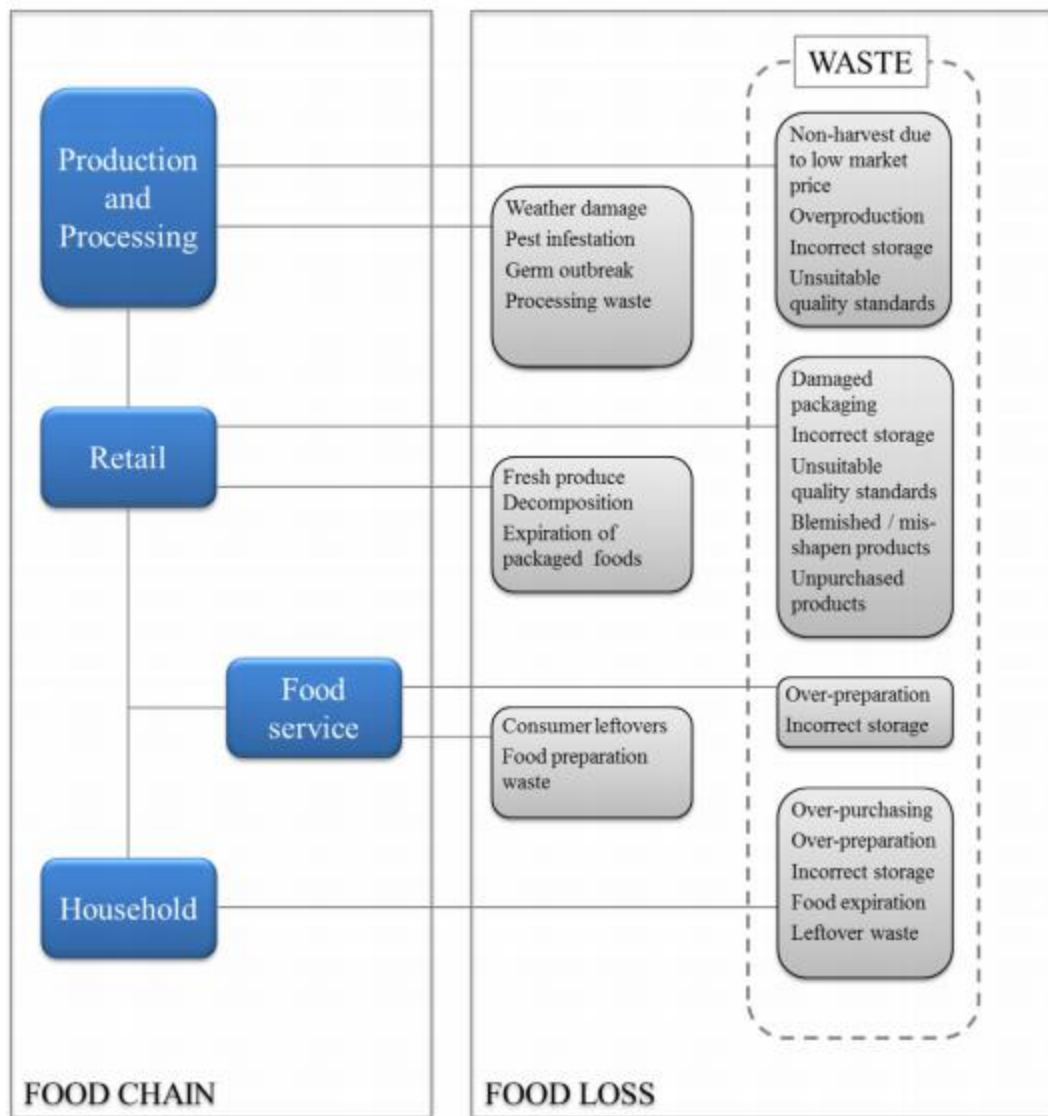


Figure 1 Conceptual model on the food losses generated all along the food chain (1)

Damaged products during harvesting or rotten food in domestic consumption are not necessarily 'waste' that has to be discarded in a landfill. Furthermore, many different types of the AWCB occurs during processing stage and for that reason they should be studied in more detail in order to valorise them through the most productive pathway.

This report presents where and how AWCB occurs during path from farm to fork. Also, the analysis studied how to valorise AWCB, primarily for the chemical and pharmaceutical industries. Barley, maize, triticale, oat, rice, rye, wheat and spelt are the types of cereal commodities that are analysed in this report. The value chain of each cereal along with the AWCB that occurs in each step (with appropriate numerical and graphic data) for every EU-28 country and finally how to valorise AWCB is presented.

Figure 2 shows steps in AWCB value chain: cultivation, processing and consumption.



Figure 2 Steps in AWCB value chain

Cereal is a crop grown as a food for people and as a feed for animals. Depending on the final purpose of the cereal, it can either be used directly after harvesting or can go to a processing facility to be used as an ingredient. Figure 3 shows how most cultivated cereals look like (2).

Cereals

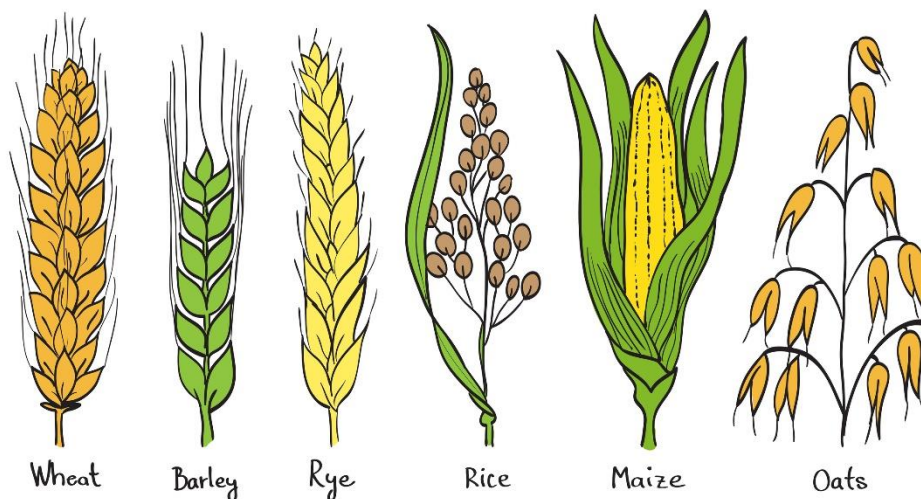


Figure 3 Cereals (2)

A certain amount of cereal is eaten or destroyed by animals (birds, rabbits, dears, wasps, etc.). Furthermore, cereals are the type of crops that generate huge amounts of AWCB during harvesting, especially, straw in the case of barley, triticale, oat, wheat, etc. Straw is a residue after harvesting that is mostly used as bedding for livestock. Bran is a by-product of a multi-stage process of producing flour. Maize is a cereal that produces AWCB products that are rather different to other cereal crops. For example, stalks are the main residues after harvesting of maize, and in many countries, farmers still burn these stalks on their lands. In that way, potential biomass is destroyed, and irreparable damage is made to the soil. Husks and cobs are by-products that also often end up as a burning material. Residues of cereals after harvesting and processing in factories have a potential to become a substrate for energy production.

Key factors in crop production are: proper site selection, soil type and its quality, water, harvesting technology and in the end market development.

Not every type of crop grows successfully in different types of soil. Also, the slope of the site should be taken into account in order to improve crop production. The amount of damaged crops due to harvesting and handling errors is an important factor when calculating the amount of AWCB produced. Traditional methods of harvesting cereal crops with manual workers are slow, and its efficiency depends on the skill of the workers. Modern methods with appropriate machinery are useful in agricultural areas where a large amount of crops are being produced, although these modern methods are much more expensive than traditional practices. Thus, the amount of AWCB varies greatly on a large number of production factors.

The amount of AWCB that is produced in the last stage of the value chain is primarily the result of human behaviour. The main reasons for throwing perfectly edible food away are that it is simply left after a meal, looked or tasted unsavoury, has become mouldy, left after cooking (3). It was found that the average person throws away around 70kg of avoidable wasted food a year.

2 Methods and commodities

This section illustrates how the different amounts of AWCB occur for a given cereal. For each cereal, there is a short description of the AWCB that produced along the value chain.

For all the types of cereal presented in the following tables, the calculations are completed for every EU28 country, using data that is collected from EUROSTAT for the period 2010-2014. Import and export data is collected from FAOSTAT for the available periods. A key assumption is that the mass of consumed food does not change in given period of time. The list below shows the notation of specific values needed for calculation of cereals and their relations:

PRD=PRODUCTION OF CEREAL IN COUNTRY (tonnes) (1)

CON=CONSUMPTION OF CEREAL (tonnes) (2)

IMP=IMPORTED QUANTITY OF CEREAL (tonnes) (3)

EXP=EXPORTED QUANTITY OF CEREAL (tonnes) (4)

PRC=QUANTITY OF PROCESSED CEREAL (tonnes) (5)

PC=CONSUMPTION OF CEREAL PER CAPITA PER YEAR (kg) (6)

CON=POP*PC (7)

PRC=(PRD+IMP)-(CON+EXP) (8)

For crops that are not consumed raw or cooked there are no relations (6) and (7) and then the quantity of processed cereals looks like:

PRC=PRD+IMP-EXP (9)

By using specific consumption data for every country and population for every year, calculation of consumed food in period 2010-2015 is carried out. Table 1 shows the population of EU-28 countries in the period 2010-2015 (4). Data from Table 1 is used for calculation of consumed food (raw and cooked).

Table 1 Population of EU-28 countries (4)

GEO/POPULATION	2010	2011	2012	2013	2014	2015
Belgium	10,839,905	11,000,638	11,094,850	11,161,642	11,180,840	11,237,274
Bulgaria	7,421,766	7,369,431	7,327,224	7,284,552	7,245,677	7,202,198
Czech Republic	10,462,088	10,486,731	10,505,445	10,516,125	10,512,419	10,538,275
Denmark	5,534,738	5,560,628	5,580,516	5,602,628	5,627,235	5,659,715
Germany	81,802,257	80,222,065	80,327,900	80,523,746	80,767,463	81,197,537
Estonia	1,333,290	1,329,660	1,325,217	1,320,174	1,315,819	1,314,870
Ireland	4,549,428	4,570,881	4,582,707	4,591,087	4,605,501	4,628,949
Greece	11,119,289	11,123,392	11,086,406	11,003,615	10,926,807	10,858,018
Spain	46,486,619	46,667,174	46,818,219	46,727,890	46,512,199	46,449,565
France	64,658,856	64,978,721	65,276,983	65,600,350	65,942,093	66,488,186
Croatia	4,302,847	4,289,857	4,275,984	4,262,140	4,246,809	4,225,316
Italy	59,190,143	59,364,690	59,394,207	59,685,227	60,782,668	60,795,612
Cyprus	819,140	839,751	862,011	865,878	858,000	847,008
Latvia	2,120,504	2,074,605	2,044,813	2,023,825	2,001,468	1,986,096
Lithuania	3,141,976	3,052,588	3,003,641	2,971,905	2,943,472	2,921,262
Luxembourg	502,066	511,840	524,853	537,039	549,680	562,958
Hungary	10,014,324	9,985,722	9,931,925	9,908,798	9,877,365	9,855,571
Malta	414,027	414,989	417,546	421,364	425,384	429,344
Netherlands	16,574,989	16,655,799	16,730,348	16,779,575	16,829,289	16,900,726
Austria	8,351,643	8,375,164	8,408,121	8,451,860	8,506,889	8,576,261
Poland	38,022,869	38,062,718	38,063,792	38,062,535	38,017,856	38,005,614
Portugal	10,573,479	10,572,721	10,542,398	10,487,289	10,427,301	10,374,822
Romania	20,294,683	20,199,059	20,095,996	20,020,074	19,947,311	19,870,647
Slovenia	2,046,976	2,050,189	2,055,496	2,058,821	2,061,085	2,062,874
Slovakia	5,390,410	5,392,446	5,404,322	5,410,836	5,415,949	5,421,349
Finland	5,351,427	5,375,276	5,401,267	5,426,674	5,451,270	5,471,753
Sweden	9,340,682	9,415,570	9,482,855	9,555,893	9,644,864	9,747,355
United Kingdom	62,510,197	63,022,532	63,495,303	63,905,297	64,351,155	64,875,165

In order to present the type and mass of AWCB for each step of the value chain, Table 2 contains data for cereals: barley, maize, triticale, oats, rice, rye and wheat. In the harvesting step, the main AWCB that occurs are stalks and straw. The processing step is similar for every cereal, with the main by-product being bran. The consumption stage is related only to rice, where the main AWCB is rotten rice. That is the result of inappropriate storing of rice and consumption habits of people.

Table 2 shows the span of values (minimum and maximum data) for each AWCB. The flowchart presents the typical value used in the calculation, the average value of the quantity of AWCB:

$$\text{typical value used in calculation} = \frac{\text{MIN} + \text{MAX}}{2}$$

Two databases are employed to determine the flows of commodities in Europe, that of Eurostat for primary production, and FAOstat for import/export data (5). For a small number of countries in certain commodities, the export value is greater than that of the production value within the country. This difference can be attributed to larger import values, leading to exporting, in one form or another, of some of the imported commodities.

Table 2 Main AWCB produced from cereals sector

Cereals		Harvesting		Processing		Consumption	
Barley	Straw to product ratio 0.68 - 1.75 kg/kg	(6), (7), (8), (9)	Bran to product ratio: 0.15-0.20 kg/kg	(10), (11)	Not applicable, as barley is not consumed directly by humans		
			Hull to product ratio: 0.13-0.25 kg/kg	(12), (13)			
Maize	Stalks to product ratio 1.00 - 3.77 kg/kg	(6), (14), (15)	Bran to product ratio: 0.11-0.15 kg/kg	(10), (17)	Not applicable, as maize is not consumed directly by humans		
	Husk to product ratio 0.20 - 0.30 kg/kg	(10), (16)					
	Cobs to product ratio 0.15 - 0.86 kg/kg	(10), (15)					
Triticale	Straw to product ratio 1.00 - 4.00 kg/kg	(6), (9), (18)	Bran to product ratio 0.15-0.17 kg/kg	(10), (19)	Not applicable, as triticale is not consumed directly by humans		
Oat	Straw to product ratio 0.75 - 2.00 kg/kg	(6), (7), (9)	Bran to product ratio: 0.15 kg/kg	(10)	Not applicable, as oat is not consumed directly by humans		
			Hull to product ratio: 0.25-32 kg/kg	(20), (21), (13)			

Rice	Straw to product ratio 0.42 – 2.15 kg/kg	(6), (9), (22)	Bran to product ratio 0.08-0.12 kg/kg	(10), (17), (23)	Rotten rice to consumed ratio 0.27 kg/kg	(25)
			Hull to product ratio 0.15-0.36 kg/kg	(6), (13), (24), (23)		
Rye	Straw to product ratio 0.90 - 2.00 kg/kg	(6), (7), (9)	Bran to product ratio 0.10-0.15 kg/kg	(10), (26)	Not applicable, as rye is not consumed directly by humans	
Wheat	Straw to product ratio 0.50 – 2.37 kg/kg	(6), (7), (27), (28)	Bran to product ratio 0.13-0.20 kg/kg	(10), (17), (29)	Not applicable, as wheat is not consumed directly by humans	

2.1 Barley

Barley is a one-year cereal grain that is cultivated globally in temperate climates (30). It is used as an animal fodder or as a source for fermentation for beer and some other beverages. There are several cultivars of barley, due to a different shape, number and position of grains and even the period of the year when it is cultivated. Figure 4 shows cultivar of barley that is grown in winter months of the year (31).



Figure 4 Winter barley (31)

The biggest producer of barley in the EU-28 is Germany, followed by France. During the harvesting step, the largest AWCB that occurs is straw. In the processing step, grains of barley are treated in order to remove bran and hull.

The flowchart (Figure 5) presents AWCB value chain for barley and specific AWCB weight factors from Table 2.

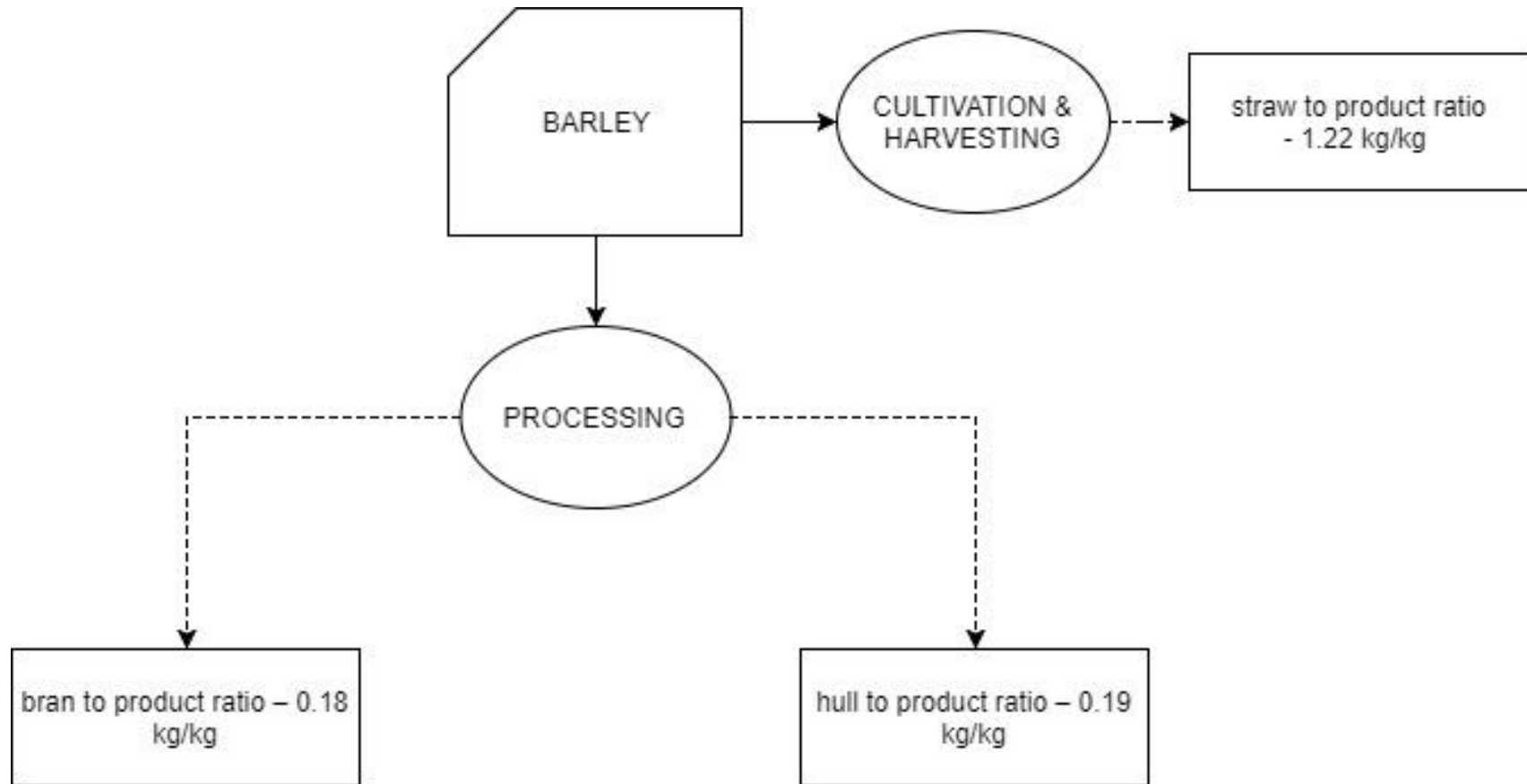


Figure 5 Barley AWCB value chain

Data for cultivated barley is taken from EUROSTAT, and data for imported and exported barley is taken from FAOSTAT. By using relation (I-IX), the amount of processed barley is calculated for every country in each year. Then the amount of AWCB is calculated for every step and every year. Presented here is an example of the calculations for Slovenia in 2010:

PRD = 80,120 tonnes

IMP = 30,103 tonnes

EXP = 4,786 tonnes

PRC = $(80,120 + 30,102 - 4,478) = 105,437$ tonnes

Per 1 kg of harvested barley, between 0.68 and 1.75 kg of straw is left. With an average mass of straw 1.22 kg per kg of harvested barley, for Slovenia, it was 97,746 tonnes of straw in 2010. Bran that occurs in processing step takes 0.15-0.20 kg per kg of processed barley. With the average value of 0.18 kg/kg for Slovenia, it was 18,979 tonnes of bran. Furthermore, a hull that occurs in the processing step takes from 0.13 to 0.25 kg per kg of processed barley. The average value is 0.19 kg/kg and for Slovenia, it was 3,480 tonnes in 2010. Results for other countries and years are presented in the tables and figures below.

Table 3 Tonnes of harvested barley per country, 2010-2015 (32)

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	373,400	339,660	363,600	390,800	399,970	433,690	339,660	433,690	383,520
Bulgaria	833,270	707,020	661,900	728,840	852,230	711,560	661,900	852,230	749,137
Czech Republic	1,584,460	1,813,680	1,616,470	1,593,760	1,967,050	1,991,420	1,584,460	1,991,420	1,761,140
Denmark	2,981,300	3,249,800	4,058,700	3,949,900	3,547,600	3,856,000	2,981,300	4,058,700	3,607,217
Germany	10,326,920	8,733,800	10,391,300	10,343,600	11,562,800	11,629,900	8,733,800	11,629,900	10,498,053
Estonia	254,400	294,600	341,300	441,000	458,100	556,600	254,400	556,600	391,000
Ireland	1,223,070	1,412,050	1,260,770	1,662,760	1,731,160	1,739,240	1,223,070	1,739,240	1,504,842
Greece	317,860	328,180	326,430	387,920	463,900	451,090	317,860	463,900	379,230
Spain	8,154,390	8,287,070	5,956,350	10,004,440	6,983,110	6,402,760	5,956,350	10,004,440	7,631,353
France	10,099,850	8,774,780	11,347,700	10,315,420	11,775,300	13,027,630	8,774,780	13,027,630	10,890,113
Croatia	172,360	193,960	235,780	201,340	175,590	181,000	172,360	235,780	193,338
Italy	990,730	900,080	940,230	873,210	848,680	930,460	848,680	990,730	913,898
Cyprus	46,060	45,720	67,030	36,010	2,720	52,180	2,720	67,030	41,620
Latvia	228,400	236,700	248,600	232,600	418,800	385,100	228,400	418,800	291,700
Lithuania	550,000	759,800	741,900	685,700	1,018,500	811,520	550,000	1,018,500	761,237
Luxembourg	43,000	38,450	37,900	42,490	45,960	44,380	37,900	45,960	42,030
Hungary	943,820	987,640	996,110	1,062,000	1,274,710	1,427,950	943,820	1,427,950	1,115,372
Malta	0	0	0	0	0	0	0	0	0
Netherlands	204,000	205,000	206,000	208,000	197,000	226,680	197,000	226,680	207,780
Austria	777,960	859,380	662,470	734,050	845,710	840,430	662,470	859,380	786,667
Poland	3,397,200	3,325,900	4,180,200	2,933,600	3,274,800	2,960,700	2,933,600	4,180,200	3,345,400
Portugal	30,620	21,000	21,150	32,950	37,910	44,400	21,000	44,400	31,338
Romania	1,311,040	1,329,690	986,360	1,542,250	1,712,510	1,623,160	986,360	1,712,510	1,417,502
Slovenia	80,120	79,390	84,730	69,300	89,740	93,170	69,300	93,170	82,742
Slovakia	361,390	525,000	470,480	446,050	675,850	678,140	361,390	678,140	526,152
Finland	1,340,200	1,514,300	1,581,000	1,904,200	1,854,800	1,574,700	1,340,200	1,904,200	1,628,200
Sweden	1,232,300	1,409,100	1,701,700	1,940,100	1,574,200	1,672,300	1,232,300	1,940,100	1,588,283
United Kingdom	5,252,000	5,494,000	5,522,000	7,092,000	6,911,000	7,370,000	5,252,000	7,370,000	6,273,500

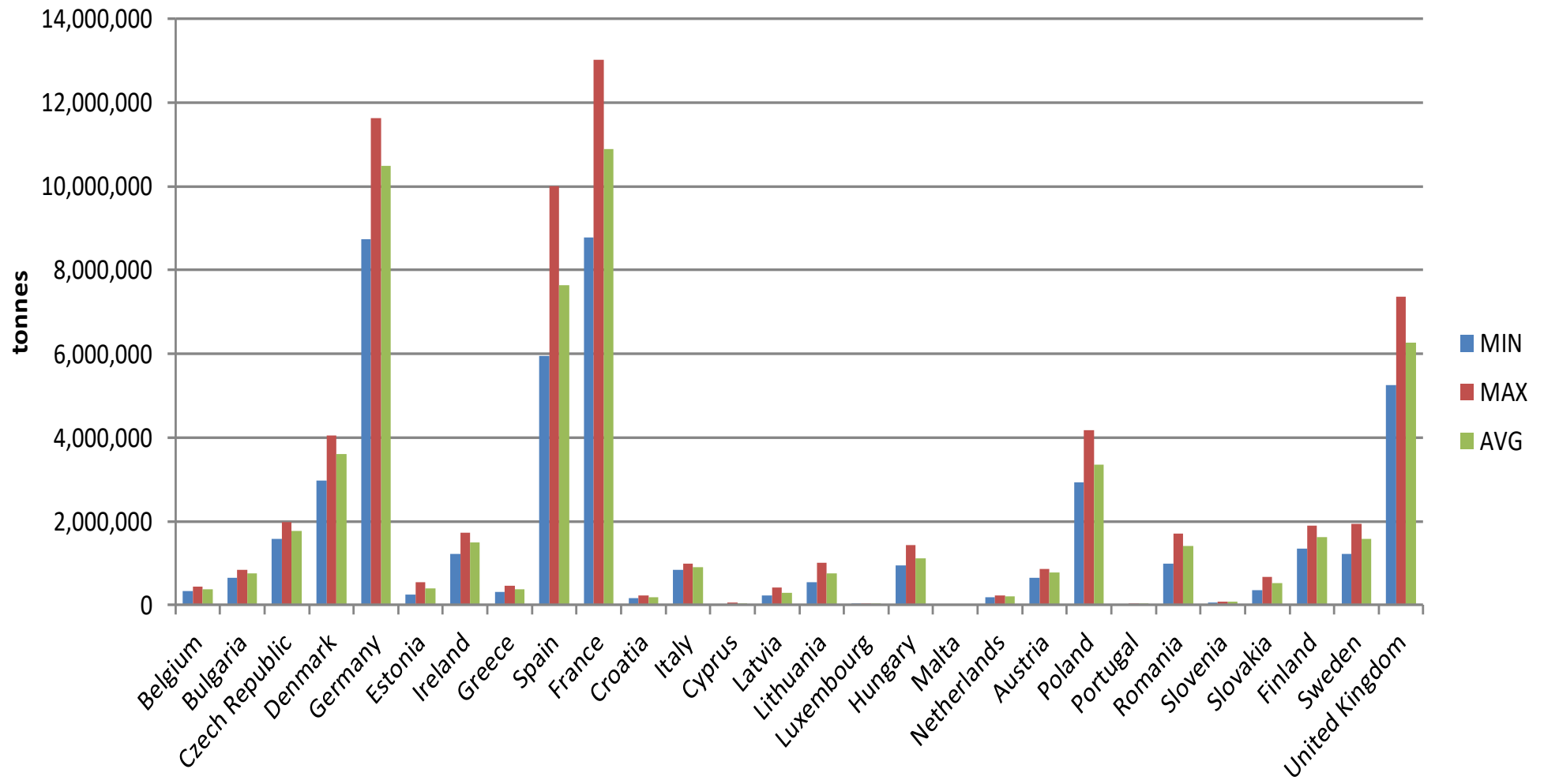


Figure 6 Tonnes of harvested barley per country, 2010-2015

Table 4 Tonnes of barley straw per country, 2010-2015

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	455,548	414,385	443,592	476,776	487,963	529,102	414,385	529,102	467,894
Bulgaria	1,016,589	862,564	807,518	889,185	1,039,721	868,103	807,518	1,039,721	913,947
Czech Republic	1,933,041	2,212,690	1,972,093	1,944,387	2,399,801	2,429,532	1,933,041	2,429,532	2,148,591
Denmark	3,637,186	3,964,756	4,951,614	4,818,878	4,328,072	4,704,320	3,637,186	4,951,614	4,400,804
Germany	12,598,842	10,655,236	12,677,386	12,619,192	14,106,616	14,188,478	10,655,236	14,188,478	12,807,625
Estonia	310,368	359,412	416,386	538,020	558,882	679,052	310,368	679,052	477,020
Ireland	1,492,145	1,722,701	1,538,139	2,028,567	2,112,015	2,121,873	1,492,145	2,121,873	1,835,907
Greece	387,789	400,380	398,245	473,262	565,958	550,330	387,789	565,958	462,661
Spain	9,948,356	10,110,225	7,266,747	12,205,417	8,519,394	7,811,367	7,266,747	12,205,417	9,310,251
France	12,321,817	10,705,232	13,844,194	12,584,812	14,365,866	15,893,709	10,705,232	15,893,709	13,285,938
Croatia	210,279	236,631	287,652	245,635	214,220	220,820	210,279	287,652	235,873
Italy	1,208,691	1,098,098	1,147,081	1,065,316	1,035,390	1,135,161	1,035,390	1,208,691	1,114,956
Cyprus	56,193	55,778	81,777	43,932	3,318	63,660	3,318	81,777	50,776
Latvia	278,648	288,774	303,292	283,772	510,936	469,822	278,648	510,936	355,874
Lithuania	671,000	926,956	905,118	836,554	1,242,570	990,054	671,000	1,242,570	928,709
Luxembourg	52,460	46,909	46,238	51,838	56,071	54,144	46,238	56,071	51,277
Hungary	1,151,460	1,204,921	1,215,254	1,295,640	1,555,146	1,742,099	1,151,460	1,742,099	1,360,753
Malta	0	0	0	0	0	0	0	0	0
Netherlands	248,880	250,100	251,320	253,760	240,340	276,550	240,340	276,550	253,492
Austria	949,111	1,048,444	808,213	895,541	1,031,766	1,025,325	808,213	1,048,444	959,733
Poland	4,144,584	4,057,598	5,099,844	3,578,992	3,995,256	3,612,054	3,578,992	5,099,844	4,081,388
Portugal	37,356	25,620	25,803	40,199	46,250	54,168	25,620	54,168	38,233
Romania	1,599,469	1,622,222	1,203,359	1,881,545	2,089,262	1,980,255	1,203,359	2,089,262	1,729,352
Slovenia	97,746	96,856	103,371	84,546	109,483	113,667	84,546	113,667	100,945
Slovakia	440,896	640,500	573,986	544,181	824,537	827,331	440,896	827,331	641,905
Finland	1,635,044	1,847,446	1,928,820	2,323,124	2,262,856	1,921,134	1,635,044	2,323,124	1,986,404
Sweden	1,503,406	1,719,102	2,076,074	2,366,922	1,920,524	2,040,206	1,503,406	2,366,922	1,937,706
United Kingdom	6,407,440	6,702,680	6,736,840	8,652,240	8,431,420	8,991,400	6,407,440	8,991,400	7,653,670

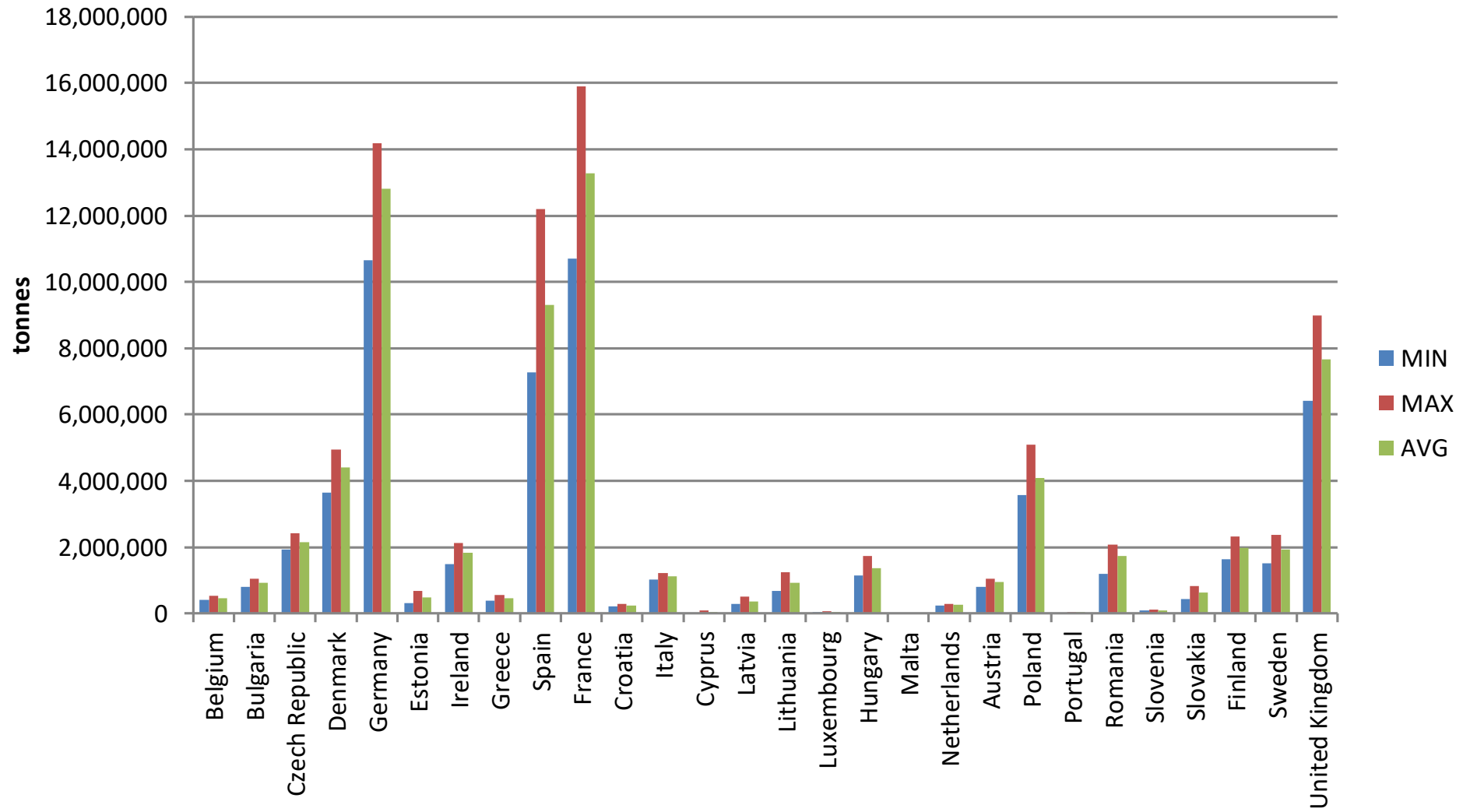


Figure 7 Tonnes of barley straw per country, 2010-2015

Table 5 Tonnes of imported and exported barley per country, 2010-2013 (5)

GEO/POPULATION	Trade	2010	2011	2012	2013
Belgium	Import	1,923,816	1,701,062	1,774,768	1,824,499
	Export	312,321	168,403	342,001	311,827
Bulgaria	Import	400	140	614	1,895
	Export	483,867	343,115	325,128	414,766
Czech Republic	Import	42,497	30,946	28,912	40,788
	Export	276,084	327,683	362,154	231,170
Denmark	Import	151,271	170,122	83,210	106,915
	Export	783,907	934,738	1,041,699	778,468
Germany	Import	1,231,718	1,343,326	1,408,889	1,128,893
	Export	1,688,625	2,255,672	1,534,747	2,851,292
Estonia	Import	12,029	42,378	8,137	31,378
	Export	73,930	184,668	84,909	170,999
Ireland	Import	300,706	122,018	198,305	243,346
	Export	23,465	90,176	69,465	34,570
Greece	Import	228,309	176,789	70,448	96,202
	Export	657	71	2,021	717
Spain	Import	918,439	999,158	276,184	313,138
	Export	186,847	115,129	71,113	77,146
France	Import	76,673	154,927	96,518	34,755
	Export	5,706,781	4,284,000	4,657,446	6,465,970
Croatia	Import	27,668	59,190	29,808	31,994
	Export	7,285	2,227	14,837	12,045
Italy	Import	849,683	914,947	497,731	637,306
	Export	7,171	10,502	6,220	10,090
Cyprus	Import	203,762	202,099	130,148	161,363
	Export	0	0	0	0
Latvia	Import	102,134	112,766	110,983	87,306
	Export	183,538	132,166	113,927	134,208
Lithuania	Import	8,749	67,651	34,548	55,864

	Export	153,973	204,695	101,609	278,356
Luxembourg	Import	4,551	4,644	4,675	2,397
	Export	16,145	10,913	13,592	13,178
Hungary	Import	20,711	68,423	68,642	52,015
	Export	303,997	522,532	299,476	455,252
Malta	Import	23,820	23,600	17,836	14,202
	Export	0	0	0	0
Netherlands	Import	2,014,214	1,658,122	1,546,509	1,743,174
	Export	267,061	274,099	84,630	264,299
Austria	Import	133,697	198,164	162,746	198,311
	Export	82,642	70,650	75,722	77,593
Poland	Import	136,454	225,188	197,035	158,260
	Export	148,844	126,515	320,873	290,647
Portugal	Import	423,517	336,303	225,471	242,725
	Export	31,368	37,784	4,560	4,494
Romania	Import	90,878	186,770	138,024	222,758
	Export	771,878	763,541	688,075	1,132,938
Slovenia	Import	30,103	29,365	15,897	22,868
	Export	4,786	7,006	8,600	8,370
Slovakia	Import	23,456	70,752	53,782	80,518
	Export	64,914	171,526	57,721	47,747
Finland	Import	200	310	4,081	800
	Export	246,036	477,356	93,206	118,421
Sweden	Import	20,111	58,554	61,023	25,305
	Export	445,501	287,610	494,457	363,304
United Kingdom	Import	114,861	128,584	161,727	194,457
	Export	1,031,198	799,251	589,738	849,432

Table 6 Tonnes of processed barley per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	1,984,895	1,872,319	1,796,367	1,903,472	1,796,367	1,984,895	1,889,263
Bulgaria	349,803	364,045	337,386	315,969	315,969	364,045	341,801
Czech Republic	1,350,873	1,516,943	1,283,228	1,403,378	1,283,228	1,516,943	1,388,606
Denmark	2,348,664	2,485,184	3,100,211	3,278,347	2,348,664	3,278,347	2,803,102
Germany	9,870,013	7,821,454	10,265,442	8,621,201	7,821,454	10,265,442	9,144,528
Estonia	192,499	152,310	264,528	301,379	152,310	301,379	227,679
Ireland	1,500,311	1,443,892	1,389,610	1,871,536	1,389,610	1,871,536	1,551,337
Greece	545,512	504,898	394,857	483,405	394,857	545,512	482,168
Spain	8,885,982	9,171,099	6,161,421	10,240,432	6,161,421	10,240,432	8,614,734
France	4,469,742	4,645,707	6,786,772	3,884,205	3,884,205	6,786,772	4,946,607
Croatia	192,743	250,923	250,751	221,289	192,743	250,923	228,927
Italy	1,833,242	1,804,525	1,431,741	1,500,426	1,431,741	1,833,242	1,642,484
Cyprus	249,822	247,819	197,178	197,373	197,178	249,822	223,048
Latvia	146,996	217,300	245,656	185,698	146,996	245,656	198,913
Lithuania	404,776	622,756	674,839	463,208	404,776	674,839	541,395
Luxembourg	31,406	32,181	28,983	31,709	28,983	32,181	31,070
Hungary	660,534	533,531	765,276	658,763	533,531	765,276	654,526
Malta	23,820	23,600	17,836	14,202	14,202	23,820	19,865
Netherlands	1,951,153	1,589,023	1,667,879	1,686,875	1,589,023	1,951,153	1,723,733
Austria	829,015	986,894	749,494	854,768	749,494	986,894	855,043
Poland	3,384,810	3,424,573	4,056,362	2,801,213	2,801,213	4,056,362	3,416,740
Portugal	422,769	319,519	242,061	271,181	242,061	422,769	313,883
Romania	630,040	752,919	436,309	632,070	436,309	752,919	612,835
Slovenia	105,437	101,749	92,027	83,798	83,798	105,437	95,753
Slovakia	319,932	424,226	466,541	478,821	319,932	478,821	422,380
Finland	1,094,364	1,037,254	1,491,875	1,786,579	1,037,254	1,786,579	1,352,518
Sweden	806,910	1,180,044	1,268,266	1,602,101	806,910	1,602,101	1,214,330
United Kingdom	4,335,663	4,823,333	5,093,989	6,437,025	4,335,663	6,437,025	5,172,503

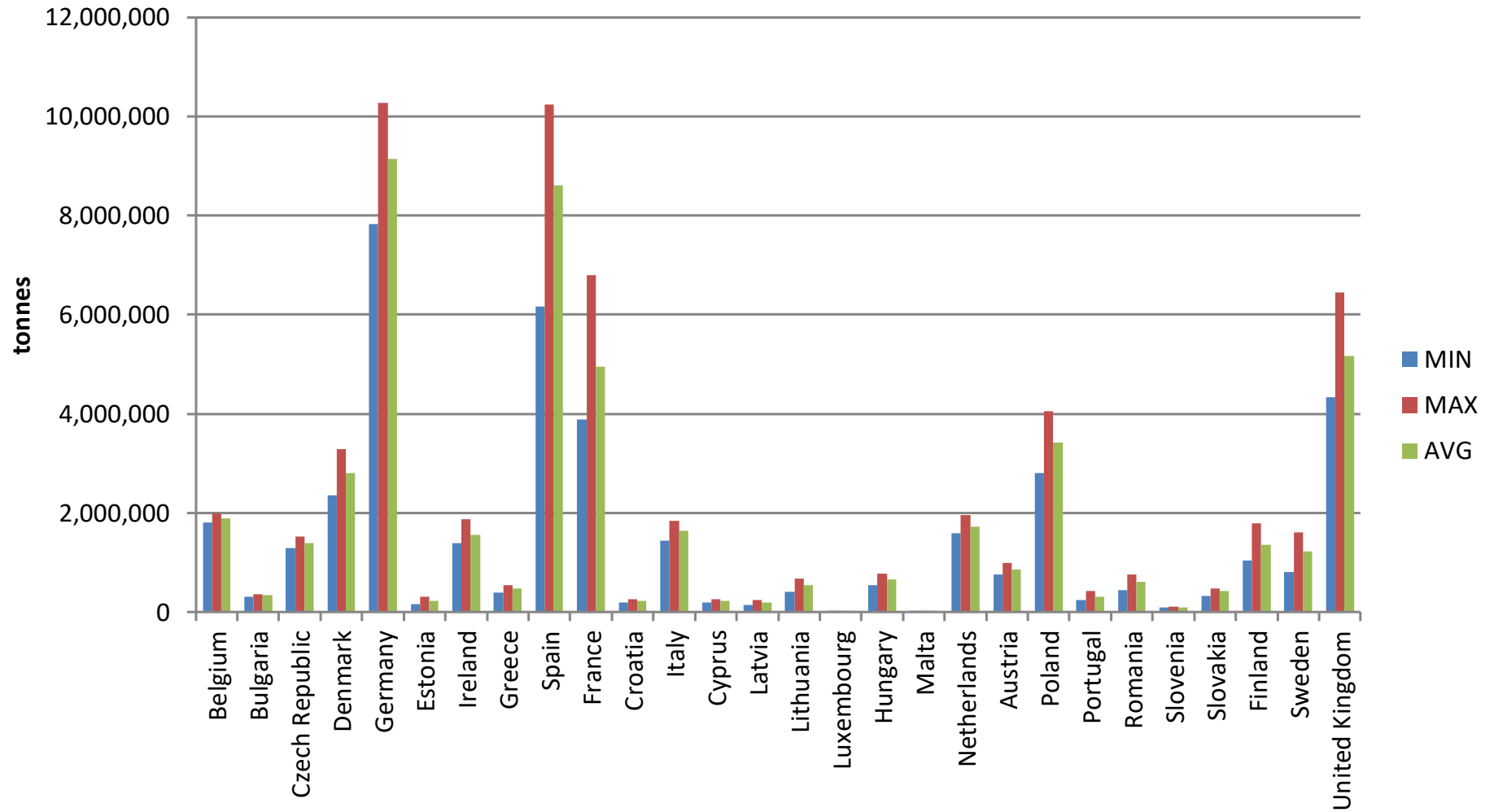


Figure 8 Tonnes of processed barley per country, 2010-2013

Table 7 Tonnes of barley bran per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	357,281	337,017	323,346	342,625	323,346	357,281	340,067
Bulgaria	62,965	65,528	60,729	56,874	56,874	65,528	61,524
Czech Republic	243,157	273,050	230,981	252,608	230,981	273,050	249,949
Denmark	422,760	447,333	558,038	590,102	422,760	590,102	504,558
Germany	1,776,602	1,407,862	1,847,780	1,551,816	1,407,862	1,847,780	1,646,015
Estonia	34,650	27,416	47,615	54,248	27,416	54,248	40,982
Ireland	270,056	259,901	250,130	336,876	250,130	336,876	279,241
Greece	98,192	90,882	71,074	87,013	71,074	98,192	86,790
Spain	1,599,477	1,650,798	1,109,056	1,843,278	1,109,056	1,843,278	1,550,652
France	804,554	836,227	1,221,619	699,157	699,157	1,221,619	890,389
Croatia	34,694	45,166	45,135	39,832	34,694	45,166	41,207
Italy	329,984	324,815	257,713	270,077	257,713	329,984	295,647
Cyprus	44,968	44,607	35,492	35,527	35,492	44,968	40,149
Latvia	26,459	39,114	44,218	33,426	26,459	44,218	35,804
Lithuania	72,860	112,096	121,471	83,377	72,860	121,471	97,451
Luxembourg	5,653	5,793	5,217	5,708	5,217	5,793	5,593
Hungary	118,896	96,036	137,750	118,577	96,036	137,750	117,815
Malta	4,288	4,248	3,210	2,556	2,556	4,288	3,576
Netherlands	351,208	286,024	300,218	303,638	286,024	351,208	310,272
Austria	149,223	177,641	134,909	153,858	134,909	177,641	153,908
Poland	609,266	616,423	730,145	504,218	504,218	730,145	615,013
Portugal	76,098	57,513	43,571	48,813	43,571	76,098	56,499
Romania	113,407	135,525	78,536	113,773	78,536	135,525	110,310
Slovenia	18,979	18,315	16,565	15,084	15,084	18,979	17,235
Slovakia	57,588	76,361	83,977	86,188	57,588	86,188	76,028
Finland	196,986	186,706	268,538	321,584	186,706	321,584	243,453
Sweden	145,244	212,408	228,288	288,378	145,244	288,378	218,579
United Kingdom	780,419	868,200	916,918	1,158,665	780,419	1,158,665	931,050

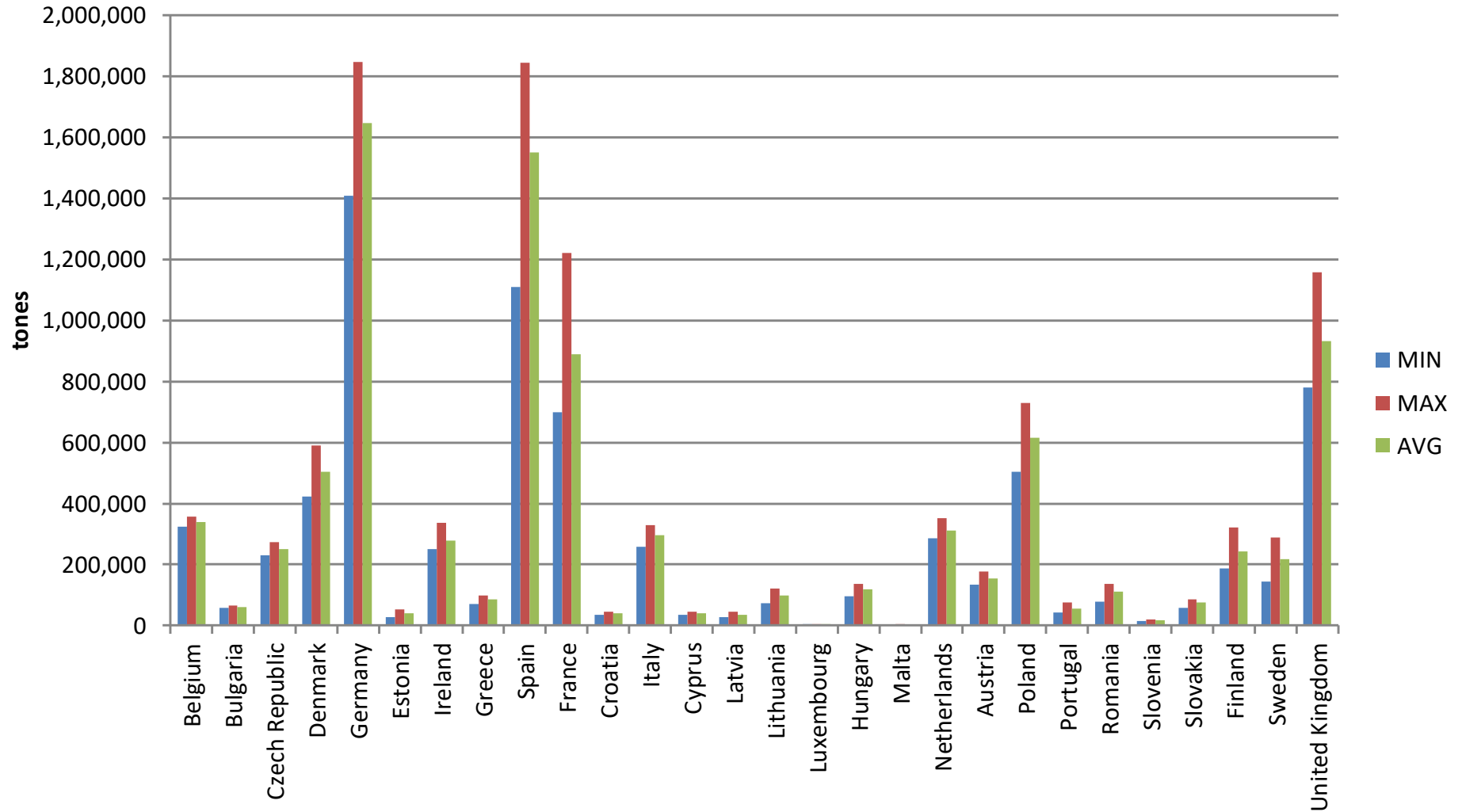


Figure 9 Tonnes of barley bran per country, 2010-2013

Table 8 Tonnes of barley hull per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	377,130	355,741	341,310	361,660	341,310	377,130	358,960
Bulgaria	66,463	69,169	64,103	60,034	60,034	69,169	64,942
Czech Republic	256,666	288,219	243,813	266,642	243,813	288,219	263,835
Denmark	446,246	472,185	589,040	622,886	446,246	622,886	532,589
Germany	1,875,302	1,486,076	1,950,434	1,638,028	1,486,076	1,950,434	1,737,460
Estonia	36,575	28,939	50,260	57,262	28,939	57,262	43,259
Ireland	285,059	274,339	264,026	355,592	264,026	355,592	294,754
Greece	103,647	95,931	75,023	91,847	75,023	103,647	91,612
Spain	1,688,337	1,742,509	1,170,670	1,945,682	1,170,670	1,945,682	1,636,799
France	849,251	882,684	1,289,487	737,999	737,999	1,289,487	939,855
Croatia	36,621	47,675	47,643	42,045	36,621	47,675	43,496
Italy	348,316	342,860	272,031	285,081	272,031	348,316	312,072
Cyprus	47,466	47,086	37,464	37,501	37,464	47,466	42,379
Latvia	27,929	41,287	46,675	35,283	27,929	46,675	37,793
Lithuania	76,907	118,324	128,219	88,010	76,907	128,219	102,865
Luxembourg	5,967	6,114	5,507	6,025	5,507	6,114	5,903
Hungary	125,501	101,371	145,402	125,165	101,371	145,402	124,360
Malta	4,526	4,484	3,389	2,698	2,698	4,526	3,774
Netherlands	370,719	301,914	316,897	320,506	301,914	370,719	327,509
Austria	157,513	187,510	142,404	162,406	142,404	187,510	162,458
Poland	643,114	650,669	770,709	532,230	532,230	770,709	649,181
Portugal	80,326	60,709	45,992	51,524	45,992	80,326	59,638
Romania	119,708	143,055	82,899	120,093	82,899	143,055	116,439
Slovenia	20,033	19,332	17,485	15,922	15,922	20,033	18,193
Slovakia	60,787	80,603	88,643	90,976	60,787	90,976	80,252
Finland	207,929	197,078	283,456	339,450	197,078	339,450	256,978
Sweden	153,313	224,208	240,971	304,399	153,313	304,399	230,723
United Kingdom	823,776	916,433	967,858	1,223,035	823,776	1,223,035	982,775

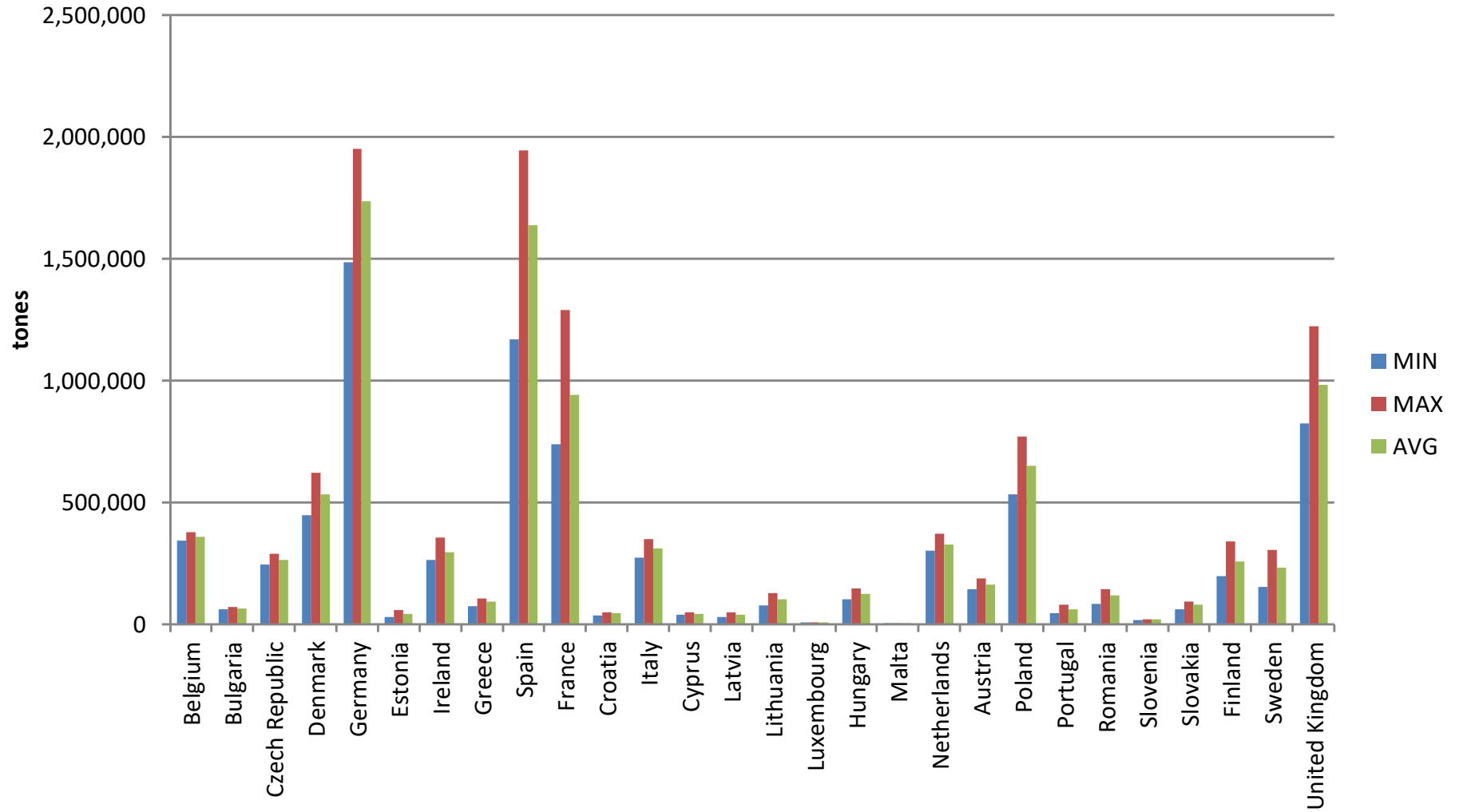


Figure 10 Tonnes of barley hull per country, 2010-2013

2.2 Maize

Maize is a one-year grain plant used as a source of food for both people and animals (33). It is a single stalk crop with multiple leaves and eventually after a period of time, ears appear. Worldwide maize production increases from year to year, with one European country in the top ten global maize producers (France). There are several types of maize that differ in the aim of application. For example, there is flour corn (75% of amylopectin) used for flour production and waxy corn that is almost 100% amylopectin (34). When maize is harvested, three main source of AWCB appear: stalks, husk and cobs. The unique name that is applied to all three of them is corn stover; Figure 11 shows the three AWCB maize streams (35).



Figure 11 Corn stover (35)

During the processing step of maize, the main by-product produced is bran, shown in Figure 12 (36).



Figure 12 Maize bran (36)

The flowchart (Figure 13) presents AWCB value chain for maize and specific AWCB weight factors from Table 2.

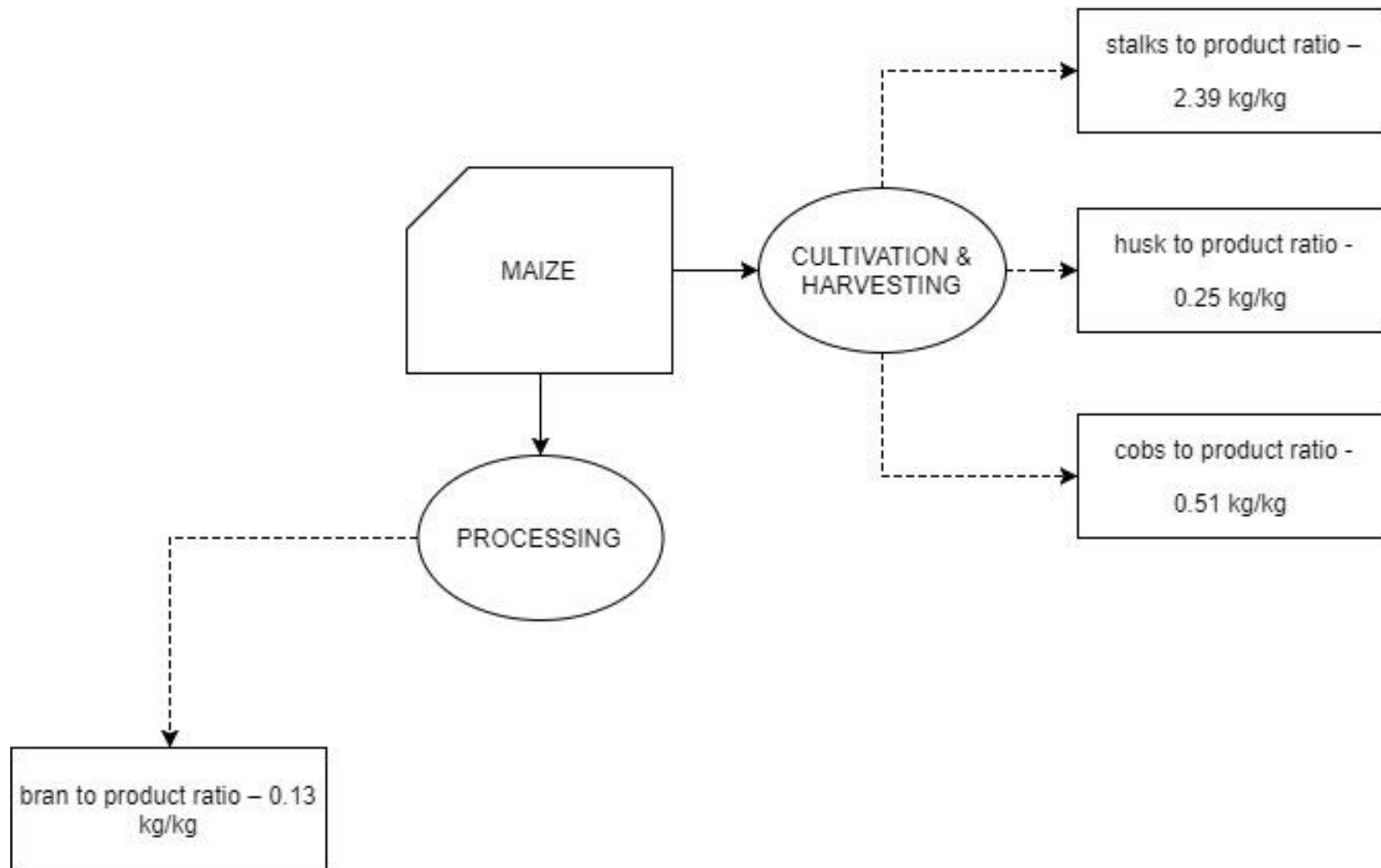


Figure 13 Maize AWCB value chain

Data for cultivated maize is taken from EUROSTAT, and data for imported and exported maize is taken from FAOSTAT. By using relation (I-IX), the quantity of processed maize is calculated for every country in each year. Then the amount of AWCB is calculated for every step and every year. Here example of calculation for Lithuania in 2010:

PRD = 47,500 tonnes

IMP = 27,591 tonnes

EXP = 9,483 tonnes

PRC = $(47,500 + 27,591 - 9,483) = 65,608$ tonnes

When 1 kg of maize is harvested mass of AWCB products follows as: stalks, between 1.00 and 3.77 kg; husks, between 0.20 and 0.30 kg; cobs, between 0.15 and 0.86 kg. By using an average number of AWCB mass (2.39 kg of stalks; 0.25 kg of husks and 0.51 kg of cobs), for Lithuania, it was 113,525 tonnes of stalks, 11,875 tonnes of husks and 24,225 tonnes of cobs in 2010. In Lithuanian maize processing facilities, 8,529 tonnes of bran occurred in 2010. Results for other countries and years are presented in the tables and figures below.

Table 9 Tonnes of harvested maize per country, 2010-2015 (32)

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	745,900	859,690	733,600	837,600	778,570	692,810	692,810	859,690	859,690
Bulgaria	2,047,410	2,209,200	1,717,800	2,738,670	3,137,480	2,691,050	1,717,800	3,137,480	3,137,480
Czech Republic	692,590	1,063,740	928,150	675,380	832,240	442,710	442,710	1,063,740	1,063,740
Denmark	45,700	55,300	75,100	75,700	72,900	53,000	45,700	75,700	75,700
Germany	4,211,500	5,183,600	5,514,700	4,387,300	5,142,100	3,973,000	3,973,000	5,514,700	5,514,700
Estonia	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0	0
Greece	1,718,460	2,165,790	2,009,790	2,134,250	1,768,000	1,702,230	1,702,230	2,165,790	2,165,790
Spain	3,312,750	4,199,930	4,261,410	4,888,460	4,776,190	4,314,720	3,312,750	4,888,460	4,888,460
France	14,134,920	15,914,120	15,614,120	15,031,140	18,541,780	13,738,240	13,738,240	18,541,780	18,541,780
Croatia	2,067,820	1,733,660	1,297,590	1,874,370	2,046,970	1,708,000	1,297,590	2,067,820	2,067,820
Italy	8,608,450	9,752,590	7,888,670	7,899,620	9,250,050	7,069,650	7,069,650	9,752,590	9,752,590
Cyprus	0	0	0	0	0	0	0	0	0
Latvia	0	0	0	0	0	0	0	0	0
Lithuania	47,500	71,900	78,800	127,200	115,000	56,340	47,500	127,200	127,200
Luxembourg	3,120	2,330	1,620	2,170	1,670	930	930	3,120	3,120
Hungary	6,984,870	7,992,440	4,762,710	6,756,440	9,315,100	6,545,290	4,762,710	9,315,100	9,315,100
Malta	0	0	0	0	0	0	0	0	0
Netherlands	271,000	279,000	254,000	253,000	240,000	170,970	170,970	279,000	279,000
Austria	1,955,990	2,453,130	2,351,370	1,639,020	2,334,390	1,637,910	1,637,910	2,453,130	2,453,130
Poland	1,994,400	2,392,100	3,995,900	4,039,700	4,468,400	3,156,200	1,994,400	4,468,400	4,468,400
Portugal	626,220	810,270	848,670	929,540	896,990	827,540	626,220	929,540	929,540
Romania	9,042,030	11,717,590	5,953,350	11,305,100	11,988,550	8,984,740	5,953,350	11,988,550	11,988,550
Slovenia	311,120	349,030	277,360	226,630	350,730	338,710	226,630	350,730	350,730
Slovakia	921,310	1,444,400	1,170,350	1,123,310	1,814,110	927,420	921,310	1,814,110	1,814,110
Finland	0	0	0	0	0	0	0	0	0
Sweden	7,500	16,000	14,600	7,400	7,100	6,400	6,400	16,000	16,000
United Kingdom	0	0	70,650	84,860	0	22,000	0	84,860	84,860

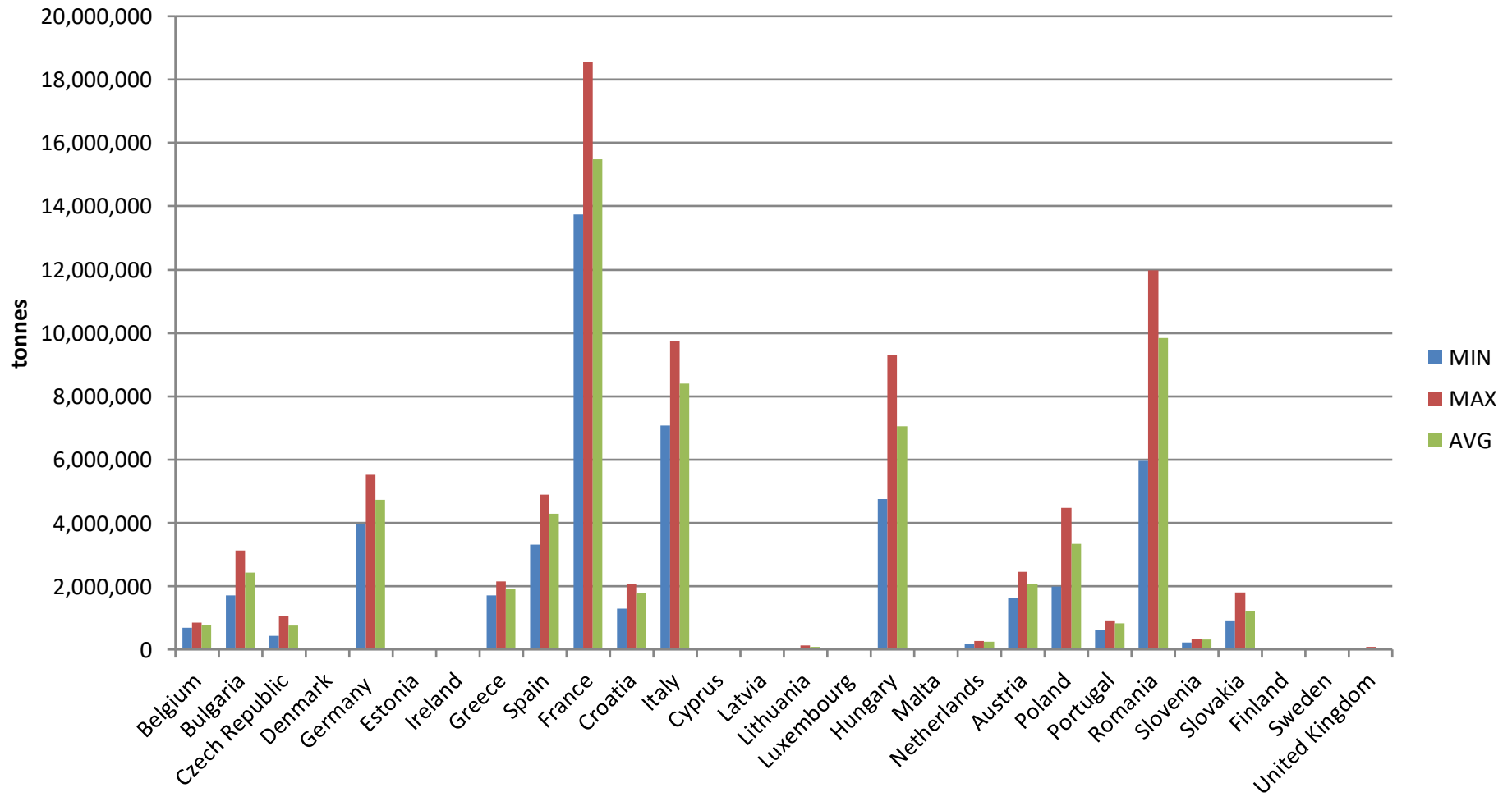


Figure 14 Tonnes of harvested maize per country, 2010-2015

Table 10 Tonnes of maize stalks per country, 2010-2015

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	1,782,701	2,054,659	1,753,304	2,001,864	1,860,782	1,655,816	1,655,816	2,054,659	1,851,521
Bulgaria	4,893,310	5,279,988	4,105,542	6,545,421	7,498,577	6,431,610	4,105,542	7,498,577	5,792,408
Czech Republic	1,655,290	2,542,339	2,218,279	1,614,158	1,989,054	1,058,077	1,058,077	2,542,339	1,846,199
Denmark	109,223	132,167	179,489	180,923	174,231	126,670	109,223	180,923	150,451
Germany	10,065,485	12,388,804	13,180,133	10,485,647	12,289,619	9,495,470	9,495,470	13,180,133	11,317,526
Estonia	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0	0
Greece	4,107,119	5,176,238	4,803,398	5,100,858	4,225,520	4,068,330	4,068,330	5,176,238	4,580,244
Spain	7,917,473	10,037,833	10,184,770	11,683,419	11,415,094	10,312,181	7,917,473	11,683,419	10,258,462
France	33,782,459	38,034,747	37,317,747	35,924,425	44,314,854	32,834,394	32,834,394	44,314,854	37,034,771
Croatia	4,942,090	4,143,447	3,101,240	4,479,744	4,892,258	4,082,120	3,101,240	4,942,090	4,273,483
Italy	20,574,196	23,308,690	18,853,921	18,880,092	22,107,620	16,896,464	16,896,464	23,308,690	20,103,497
Cyprus	0	0	0	0	0	0	0	0	0
Latvia	0	0	0	0	0	0	0	0	0
Lithuania	113,525	171,841	188,332	304,008	274,850	134,653	113,525	304,008	197,868
Luxembourg	7,457	5,569	3,872	5,186	3,991	2,223	2,223	7,457	4,716
Hungary	16,693,839	19,101,932	11,382,877	16,147,892	22,263,089	15,643,243	11,382,877	22,263,089	16,872,145
Malta	0	0	0	0	0	0	0	0	0
Netherlands	647,690	666,810	607,060	604,670	573,600	408,618	408,618	666,810	584,741
Austria	4,674,816	5,862,981	5,619,774	3,917,258	5,579,192	3,914,605	3,914,605	5,862,981	4,928,104
Poland	4,766,616	5,717,119	9,550,201	9,654,883	10,679,476	7,543,318	4,766,616	10,679,476	7,985,269
Portugal	1,496,666	1,936,545	2,028,321	2,221,601	2,143,806	1,977,821	1,496,666	2,221,601	1,967,460
Romania	21,610,452	28,005,040	14,228,507	27,019,189	28,652,635	21,473,529	14,228,507	28,652,635	23,498,225
Slovenia	743,577	834,182	662,890	541,646	838,245	809,517	541,646	838,245	738,343
Slovakia	2,201,931	3,452,116	2,797,137	2,684,711	4,335,723	2,216,534	2,201,931	4,335,723	2,948,025
Finland	0	0	0	0	0	0	0	0	0
Sweden	17,925	38,240	34,894	17,686	16,969	15,296	15,296	38,240	23,502
United Kingdom	0	0	168,854	202,815	0	52,580	0	202,815	70,708

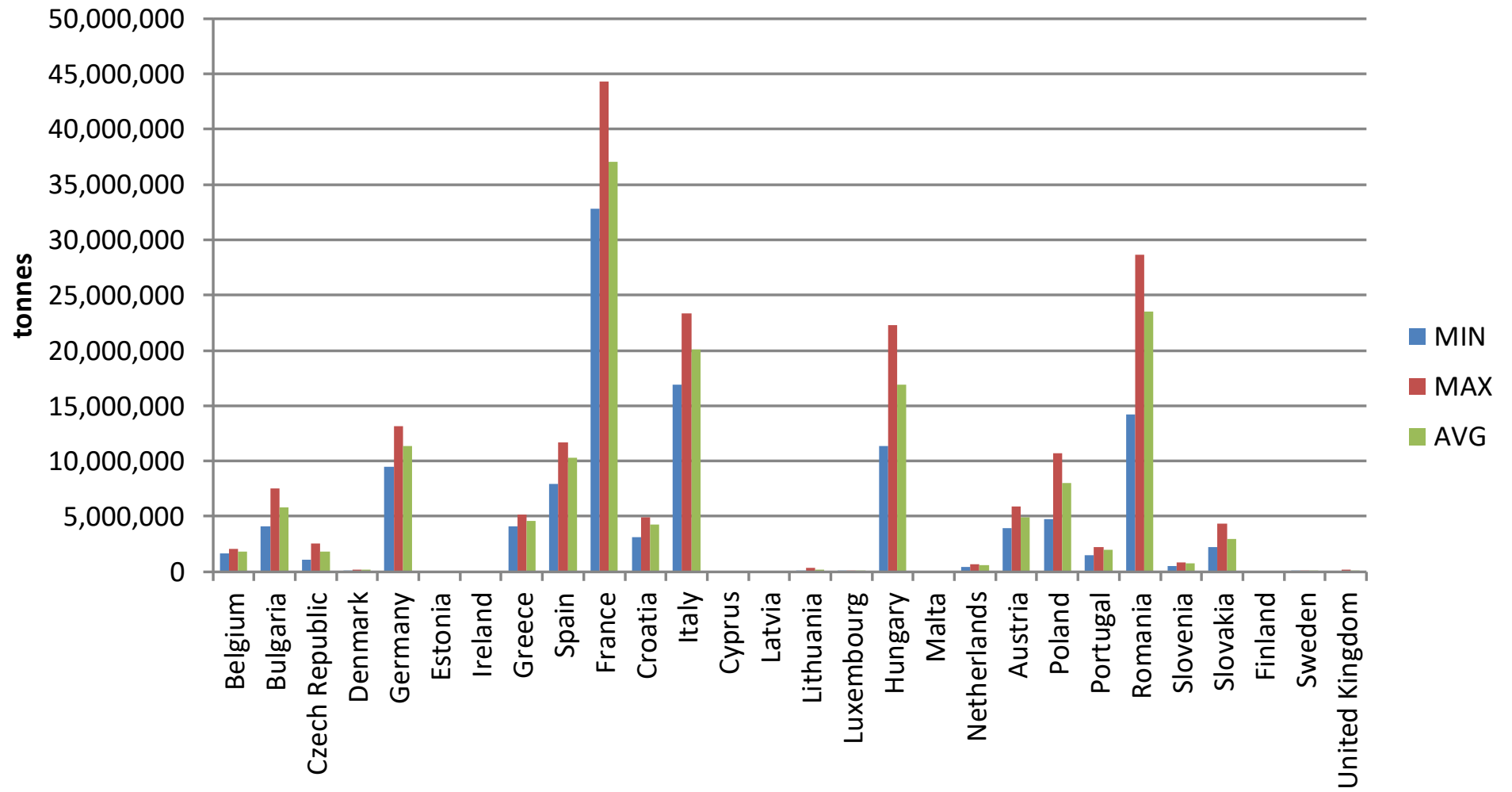


Figure 15 Tonnes of maize stalks per country, 2010-2015

Table 11 Tonnes of maize husks per country, 2010-2015

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	186,475	214,923	183,400	209,400	194,643	173,203	173,203	214,923	193,674
Bulgaria	511,853	552,300	429,450	684,668	784,370	672,763	429,450	784,370	605,900
Czech Republic	173,148	265,935	232,038	168,845	208,060	110,678	110,678	265,935	193,117
Denmark	11,425	13,825	18,775	18,925	18,225	13,250	11,425	18,925	15,738
Germany	1,052,875	1,295,900	1,378,675	1,096,825	1,285,525	993,250	993,250	1,378,675	1,183,842
Estonia	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0	0
Greece	429,615	541,448	502,448	533,563	442,000	425,558	425,558	541,448	479,105
Spain	828,188	1,049,983	1,065,353	1,222,115	1,194,048	1,078,680	828,188	1,222,115	1,073,061
France	3,533,730	3,978,530	3,903,530	3,757,785	4,635,445	3,434,560	3,434,560	4,635,445	3,873,930
Croatia	516,955	433,415	324,398	468,593	511,743	427,000	324,398	516,955	447,017
Italy	2,152,113	2,438,148	1,972,168	1,974,905	2,312,513	1,767,413	1,767,413	2,438,148	2,102,876
Cyprus	0	0	0	0	0	0	0	0	0
Latvia	0	0	0	0	0	0	0	0	0
Lithuania	11,875	17,975	19,700	31,800	28,750	14,085	11,875	31,800	20,698
Luxembourg	780	583	405	543	418	233	233	780	493
Hungary	1,746,218	1,998,110	1,190,678	1,689,110	2,328,775	1,636,323	1,190,678	2,328,775	1,764,869
Malta	0	0	0	0	0	0	0	0	0
Netherlands	67,750	69,750	63,500	63,250	60,000	42,743	42,743	69,750	61,165
Austria	488,998	613,283	587,843	409,755	583,598	409,478	409,478	613,283	515,492
Poland	498,600	598,025	998,975	1,009,925	1,117,100	789,050	498,600	1,117,100	835,279
Portugal	156,555	202,568	212,168	232,385	224,248	206,885	156,555	232,385	205,801
Romania	2,260,508	2,929,398	1,488,338	2,826,275	2,997,138	2,246,185	1,488,338	2,997,138	2,457,973
Slovenia	77,780	87,258	69,340	56,658	87,683	84,678	56,658	87,683	77,233
Slovakia	230,328	361,100	292,588	280,828	453,528	231,855	230,328	453,528	308,371
Finland	0	0	0	0	0	0	0	0	0
Sweden	1,875	4,000	3,650	1,850	1,775	1,600	1,600	4,000	2,458
United Kingdom	0	0	17,663	21,215	0	5,500	0	21,215	7,396

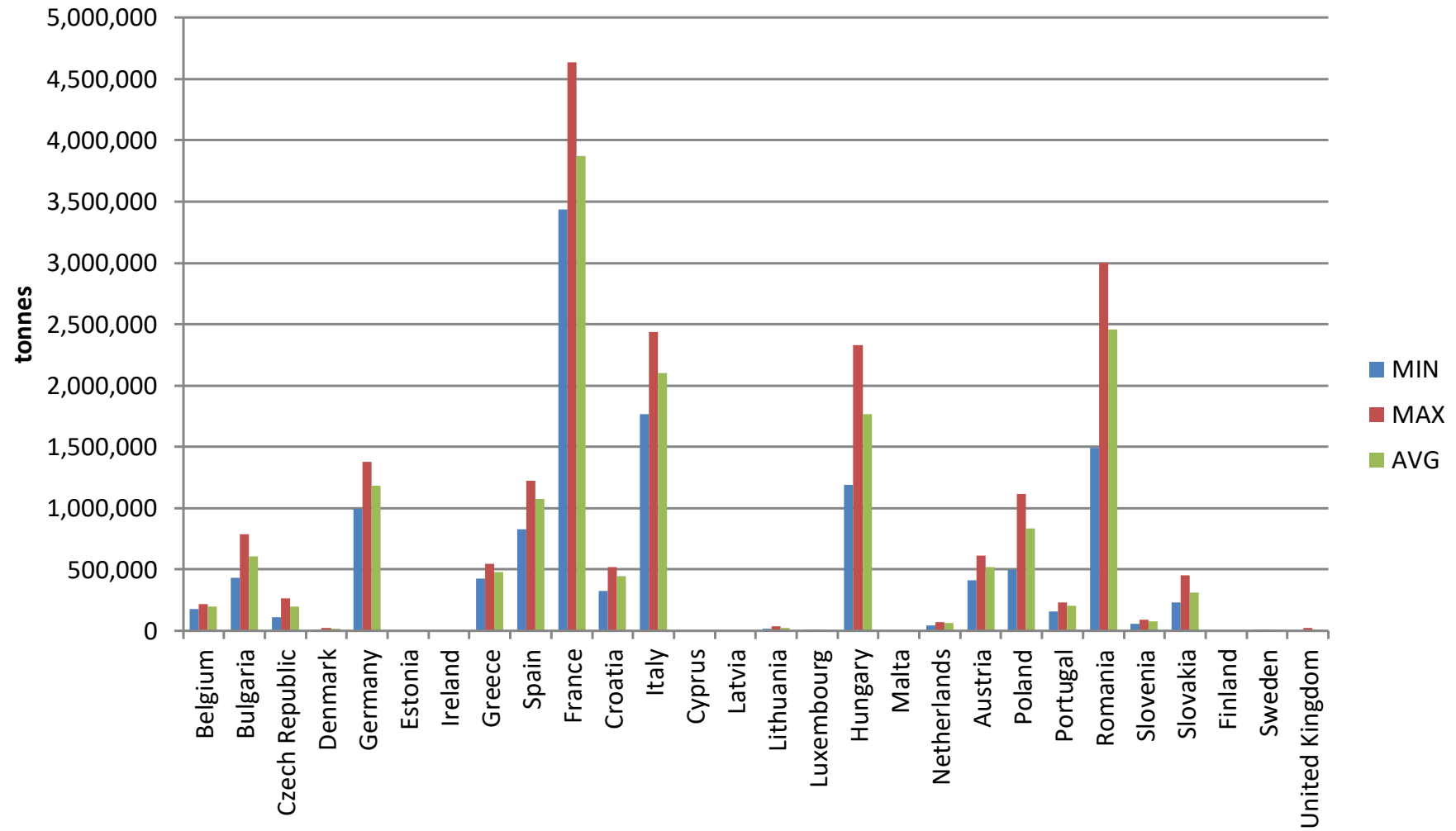


Figure 16 Tonnes of maize husks per country, 2010-2015

Table 12 Tonnes of maize cobs per country, 2010-2015

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	380,409	438,442	374,136	427,176	397,071	353,333	353,333	438,442	395,094
Bulgaria	1,044,179	1,126,692	876,078	1,396,722	1,600,115	1,372,436	876,078	1,600,115	1,236,037
Czech Republic	353,221	542,507	473,357	344,444	424,442	225,782	225,782	542,507	393,959
Denmark	23,307	28,203	38,301	38,607	37,179	27,030	23,307	38,607	32,105
Germany	2,147,865	2,643,636	2,812,497	2,237,523	2,622,471	2,026,230	2,026,230	2,812,497	2,415,037
Estonia	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0	0
Greece	876,415	1,104,553	1,024,993	1,088,468	901,680	868,137	868,137	1,104,553	977,374
Spain	1,689,503	2,141,964	2,173,319	2,493,115	2,435,857	2,200,507	1,689,503	2,493,115	2,189,044
France	7,208,809	8,116,201	7,963,201	7,665,881	9,456,308	7,006,502	7,006,502	9,456,308	7,902,817
Croatia	1,054,588	884,167	661,771	955,929	1,043,955	871,080	661,771	1,054,588	911,915
Italy	4,390,310	4,973,821	4,023,222	4,028,806	4,717,526	3,605,522	3,605,522	4,973,821	4,289,868
Cyprus	0	0	0	0	0	0	0	0	0
Latvia	0	0	0	0	0	0	0	0	0
Lithuania	24,225	36,669	40,188	64,872	58,650	28,733	24,225	64,872	42,223
Luxembourg	1,591	1,188	826	1,107	852	474	474	1,591	1,006
Hungary	3,562,284	4,076,144	2,428,982	3,445,784	4,750,701	3,338,098	2,428,982	4,750,701	3,600,332
Malta	0	0	0	0	0	0	0	0	0
Netherlands	138,210	142,290	129,540	129,030	122,400	87,195	87,195	142,290	124,777
Austria	997,555	1,251,096	1,199,199	835,900	1,190,539	835,334	835,334	1,251,096	1,051,604
Poland	1,017,144	1,219,971	2,037,909	2,060,247	2,278,884	1,609,662	1,017,144	2,278,884	1,703,970
Portugal	319,372	413,238	432,822	474,065	457,465	422,045	319,372	474,065	419,835
Romania	4,611,435	5,975,971	3,036,209	5,765,601	6,114,161	4,582,217	3,036,209	6,114,161	5,014,266
Slovenia	158,671	178,005	141,454	115,581	178,872	172,742	115,581	178,872	157,554
Slovakia	469,868	736,644	596,879	572,888	925,196	472,984	469,868	925,196	629,077
Finland	0	0	0	0	0	0	0	0	0
Sweden	3,825	8,160	7,446	3,774	3,621	3,264	3,264	8,160	5,015
United Kingdom	0	0	36,032	43,279	0	11,220	0	43,279	15,088

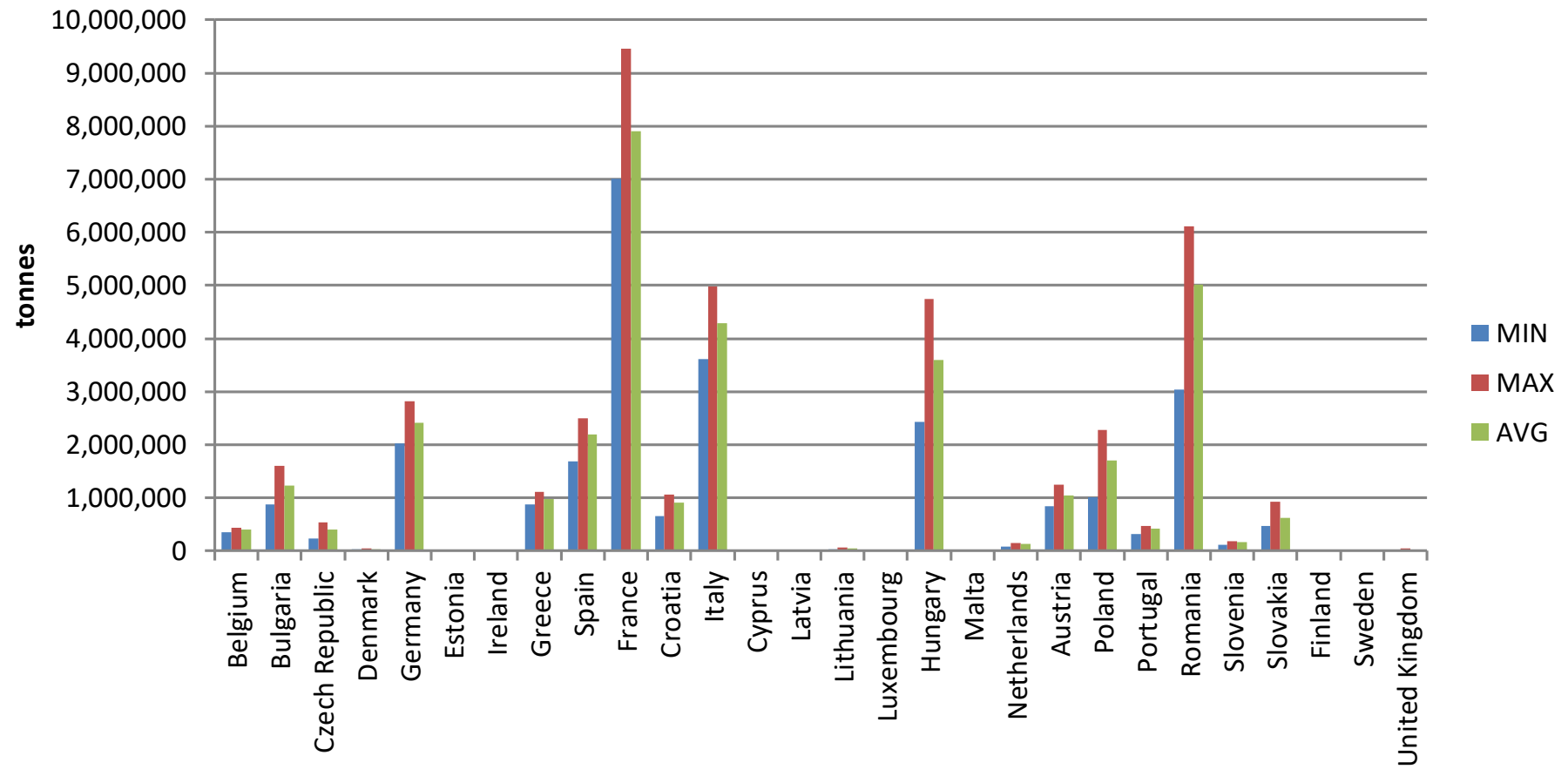


Figure 17 Tonnes of maize cobs per country, 2010-2015

Table 13 Tonnes of imported and exported maize per country, 2010-2013 (5)

GEO/POPULATION	Trade	2010	2011	2012	2013
Belgium	Import	762,296	1,242,225	1,765,928	1,449,712
	Export	174,792	439,155	537,022	308,541
Bulgaria	Import	116,908	87,920	92,001	41,408
	Export	650,566	938,936	825,392	2,115,530
Czech Republic	Import	16,273	20,555	138,789	99,135
	Export	255,136	335,867	533,502	326,277
Denmark	Import	54,590	47,117	121,228	245,053
	Export	6,374	19,598	11,829	21,184
Germany	Import	1,880,907	1,901,563	2,215,374	2,133,720
	Export	646,600	764,362	1,072,395	864,857
Estonia	Import	18,033	19,250	16,975	30,152
	Export	5	23	4,435	2,180
Ireland	Import	368,166	316,037	447,133	797,830
	Export	4,344	32,582	3,500	8,306
Greece	Import	363,885	428,763	238,363	396,605
	Export	18,417	31,318	88,748	60,752
Spain	Import	3,955,005	4,824,485	6,094,528	5,523,687
	Export	187,070	114,948	163,135	106,892
France	Import	348,191	481,643	429,312	535,338
	Export	6,609,262	6,246,519	6,294,289	6,278,304
Croatia	Import	22,646	35,316	28,173	23,245
	Export	179,484	165,114	106,495	115,795
Italy	Import	2,219,022	2,702,734	2,653,855	3,946,648
	Export	143,292	132,892	68,240	38,981
Cyprus	Import	180,379	187,394	190,628	167,416
	Export	0	0	0	2,707
Latvia	Import	6,467	10,420	19,746	30,589
	Export	107	824	1,830	9,459
Lithuania	Import	27,591	88,170	84,815	149,261
	Export	9,483	18,637	16,645	28,373
Luxembourg	Import	6,190	8,046	9,198	11,053

	Export	939	1,200	1,914	1,245
Hungary	Import	96,206	101,606	146,683	131,639
	Export	3,910,699	3,643,766	4,362,074	2,154,853
Malta	Import	47,812	41,210	43,829	52,745
	Export	0	0	0	0
Netherlands	Import	2,911,583	3,482,563	4,030,812	4,263,147
	Export	136,980	247,945	386,814	436,844
Austria	Import	617,336	805,721	621,494	920,828
	Export	320,416	361,133	536,644	405,750
Poland	Import	285,290	477,964	495,405	284,055
	Export	158,485	306,445	1,047,764	885,486
Portugal	Import	1,411,143	1,601,974	1,682,169	1,645,497
	Export	23,763	33,073	31,489	27,518
Romania	Import	430,549	373,881	698,580	284,166
	Export	2,054,489	2,310,666	2,273,741	3,233,351
Slovenia	Import	200,713	211,808	117,634	62,633
	Export	259,230	320,608	411,726	329,103
Slovakia	Import	247,001	265,407	201,770	237,020
	Export	167,130	176,155	140,239	135,037
Finland	Import	177	220	1,618	2,457
	Export	0	0	1	0
Sweden	Import	14,546	18,051	22,783	18,531
	Export	360	281	208	81
United Kingdom	Import	963,116	963,458	1,282,377	2,061,883
	Export	24,009	35,125	40,010	138,096

Table 14 Tonnes of processed maize per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	1,333,404	1,662,760	1,962,506	1,978,771	1,333,404	1,978,771	1,734,360
Bulgaria	1,513,752	1,358,184	984,409	664,548	664,548	1,513,752	1,130,223
Czech Republic	453,727	748,428	533,437	448,238	448,238	748,428	545,958
Denmark	93,916	82,819	184,499	299,569	82,819	299,569	165,201
Germany	5,445,807	6,320,801	6,657,679	5,656,163	5,445,807	6,657,679	6,020,113
Estonia	18,028	19,227	12,540	27,972	12,540	27,972	19,442
Ireland	363,822	283,455	443,633	789,524	283,455	789,524	470,109
Greece	2,063,928	2,563,235	2,159,405	2,470,103	2,063,928	2,563,235	2,314,168
Spain	7,080,685	8,909,467	10,192,803	10,305,255	7,080,685	10,305,255	9,122,053
France	7,873,849	10,149,244	9,749,143	9,288,174	7,873,849	10,149,244	9,265,103
Croatia	1,910,982	1,603,862	1,219,268	1,781,820	1,219,268	1,910,982	1,628,983
Italy	10,684,180	12,322,432	10,474,285	11,807,287	10,474,285	12,322,432	11,322,046
Cyprus	180,379	187,394	190,628	164,709	164,709	190,628	180,778
Latvia	6,360	9,596	17,916	21,130	6,360	21,130	13,751
Lithuania	65,608	141,433	146,970	248,088	65,608	248,088	150,525
Luxembourg	8,371	9,176	8,904	11,978	8,371	11,978	9,607
Hungary	3,170,377	4,450,280	547,319	4,733,226	547,319	4,733,226	3,225,301
Malta	47,812	41,210	43,829	52,745	41,210	52,745	46,399
Netherlands	3,045,603	3,513,618	3,897,998	4,079,303	3,045,603	4,079,303	3,634,131
Austria	2,252,910	2,897,718	2,436,220	2,154,098	2,154,098	2,897,718	2,435,237
Poland	2,121,205	2,563,619	3,443,541	3,438,269	2,121,205	3,443,541	2,891,659
Portugal	2,013,600	2,379,171	2,499,350	2,547,519	2,013,600	2,547,519	2,359,910
Romania	7,418,090	9,780,805	4,378,189	8,355,915	4,378,189	9,780,805	7,483,250
Slovenia	252,603	240,230	240,230	240,230	240,230	252,603	246,417
Slovakia	1,001,181	1,533,652	1,231,881	1,225,293	1,001,181	1,533,652	1,248,002
Finland	177	220	1,617	2,457	177	2,457	1,118
Sweden	21,686	33,770	37,175	25,850	21,686	37,175	29,620
United Kingdom	939,107	928,333	1,313,017	2,008,647	928,333	2,008,647	1,297,276

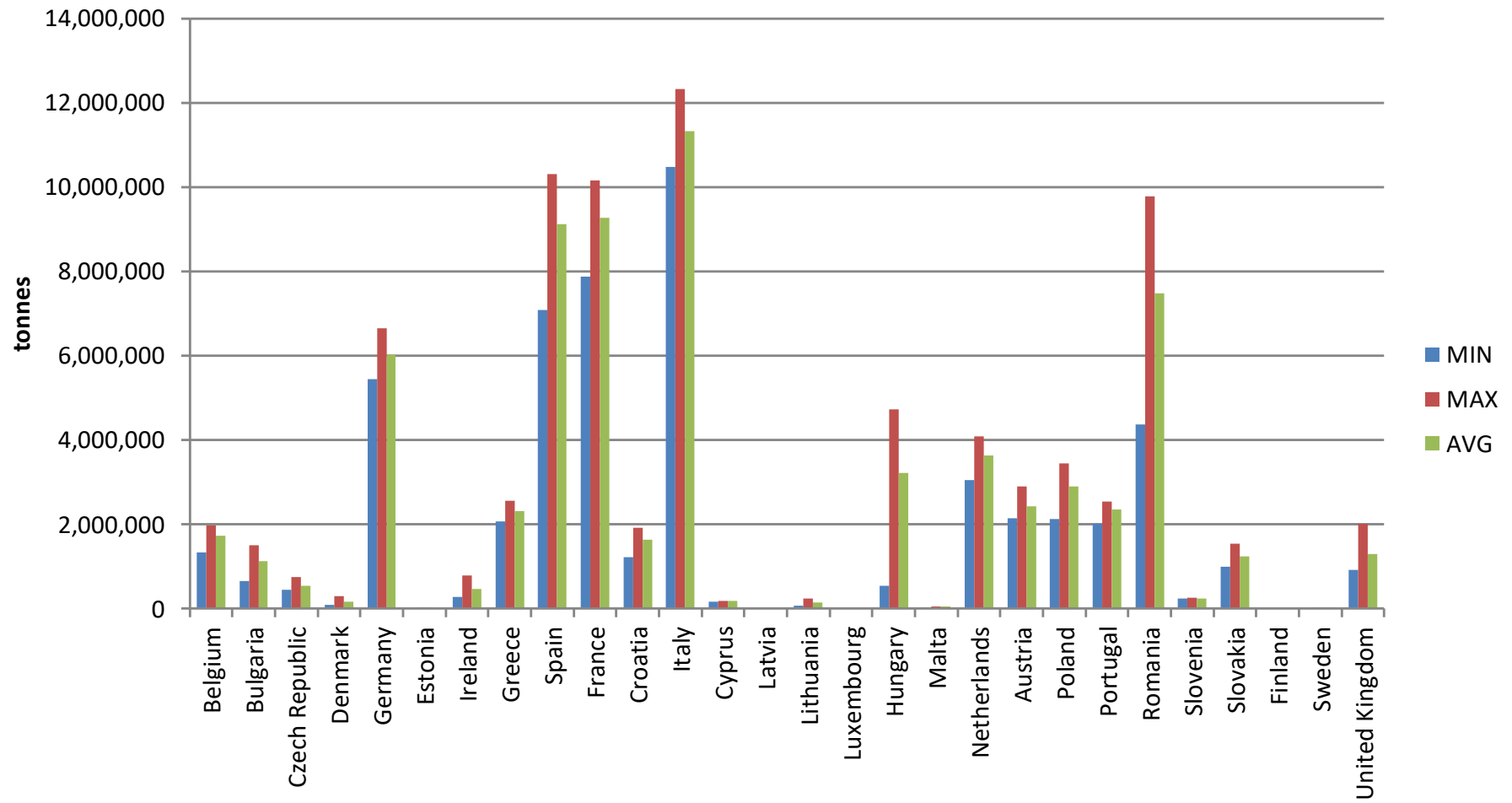


Figure 18 Tonnes of processed maize per country, 2010-2013

Table 15 Tonnes of maize bran per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	173,343	216,159	255,126	257,240	173,343	257,240	225,467
Bulgaria	196,788	176,564	127,973	86,391	86,391	196,788	146,929
Czech Republic	58,985	97,296	69,347	58,271	58,271	97,296	70,974
Denmark	12,209	10,766	23,985	38,944	10,766	38,944	21,476
Germany	707,955	821,704	865,498	735,301	707,955	865,498	782,615
Estonia	2,344	2,500	1,630	3,636	1,630	3,636	2,527
Ireland	47,297	36,849	57,672	102,638	36,849	102,638	61,114
Greece	268,311	333,221	280,723	321,113	268,311	333,221	300,842
Spain	920,489	1,158,231	1,325,064	1,339,683	920,489	1,339,683	1,185,867
France	1,023,600	1,319,402	1,267,389	1,207,463	1,023,600	1,319,402	1,204,463
Croatia	248,428	208,502	158,505	231,637	158,505	248,428	211,768
Italy	1,388,943	1,601,916	1,361,657	1,534,947	1,361,657	1,601,916	1,471,866
Cyprus	23,449	24,361	24,782	21,412	21,412	24,782	23,501
Latvia	827	1,247	2,329	2,747	827	2,747	1,788
Lithuania	8,529	18,386	19,106	32,251	8,529	32,251	19,568
Luxembourg	1,088	1,193	1,158	1,557	1,088	1,557	1,249
Hungary	412,149	578,536	71,151	615,319	71,151	615,319	419,289
Malta	6,216	5,357	5,698	6,857	5,357	6,857	6,032
Netherlands	395,928	456,770	506,740	530,309	395,928	530,309	472,437
Austria	292,878	376,703	316,709	280,033	280,033	376,703	316,581
Poland	275,757	333,270	447,660	446,975	275,757	447,660	375,916
Portugal	261,768	309,292	324,916	331,177	261,768	331,177	306,788
Romania	964,352	1,271,505	569,165	1,086,269	569,165	1,271,505	972,822
Slovenia	32,838	31,230	31,230	31,230	31,230	32,838	32,034
Slovakia	130,154	199,375	160,145	159,288	130,154	199,375	162,240
Finland	23	29	210	319	23	319	145
Sweden	2,819	4,390	4,833	3,361	2,819	4,833	3,851
United Kingdom	122,084	120,683	170,692	261,124	120,683	261,124	168,646

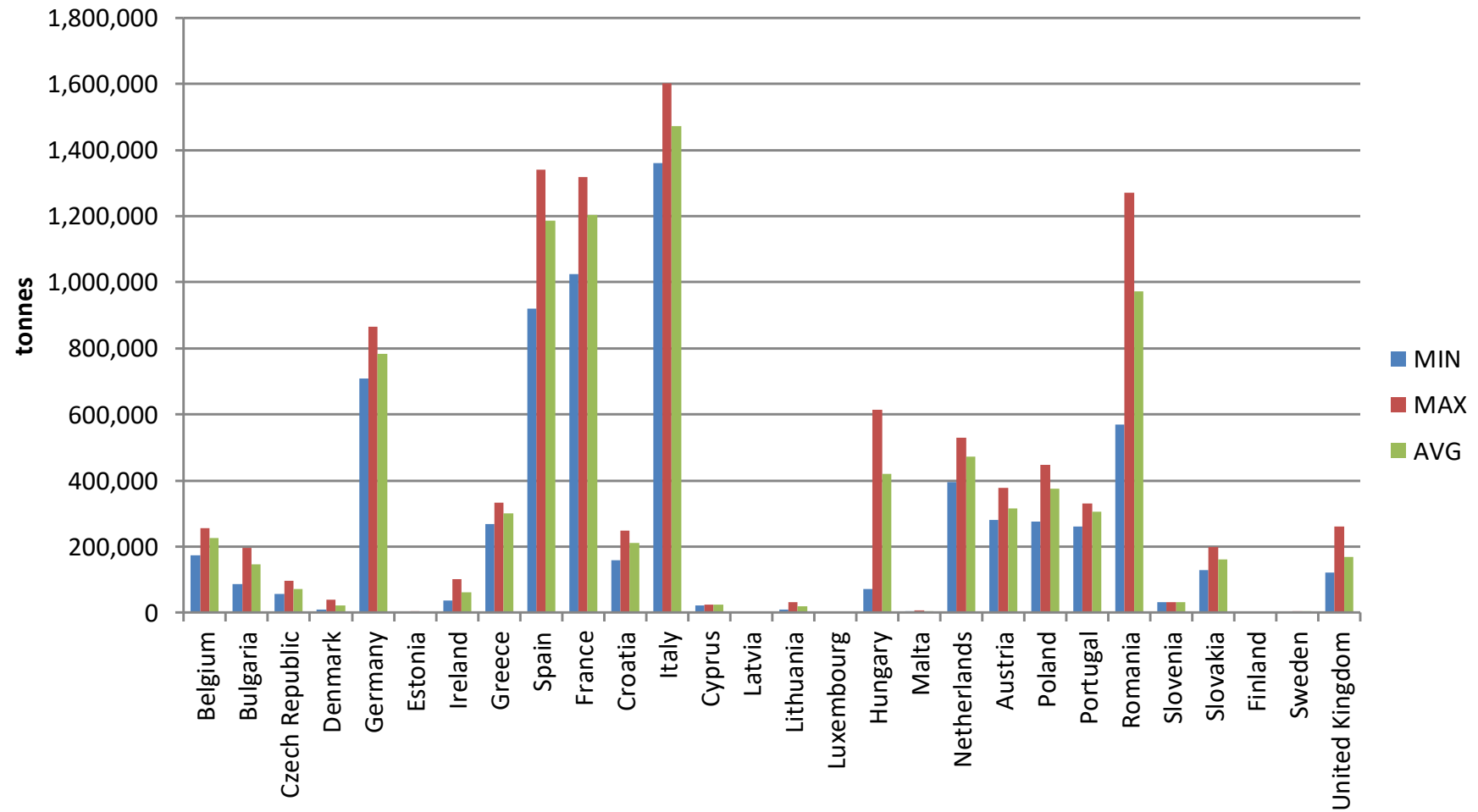


Figure 19 Tonnes of maize bran per country, 2010-2013

2.3 Triticale

Triticale is a hybrid of wheat and rye (37). It is created to have a grain quality of wheat, and disease tolerance of rye. Triticale is mostly cultivated for fodder or forage, but at the same time, it is used for the production of breakfast cereals. The largest triticale producers in Europe are Poland, Germany, and France. Figure 20 presents the grains of wheat, rye and triticale, respectively.



Figure 20 Grains of wheat, rye and triticale

During the harvesting of triticale, a mass of straw is left on the field, between 1.40 and 4.00 times the mass of the harvested triticale. Processed triticale can be used for the production of flour or the production of ethanol.

Flowchart in Figure 21 presents AWCB value chain for triticale and specific AWCB weight factors from Table 2.

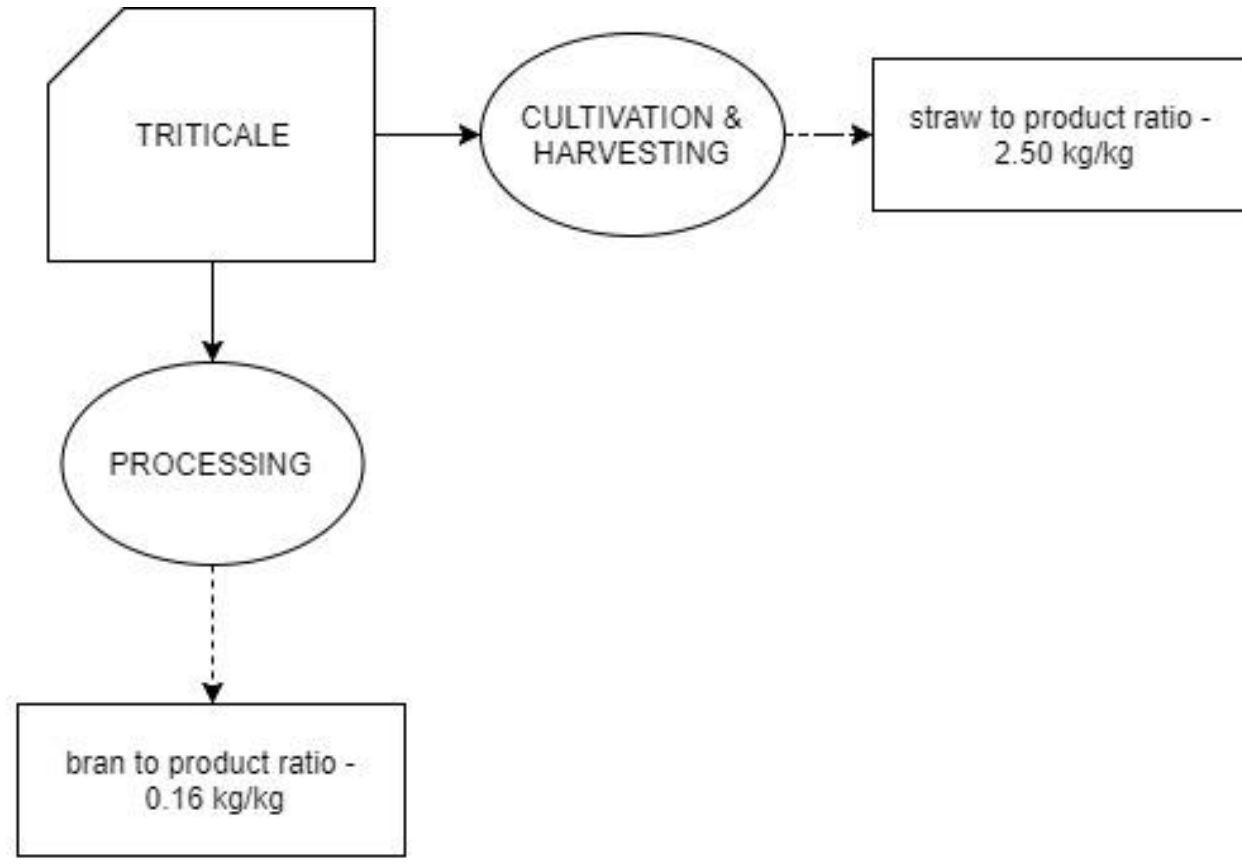


Figure 21 Triticale AWCB value chain

Data for cultivated triticale is taken from EUROSTAT, and data for imported and exported triticale is taken from FAOSTAT. By using relation (I-IX), the amount of processed triticale is calculated for every country in each year. Then the amount of AWCB is calculated for every step and every year. An example of the calculations for Sweden in 2010:

PRD = 158,700 tonnes

IMP = 54,157 tonnes

EXP = 1,591 tonnes

PRC = $(158,700 + 54,157 - 1,591) = 211,266$ tonnes

Using the average mass of straw per 1 kg of harvested triticale (2.50 kg) calculated the quantity of straw for Sweden was 396,750 tonnes in 2010. Also, in Sweden triticale processing facilities 33,803 tonnes of bran occurred in 2010. Results for other countries and years are presented in the tables and figures below.

Table 16 Tonnes of harvested triticale per country, 2010-2015 (32)

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	43,800	29,540	41,600	43,100	39,770	40,540	29,540	43,800	39,725
Bulgaria	29,440	26,520	26,500	38,810	60,360	38,400	26,500	60,360	36,672
Czech Republic	171,200	196,920	190,370	214,210	243,890	202,650	171,200	243,890	203,207
Denmark	177,400	138,000	114,600	74,400	95,900	82,000	74,400	177,400	113,717
Germany	2,156,960	2,004,300	2,294,800	2,609,000	2,972,200	2,598,300	2,004,300	2,972,200	2,439,260
Estonia	9,000	13,600	24,800	8,800	25,200	35,100	8,800	35,100	19,417
Ireland	0	0	0	0	0	0	0	0	0
Greece	9,630	11,870	12,050	19,820	43,010	43,460	9,630	43,460	23,307
Spain	144,990	207,220	217,310	394,750	449,670	440,310	144,990	449,670	309,042
France	2,060,660	1,987,370	2,301,260	2,031,990	2,022,510	1,863,610	1,863,610	2,301,260	2,044,567
Croatia	33,560	35,150	54,360	47,860	61,320	42,000	33,560	61,320	45,708
Italy	0	0	0	0	0	0	0	0	0
Cyprus	0	0	0	0	0	0	0	0	0
Latvia	26,400	21,400	48,800	36,600	26,900	41,200	21,400	48,800	33,550
Lithuania	258,400	237,000	434,800	453,800	395,200	468,500	237,000	468,500	374,617
Luxembourg	25,520	22,300	23,420	25,750	30,070	27,370	22,300	30,070	25,738
Hungary	366,820	345,730	345,090	459,050	486,450	509,550	345,090	509,550	418,782
Malta	0	0	0	0	0	0	0	0	0
Netherlands	14,000	10,000	12,000	10,000	9,000	6,840	6,840	14,000	10,307
Austria	230,520	228,070	220,100	224,140	302,600	284,130	220,100	302,600	248,260
Poland	4,575,800	4,235,300	3,349,200	4,273,000	5,246,600	5,339,400	3,349,200	5,339,400	4,503,217
Portugal	25,870	23,490	17,020	46,910	47,160	38,480	17,020	47,160	33,155
Romania	123,120	144,800	133,930	245,030	275,220	262,140	123,120	275,220	197,373
Slovenia	14,070	14,770	15,920	12,640	20,060	20,930	12,640	20,930	16,398
Slovakia	24,750	33,400	33,640	39,490	49,390	39,040	24,750	49,390	36,618
Finland	0	0	0	0	0	0	0	0	0
Sweden	158,700	107,200	140,400	111,700	226,400	243,800	107,200	243,800	164,700
United Kingdom	70,000	60,000	49,000	45,000	46,000	43,000	43,000	70,000	52,167

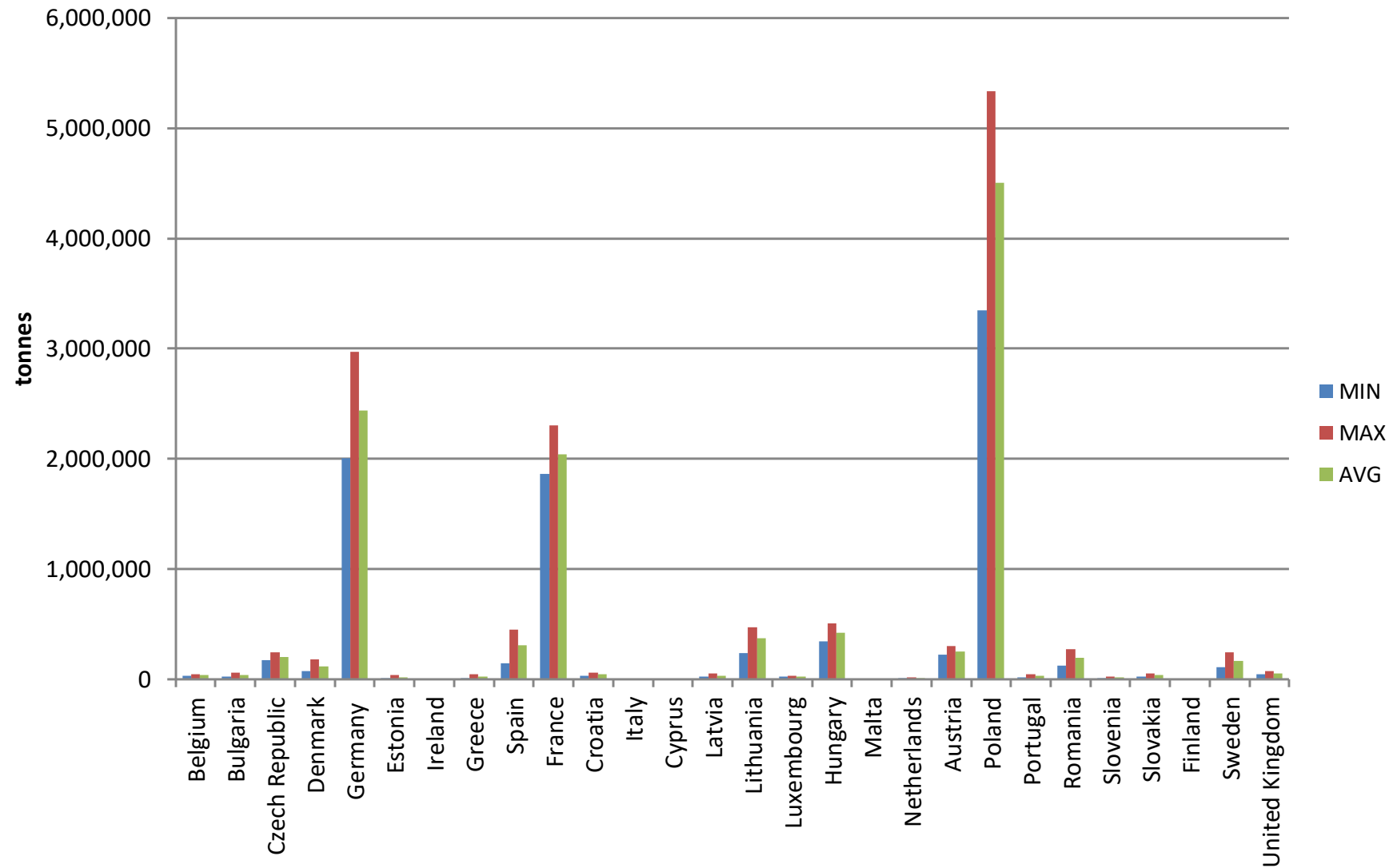


Figure 22 Tonnes of harvested triticale per country, 2010-2015

Table 17 Tonnes of triticale straw per country, 2010-2015

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	109,500	73,850	104,000	107,750	99,425	101,350	73,850	109,500	99,313
Bulgaria	73,600	66,300	66,250	97,025	150,900	96,000	66,250	150,900	91,679
Czech Republic	428,000	492,300	475,925	535,525	609,725	506,625	428,000	609,725	508,017
Denmark	443,500	345,000	286,500	186,000	239,750	205,000	186,000	443,500	284,292
Germany	5,392,400	5,010,750	5,737,000	6,522,500	7,430,500	6,495,750	5,010,750	7,430,500	6,098,150
Estonia	22,500	34,000	62,000	22,000	63,000	87,750	22,000	87,750	48,542
Ireland	0	0	0	0	0	0	0	0	0
Greece	24,075	29,675	30,125	49,550	107,525	108,650	24,075	108,650	58,267
Spain	362,475	518,050	543,275	986,875	1,124,175	1,100,775	362,475	1,124,175	772,604
France	5,151,650	4,968,425	5,753,150	5,079,975	5,056,275	4,659,025	4,659,025	5,753,150	5,111,417
Croatia	83,900	87,875	135,900	119,650	153,300	105,000	83,900	153,300	114,271
Italy	0	0	0	0	0	0	0	0	0
Cyprus	0	0	0	0	0	0	0	0	0
Latvia	66,000	53,500	122,000	91,500	67,250	103,000	53,500	122,000	83,875
Lithuania	646,000	592,500	1,087,000	1,134,500	988,000	1,171,250	592,500	1,171,250	936,542
Luxembourg	63,800	55,750	58,550	64,375	75,175	68,425	55,750	75,175	64,346
Hungary	917,050	864,325	862,725	1,147,625	1,216,125	1,273,875	862,725	1,273,875	1,046,954
Malta	0	0	0	0	0	0	0	0	0
Netherlands	35,000	25,000	30,000	25,000	22,500	17,100	17,100	35,000	25,767
Austria	576,300	570,175	550,250	560,350	756,500	710,325	550,250	756,500	620,650
Poland	11,439,500	10,588,250	8,373,000	10,682,500	13,116,500	13,348,500	8,373,000	13,348,500	11,258,042
Portugal	64,675	58,725	42,550	117,275	117,900	96,200	42,550	117,900	82,888
Romania	307,800	362,000	334,825	612,575	688,050	655,350	307,800	688,050	493,433
Slovenia	35,175	36,925	39,800	31,600	50,150	52,325	31,600	52,325	40,996
Slovakia	61,875	83,500	84,100	98,725	123,475	97,600	61,875	123,475	91,546
Finland	0	0	0	0	0	0	0	0	0
Sweden	396,750	268,000	351,000	279,250	566,000	609,500	268,000	609,500	411,750
United Kingdom	175,000	150,000	122,500	112,500	115,000	107,500	107,500	175,000	130,417

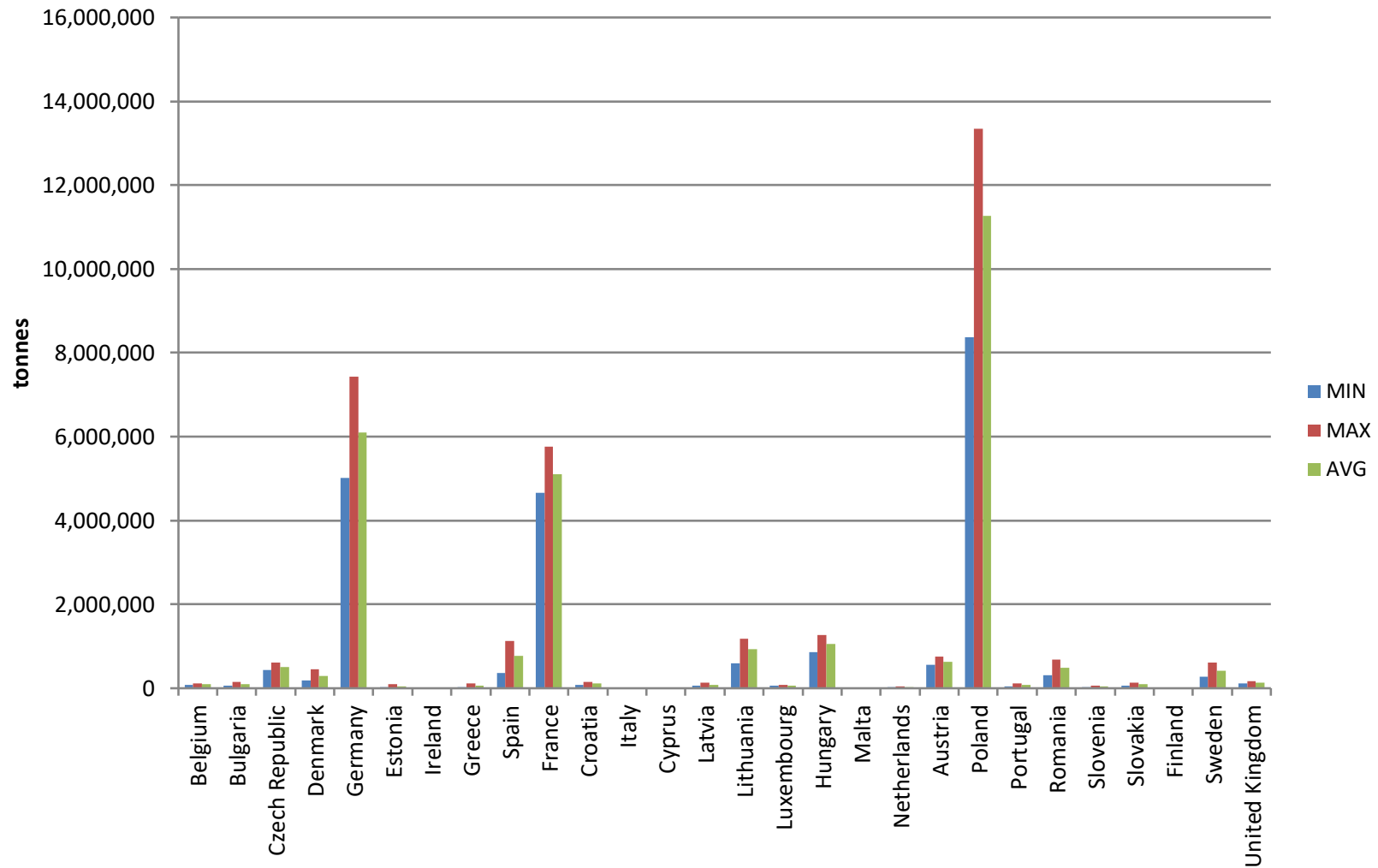


Figure 23 Tonnes of triticale straw per country, 2010-2015

Table 18 Tonnes of imported and exported triticale per country, 2010-2013 (5)

GEO/POPULATION	Trade	2010	2011	2012	2013
Belgium	Import	4,151	5,625	10,281	23,403
	Export	4,832	1,244	1,581	1,906
Bulgaria	Import	1,353	127	1,160	3,539
	Export	0	511	151	264
Czech Republic	Import	112	145	806	486
	Export	11,398	12,998	18,844	18,031
Denmark	Import	879	2,214	12,575	21,292
	Export	524	2,120	57	1,112
Germany	Import	147,002	107,265	153,399	166,694
	Export	138,140	93,328	121,193	158,827
Estonia	Import	120	157	247	2,316
	Export	262	59	2	149
Ireland	Import	170	279	32	0
	Export	94	0	0	0
Greece	Import	98	108	35	97
	Export	196	162	98	174
Spain	Import	11,478	2,763	11,551	9,292
	Export	997	1,098	1,281	2,457
France	Import	2,651	560	655	1,676
	Export	38,223	35,913	65,467	44,185
Croatia	Import	763	564	707	305
	Export	185	148	113	181
Italy	Import	18,100	12,675	39,244	55,406
	Export	325	367	491	672
Cyprus	Import	933	288	161	50
	Export	0	0	0	0
Latvia	Import	0	0	7,329	7,681
	Export	0	0	7,203	9,082
Lithuania	Import	371	204	48	3,849

	Export	57,833	22,511	150,483	193,662
Luxembourg	Import	2,147	4,322	2,934	4,369
	Export	6,534	5,970	7,990	3,317
Hungary	Import	186	321	1,017	788
	Export	11,732	8,165	16,460	18,177
Malta	Import	9	59	35	83
	Export	0	0	0	0
Netherlands	Import	191,124	101,855	67,166	119,329
	Export	10,641	18,040	3,536	37,934
Austria	Import	8,231	5,141	11,636	17,522
	Export	3,438	4,917	5,876	4,447
Poland	Import	3,974	6,451	8,707	4,232
	Export	211,381	103,367	90,718	186,611
Portugal	Import	208	453	283	370
	Export	2,767	2,268	1,148	1,531
Romania	Import	1,907	186	940	357
	Export	436	2,525	11,223	20,341
Slovenia	Import	3,501	4,038	2,960	4,488
	Export	293	256	361	603
Slovakia	Import	60	371	32	66
	Export	456	303	1,727	916
Finland	Import	0	4	0	0
	Export	0	0	0	0
Sweden	Import	54,157	12,953	31,977	125,419
	Export	1,591	67	53	17
United Kingdom	Import	20	79	26	105
	Export	43	114	68	16

Table 19 Tonnes of processed triticale per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	43,119	33,921	50,300	64,597	33,921	64,597	47,984
Bulgaria	30,793	26,136	27,509	42,085	26,136	42,085	31,631
Czech Republic	159,914	184,067	172,332	196,665	159,914	196,665	178,245
Denmark	177,755	138,094	127,118	94,580	94,580	177,755	134,387
Germany	2,165,822	2,018,237	2,327,006	2,616,867	2,018,237	2,616,867	2,281,983
Estonia	8,858	13,698	25,045	10,967	8,858	25,045	14,642
Ireland	76	279	32	0	0	279	97
Greece	9,532	11,816	11,987	19,743	9,532	19,743	13,270
Spain	155,471	208,885	227,580	401,585	155,471	401,585	248,380
France	2,025,088	1,952,017	2,236,448	1,989,481	1,952,017	2,236,448	2,050,759
Croatia	34,138	35,566	54,954	47,984	34,138	54,954	43,161
Italy	17,775	12,308	38,753	54,734	12,308	54,734	30,893
Cyprus	933	288	161	50	50	933	358
Latvia	26,400	21,400	48,926	35,199	21,400	48,926	32,981
Lithuania	200,938	214,693	284,365	263,987	200,938	284,365	240,996
Luxembourg	21,133	20,652	18,364	26,802	18,364	26,802	21,738
Hungary	355,274	337,886	329,647	441,661	329,647	441,661	366,117
Malta	9	59	35	83	9	83	47
Netherlands	194,483	93,815	75,630	91,395	75,630	194,483	113,831
Austria	235,313	228,294	225,860	237,215	225,860	237,215	231,671
Poland	4,368,393	4,138,384	3,267,189	4,090,621	3,267,189	4,368,393	3,966,147
Portugal	23,311	21,675	16,155	45,749	16,155	45,749	26,723
Romania	124,591	142,461	123,647	225,046	123,647	225,046	153,936
Slovenia	17,278	18,552	18,519	16,525	16,525	18,552	17,719
Slovakia	24,354	33,468	31,945	38,640	24,354	38,640	32,102
Finland	0	4	0	0	0	4	1
Sweden	211,266	120,086	172,324	237,102	120,086	237,102	185,195
United Kingdom	69,977	59,965	48,958	45,089	45,089	69,977	55,997

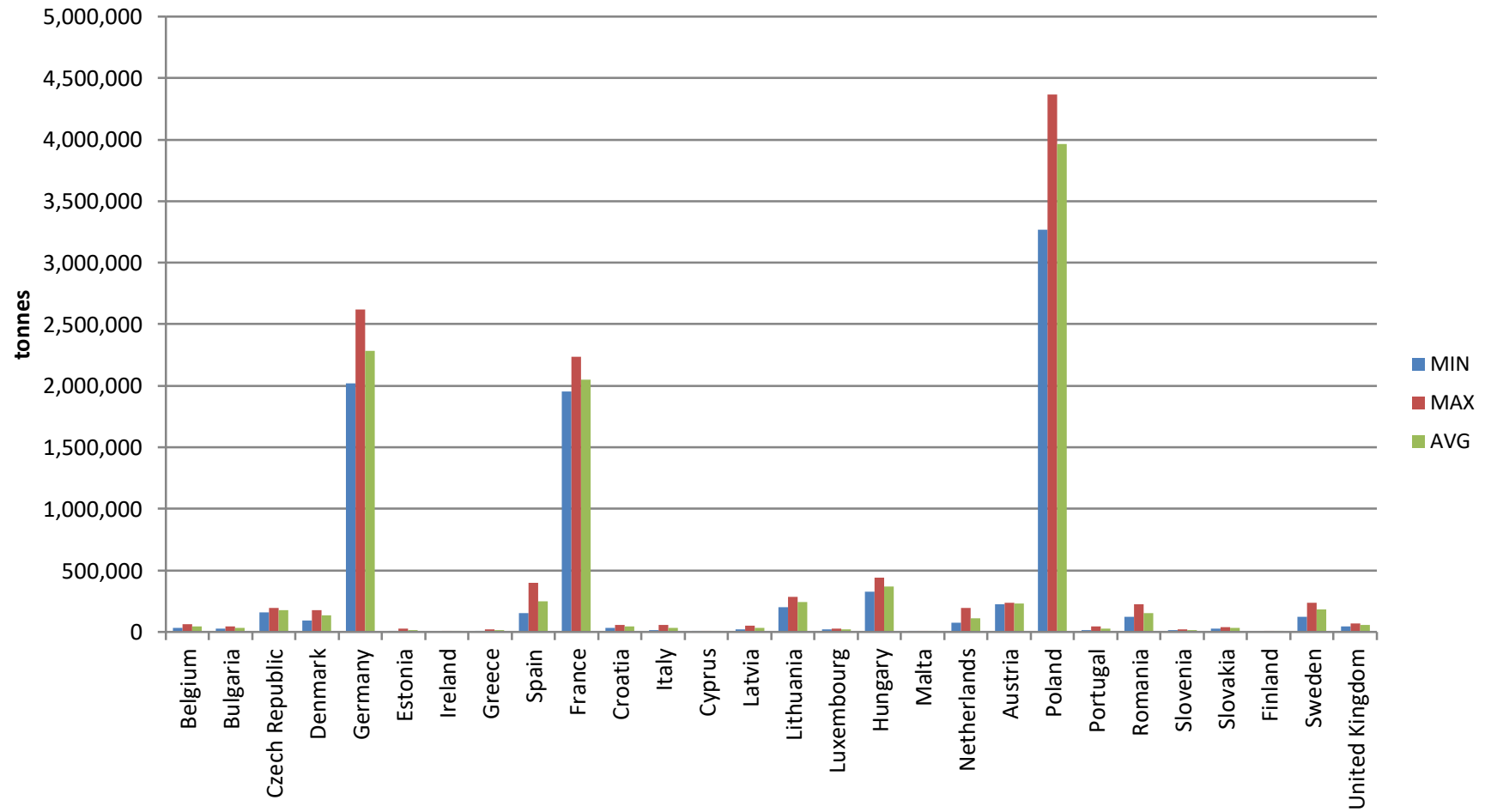


Figure 24 Tonnes of processed triticale per country, 2010-2013

Table 20 Tonnes of triticale bran per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	6,899	5,427	8,048	10,336	5,427	10,336	7,677
Bulgaria	4,927	4,182	4,401	6,734	4,182	6,734	5,061
Czech Republic	25,586	29,451	27,573	31,466	25,586	31,466	28,519
Denmark	28,441	22,095	20,339	15,133	15,133	28,441	21,502
Germany	346,532	322,918	372,321	418,699	322,918	418,699	365,117
Estonia	1,417	2,192	4,007	1,755	1,417	4,007	2,343
Ireland	12	45	5	0	0	45	15
Greece	1,525	1,891	1,918	3,159	1,525	3,159	2,123
Spain	24,875	33,422	36,413	64,254	24,875	64,254	39,741
France	324,014	312,323	357,832	318,317	312,323	357,832	328,121
Croatia	5,462	5,691	8,793	7,677	5,462	8,793	6,906
Italy	2,844	1,969	6,200	8,757	1,969	8,757	4,943
Cyprus	149	46	26	8	8	149	57
Latvia	4,224	3,424	7,828	5,632	3,424	7,828	5,277
Lithuania	32,150	34,351	45,498	42,238	32,150	45,498	38,559
Luxembourg	3,381	3,304	2,938	4,288	2,938	4,288	3,478
Hungary	56,844	54,062	52,744	70,666	52,744	70,666	58,579
Malta	1	9	6	13	1	13	7
Netherlands	31,117	15,010	12,101	14,623	12,101	31,117	18,213
Austria	37,650	36,527	36,138	37,954	36,138	37,954	37,067
Poland	698,943	662,141	522,750	654,499	522,750	698,943	634,583
Portugal	3,730	3,468	2,585	7,320	2,585	7,320	4,276
Romania	19,935	22,794	19,784	36,007	19,784	36,007	24,630
Slovenia	2,764	2,968	2,963	2,644	2,644	2,968	2,835
Slovakia	3,897	5,355	5,111	6,182	3,897	6,182	5,136
Finland	0	0	0	0	0	0	0
Sweden	33,803	19,214	27,572	37,936	19,214	37,936	29,631
United Kingdom	11,196	9,594	7,833	7,214	7,214	11,196	8,960

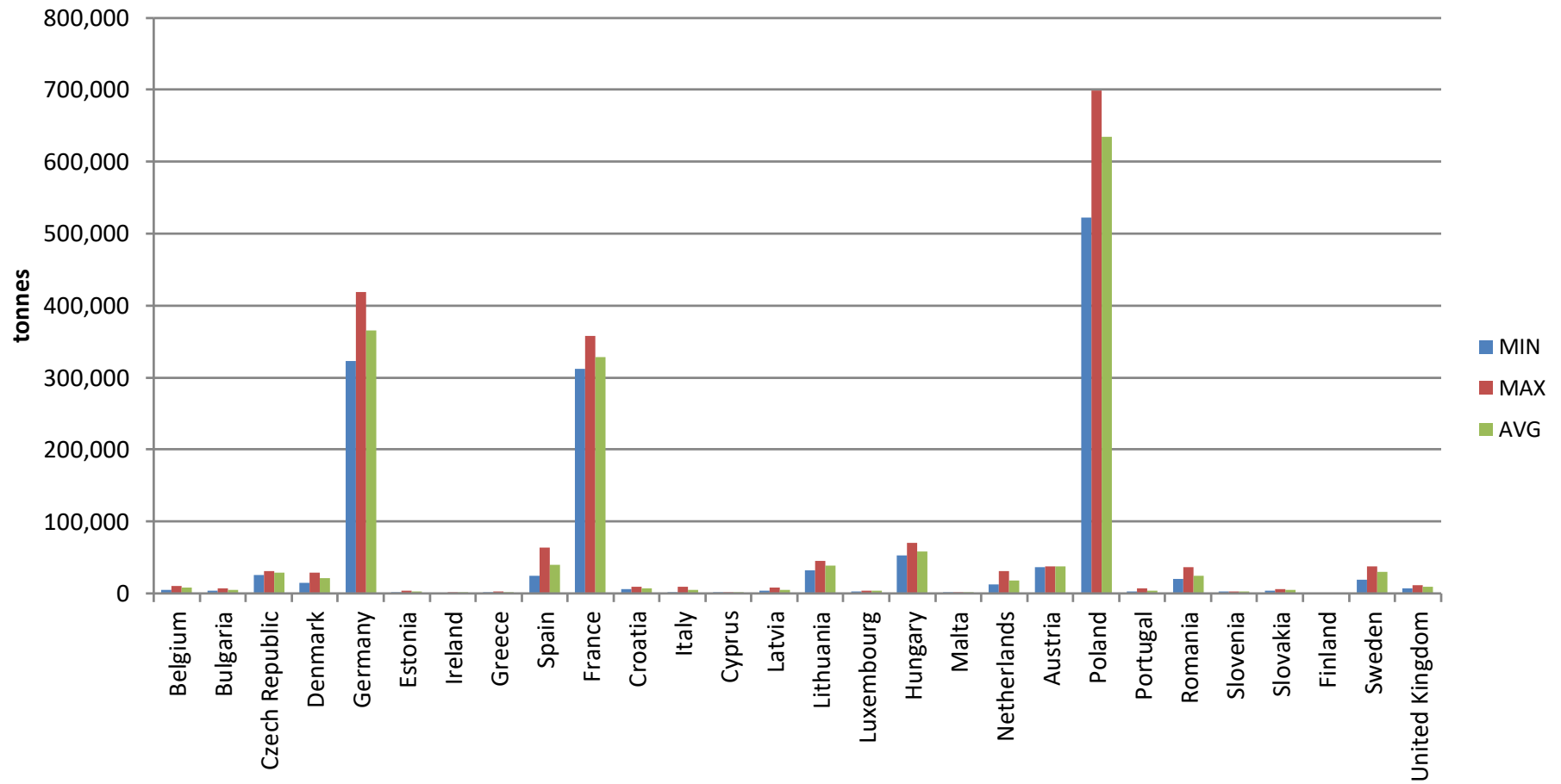


Figure 25 Tonnes of triticale bran per country, 2010-2013

2.4 Oats

Oats are a cereal that is mostly used as a livestock feed (38). They are best cultivated in temperate regions, with higher tolerance to rain than other cereals. Oats are an annual plant, and similar to barley they can be planted either in autumn or in the spring. Figure 26 shows an oat field (39)



Figure 26 Oats field (39)

The top oat producer in Europe is Poland, followed by Finland and Spain. During harvesting, the main AWCB is straw, where per 1 kg of harvested oat, 0.75-2.00 kg of straw occurs. In processing, the main AWCB are bran (0.15 kg per kg of harvested oat) and hulls (0.25-0.32 kg per kg of harvested oat).

The flowchart (Figure 27) presents AWCB value chain for oats and specific AWCB weight factors from Table 2.

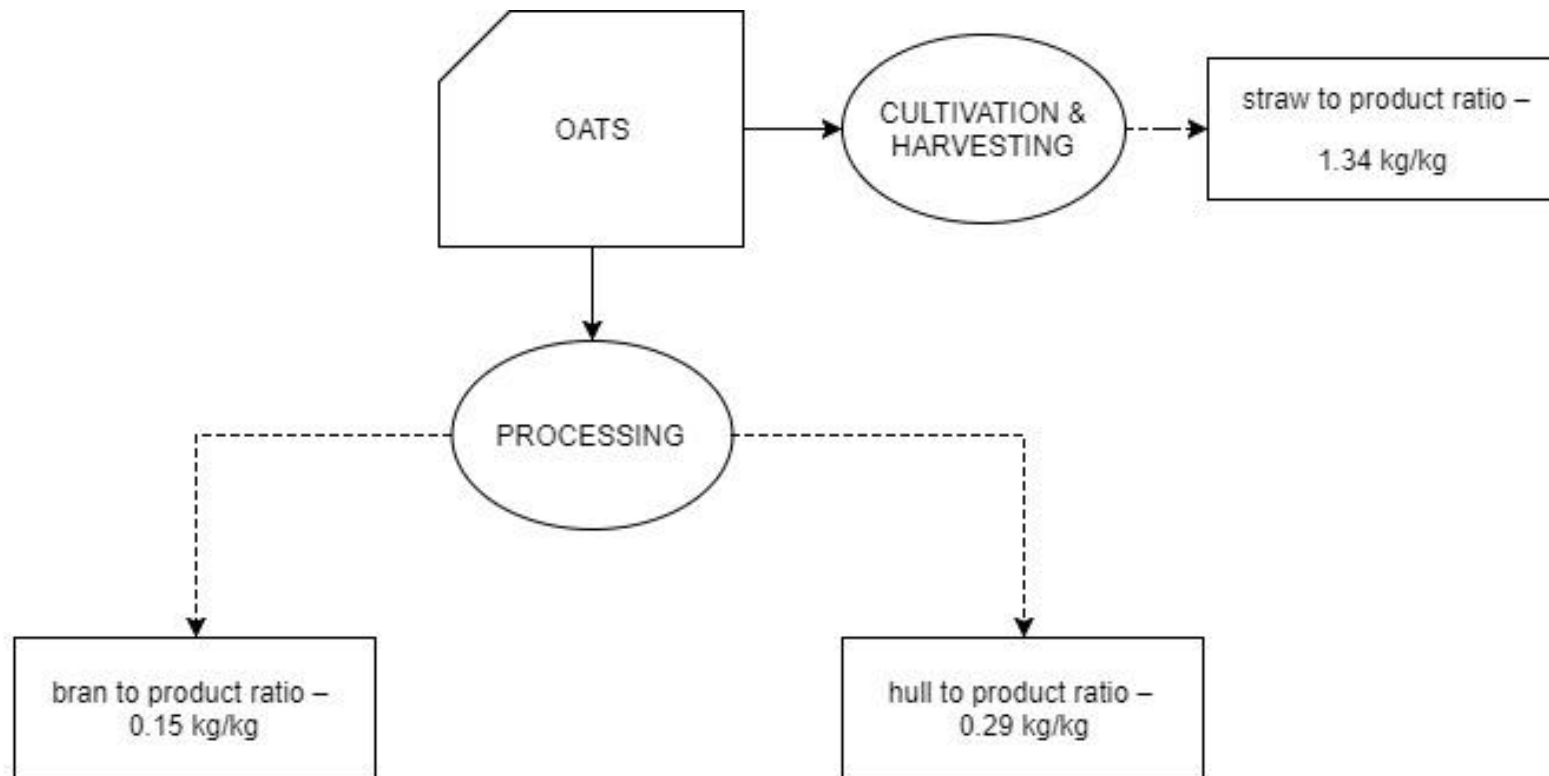


Figure 27 Oats AWCB value chain

Data for cultivated oats is taken from EUROSTAT, and data for imported and exported oats is taken from FAOSTAT. By using relation (I-IX), the amount of processed oats is calculated for every country in each year. Then the amount of AWCB is calculated for every step and every year. An example of the calculations for Latvia in 2010:

PRD = 100,600 tonnes

IMP = 2,913 tonnes

EXP = 21,376 tonnes

PRC = $(100,600 + 2,913 - 21,376) = 82,137$ tonnes

Using the average mass of straw per 1 kg of harvested triticale (1.34 kg) the calculated quantity of straw for Latvia was 134,804 tonnes in 2010. Also, in Latvian oats processing facilities 12,321 tonnes of bran and 23,820 tonnes of hull occurred in 2010. Results for other countries and years are presented in the tables and figures below.

Table 21 Tonnes of harvested oats per country, 2010-2015 (32)

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	24,800	17,700	17,600	22,700	17,650	22,230	17,600	24,800	20,447
Bulgaria	42,040	29,230	30,800	35,580	26,880	21,800	21,800	42,040	31,055
Czech Republic	138,240	164,250	171,980	139,120	152,230	154,580	138,240	171,980	153,400
Denmark	204,500	208,800	271,100	278,700	184,900	206,800	184,900	278,700	225,800
Germany	598,050	627,400	756,500	627,700	627,100	566,300	566,300	756,500	633,842
Estonia	54,500	62,800	78,400	85,300	65,000	67,800	54,500	85,300	68,967
Ireland	148,080	168,140	156,510	192,510	149,700	197,710	148,080	197,710	168,775
Greece	115,910	162,790	119,010	114,570	79,520	78,860	78,860	162,790	111,777
Spain	1,024,660	1,119,210	683,480	957,660	649,100	779,460	649,100	1,119,210	868,928
France	392,000	318,500	400,800	432,280	443,630	399,350	318,500	443,630	397,760
Croatia	48,190	77,220	94,540	60,180	56,560	63,000	48,190	94,540	66,615
Italy	279,180	266,650	292,360	246,920	241,140	258,430	241,140	292,360	264,113
Cyprus	780	740	800	740	200	600	200	800	643
Latvia	100,600	120,900	137,000	134,200	155,100	160,400	100,600	160,400	134,700
Lithuania	93,900	128,500	163,500	164,700	183,800	163,360	93,900	183,800	149,627
Luxembourg	4,790	4,040	4,750	5,540	5,480	5,880	4,040	5,880	5,080
Hungary	117,880	129,140	137,150	131,600	135,630	130,080	117,880	137,150	130,247
Malta	0	0	0	0	0	0	0	0	0
Netherlands	8,000	8,000	10,000	10,000	10,000	8,040	8,000	10,000	9,007
Austria	97,890	109,810	93,490	86,940	105,910	96,260	86,940	109,810	98,383
Poland	1,516,500	1,381,600	1,467,900	1,190,000	1,458,600	1,219,600	1,190,000	1,516,500	1,372,367
Portugal	66,150	48,260	30,510	62,630	67,440	48,970	30,510	67,440	53,993
Romania	304,460	375,860	339,000	373,780	381,630	344,220	304,460	381,630	353,158
Slovenia	5,170	5,820	4,350	3,110	4,450	5,020	3,110	5,820	4,653
Slovakia	24,630	36,000	33,720	30,630	38,730	46,790	24,630	46,790	35,083
Finland	809,700	1,043,100	1,073,100	1,196,400	1,039,000	980,000	809,700	1,196,400	1,023,550
Sweden	559,300	692,000	731,200	851,500	665,900	744,700	559,300	851,500	707,433
United Kingdom	685,000	613,000	627,000	964,000	820,000	799,000	613,000	964,000	751,333

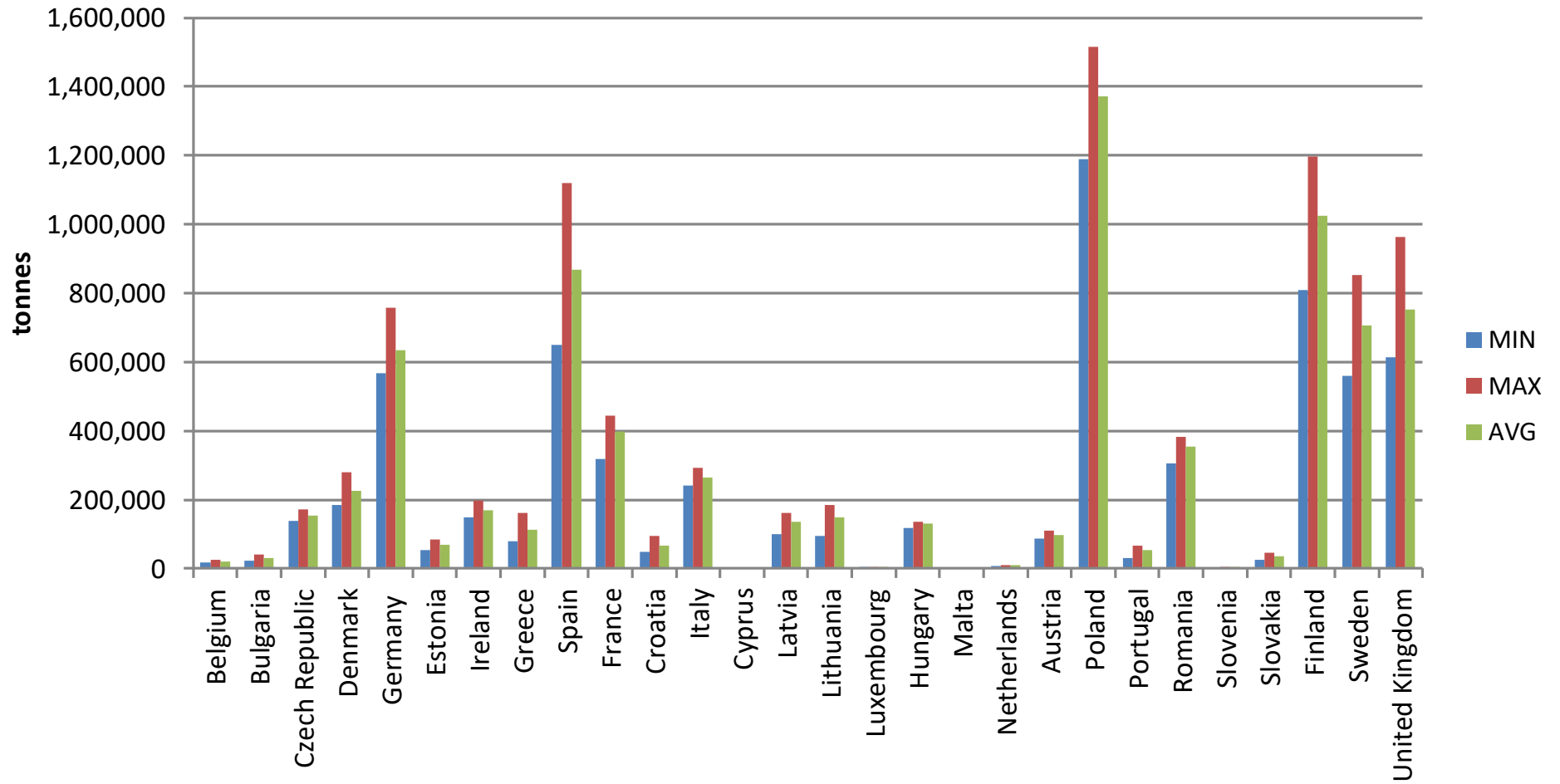


Figure 28 Tonnes of harvested oats per country, 2010-2015

Table 22 Tonnes of oats straw per country, 2010-2015

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	33,232	23,718	23,584	30,418	23,651	29,788	23,584	33,232	27,399
Bulgaria	56,334	39,168	41,272	47,677	36,019	29,212	29,212	56,334	41,614
Czech Republic	185,242	220,095	230,453	186,421	203,988	207,137	185,242	230,453	205,556
Denmark	274,030	279,792	363,274	373,458	247,766	277,112	247,766	373,458	302,572
Germany	801,387	840,716	1,013,710	841,118	840,314	758,842	758,842	1,013,710	849,348
Estonia	73,030	84,152	105,056	114,302	87,100	90,852	73,030	114,302	92,415
Ireland	198,427	225,308	209,723	257,963	200,598	264,931	198,427	264,931	226,159
Greece	155,319	218,139	159,473	153,524	106,557	105,672	105,672	218,139	149,781
Spain	1,373,044	1,499,741	915,863	1,283,264	869,794	1,044,476	869,794	1,499,741	1,164,364
France	525,280	426,790	537,072	579,255	594,464	535,129	426,790	594,464	532,998
Croatia	64,575	103,475	126,684	80,641	75,790	84,420	64,575	126,684	89,264
Italy	374,101	357,311	391,762	330,873	323,128	346,296	323,128	391,762	353,912
Cyprus	1,045	992	1,072	992	268	804	268	1,072	862
Latvia	134,804	162,006	183,580	179,828	207,834	214,936	134,804	214,936	180,498
Lithuania	125,826	172,190	219,090	220,698	246,292	218,902	125,826	246,292	200,500
Luxembourg	6,419	5,414	6,365	7,424	7,343	7,879	5,414	7,879	6,807
Hungary	157,959	173,048	183,781	176,344	181,744	174,307	157,959	183,781	174,531
Malta	0	0	0	0	0	0	0	0	0
Netherlands	10,720	10,720	13,400	13,400	13,400	10,774	10,720	13,400	12,069
Austria	131,173	147,145	125,277	116,500	141,919	128,988	116,500	147,145	131,834
Poland	2,032,110	1,851,344	1,966,986	1,594,600	1,954,524	1,634,264	1,594,600	2,032,110	1,838,971
Portugal	88,641	64,668	40,883	83,924	90,370	65,620	40,883	90,370	72,351
Romania	407,976	503,652	454,260	500,865	511,384	461,255	407,976	511,384	473,232
Slovenia	6,928	7,799	5,829	4,167	5,963	6,727	4,167	7,799	6,235
Slovakia	33,004	48,240	45,185	41,044	51,898	62,699	33,004	62,699	47,012
Finland	1,084,998	1,397,754	1,437,954	1,603,176	1,392,260	1,313,200	1,084,998	1,603,176	1,371,557
Sweden	749,462	927,280	979,808	1,141,010	892,306	997,898	749,462	1,141,010	947,961
United Kingdom	917,900	821,420	840,180	1,291,760	1,098,800	1,070,660	821,420	1,291,760	1,006,787

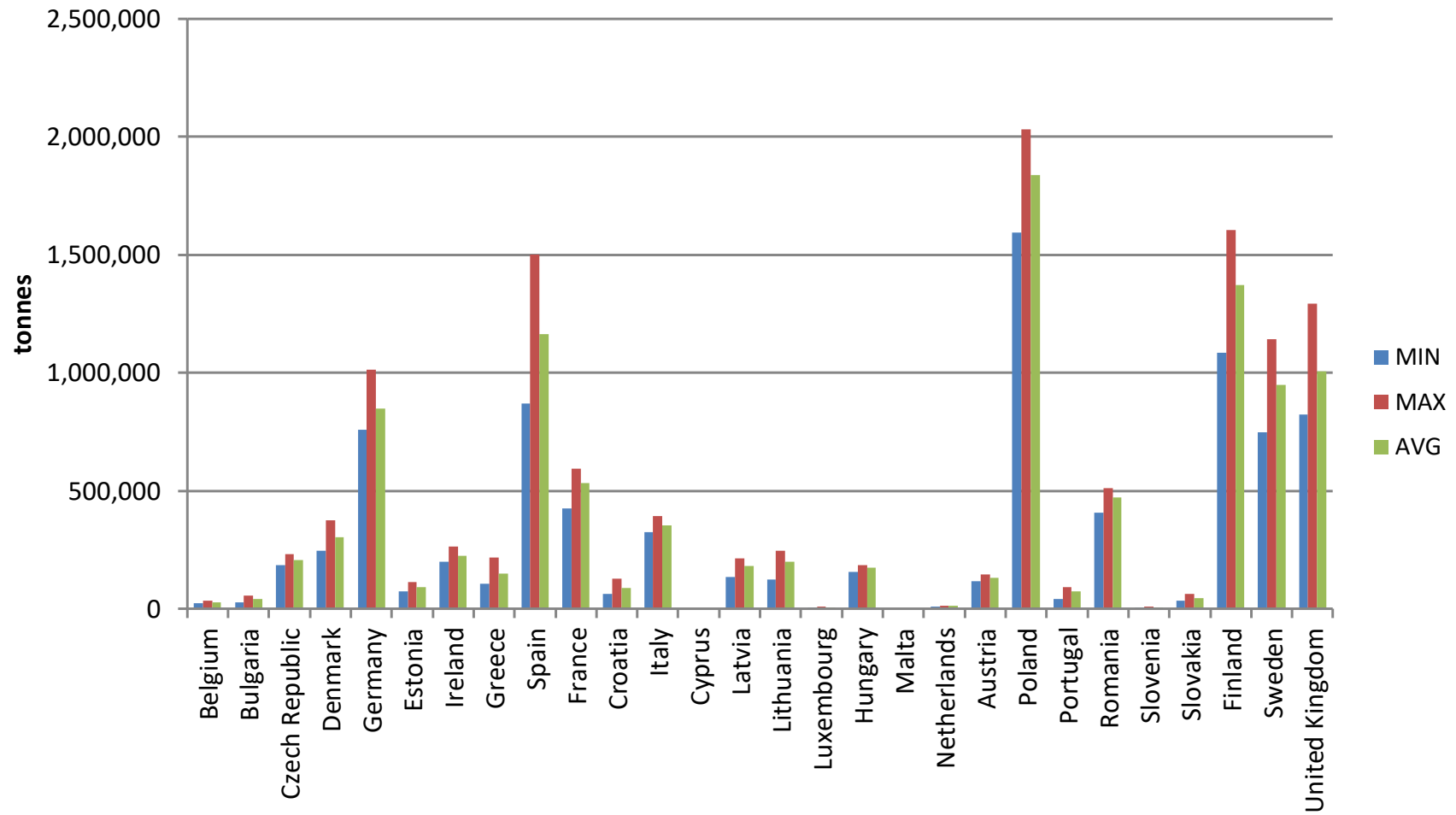


Figure 29 Tonnes of oats straw per country, 2010-2015

Table 23 Tonnes of imported and exported oats per country, 2010-2013 (5)

GEO/POPULATION	Trade	2010	2011	2012	2013
Belgium	Import	95,746	85,867	75,079	86,070
	Export	5,046	2,376	3,241	1,591
Bulgaria	Import	44	76	88	10
	Export	5,787	6,498	3,544	4,371
Czech Republic	Import	202	319	547	710
	Export	28,093	35,369	39,466	42,364
Denmark	Import	40,371	39,199	29,604	30,397
	Export	29,885	36,178	24,627	27,517
Germany	Import	259,668	301,292	282,575	316,155
	Export	30,555	39,415	36,568	45,800
Estonia	Import	1,321	1,475	7,372	1,042
	Export	15,037	14,473	28,113	30,270
Ireland	Import	1,943	928	595	748
	Export	19,170	60,575	44,099	21,320
Greece	Import	18,309	9,152	4,788	11,466
	Export	76	17	4	728
Spain	Import	111,366	68,339	132,429	74,377
	Export	34,513	52,306	18,159	26,210
France	Import	3,374	10,431	11,333	11,378
	Export	85,524	67,657	25,614	50,414
Croatia	Import	57	145	43	46
	Export	943	338	5,590	2,666
Italy	Import	44,067	45,100	32,051	24,295
	Export	6,463	4,993	9,822	12,857
Cyprus	Import	202	42	57	28
	Export	0	0	0	0
Latvia	Import	2,913	9,501	4,541	6,533
	Export	21,376	9,059	6,441	18,800
Lithuania	Import	285	593	1,114	1,068

	Export	10,543	10,516	13,825	22,758
Luxembourg	Import	1,678	1,960	2,711	416
	Export	2,272	1,187	1,734	1,932
Hungary	Import	20	169	799	1,111
	Export	5,712	4,921	5,041	4,587
Malta	Import	316	295	222	155
	Export	0	0	0	0
Netherlands	Import	42,404	46,546	39,339	55,871
	Export	18,506	29,133	24,703	19,499
Austria	Import	11,282	11,036	10,888	11,717
	Export	14,137	15,588	21,467	9,690
Poland	Import	4,432	5,740	4,450	14,743
	Export	45,047	25,476	47,490	61,150
Portugal	Import	13,005	15,562	13,473	23,566
	Export	553	161	313	97
Romania	Import	298	350	786	578
	Export	669	1,703	2,512	2,122
Slovenia	Import	2,790	2,611	4,716	2,133
	Export	89	312	886	305
Slovakia	Import	995	1,190	1,119	626
	Export	1,437	1,549	1,785	1,404
Finland	Import	91	633	4,131	2,667
	Export	320,306	320,687	371,012	326,702
Sweden	Import	893	17,668	13,946	3,874
	Export	102,398	143,805	212,936	189,333
United Kingdom	Import	19,435	33,720	63,915	66,100
	Export	73,156	23,313	11,451	16,956

Table 24 Tonnes of processed oats per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	115,500	101,191	89,438	107,179	89,438	115,500	103,327
Bulgaria	36,297	22,808	27,344	31,219	22,808	36,297	29,417
Czech Republic	110,349	129,200	133,061	97,466	97,466	133,061	117,519
Denmark	214,986	211,821	276,077	281,580	211,821	281,580	246,116
Germany	827,163	889,277	1,002,507	898,055	827,163	1,002,507	904,251
Estonia	40,784	49,802	57,659	56,072	40,784	57,659	51,079
Ireland	130,853	108,493	113,006	171,938	108,493	171,938	131,073
Greece	134,143	171,925	123,794	125,308	123,794	171,925	138,793
Spain	1,101,513	1,135,243	797,750	1,005,827	797,750	1,135,243	1,010,083
France	309,850	261,274	386,519	393,244	261,274	393,244	337,722
Croatia	47,304	77,027	88,993	57,560	47,304	88,993	67,721
Italy	316,784	306,757	314,589	258,358	258,358	316,784	299,122
Cyprus	982	782	857	768	768	982	847
Latvia	82,137	121,342	135,100	121,933	82,137	135,100	115,128
Lithuania	83,642	118,577	150,789	143,010	83,642	150,789	124,005
Luxembourg	4,196	4,813	5,727	4,024	4,024	5,727	4,690
Hungary	112,188	124,388	132,908	128,124	112,188	132,908	124,402
Malta	316	295	222	155	155	316	247
Netherlands	31,898	25,413	24,636	46,372	24,636	46,372	32,080
Austria	95,035	105,258	82,911	88,967	82,911	105,258	93,043
Poland	1,475,885	1,361,864	1,424,860	1,143,593	1,143,593	1,475,885	1,351,551
Portugal	78,602	63,661	43,670	86,099	43,670	86,099	68,008
Romania	304,089	374,507	337,274	372,236	304,089	374,507	347,027
Slovenia	7,871	8,119	8,180	4,938	4,938	8,180	7,277
Slovakia	24,188	35,641	33,054	29,852	24,188	35,641	30,684
Finland	489,485	723,046	706,219	872,365	489,485	872,365	697,779
Sweden	457,795	565,863	532,210	666,041	457,795	666,041	555,477
United Kingdom	631,279	623,407	679,464	1,013,144	623,407	1,013,144	736,824

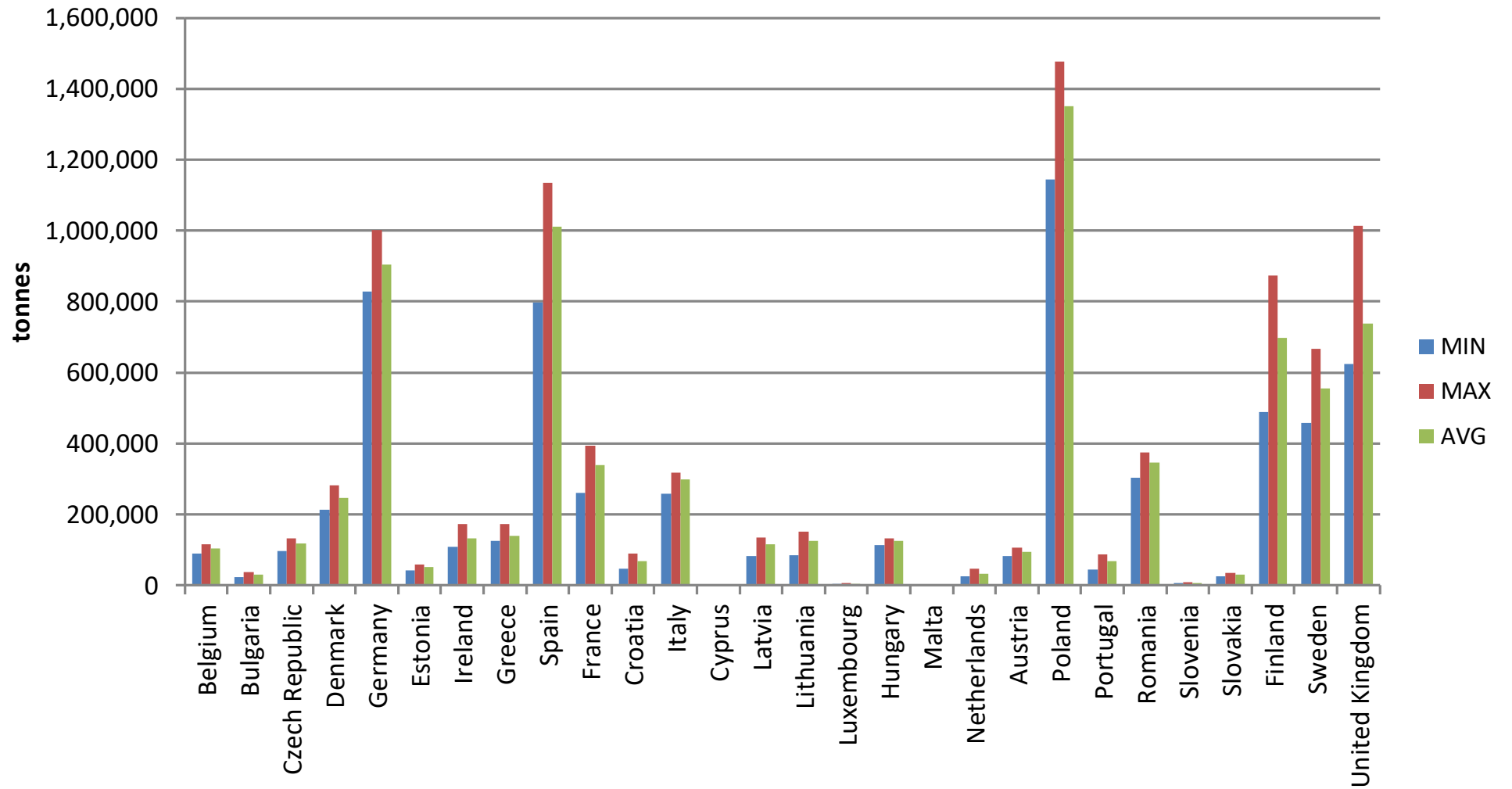


Figure 30 Tonnes of processed oats per country, 2010-2013

Table 25 Tonnes of oat bran per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	17,325	15,179	13,416	16,077	13,416	17,325	15,499
Bulgaria	5,445	3,421	4,102	4,683	3,421	5,445	4,413
Czech Republic	16,552	19,380	19,959	14,620	14,620	19,959	17,628
Denmark	32,248	31,773	41,412	42,237	31,773	42,237	36,917
Germany	124,074	133,392	150,376	134,708	124,074	150,376	135,638
Estonia	6,118	7,470	8,649	8,411	6,118	8,649	7,662
Ireland	19,628	16,274	16,951	25,791	16,274	25,791	19,661
Greece	20,121	25,789	18,569	18,796	18,569	25,789	20,819
Spain	165,227	170,286	119,663	150,874	119,663	170,286	151,512
France	46,478	39,191	57,978	58,987	39,191	58,987	50,658
Croatia	7,096	11,554	13,349	8,634	7,096	13,349	10,158
Italy	47,518	46,014	47,188	38,754	38,754	47,518	44,868
Cyprus	147	117	129	115	115	147	127
Latvia	12,321	18,201	20,265	18,290	12,321	20,265	17,269
Lithuania	12,546	17,787	22,618	21,452	12,546	22,618	18,601
Luxembourg	629	722	859	604	604	859	704
Hungary	16,828	18,658	19,936	19,219	16,828	19,936	18,660
Malta	47	44	33	23	23	47	37
Netherlands	4,785	3,812	3,695	6,956	3,695	6,956	4,812
Austria	14,255	15,789	12,437	13,345	12,437	15,789	13,956
Poland	221,383	204,280	213,729	171,539	171,539	221,383	202,733
Portugal	11,790	9,549	6,551	12,915	6,551	12,915	10,201
Romania	45,613	56,176	50,591	55,835	45,613	56,176	52,054
Slovenia	1,181	1,218	1,227	741	741	1,227	1,092
Slovakia	3,628	5,346	4,958	4,478	3,628	5,346	4,603
Finland	73,423	108,457	105,933	130,855	73,423	130,855	104,667
Sweden	68,669	84,879	79,832	99,906	68,669	99,906	83,322
United Kingdom	94,692	93,511	101,920	151,972	93,511	151,972	110,524

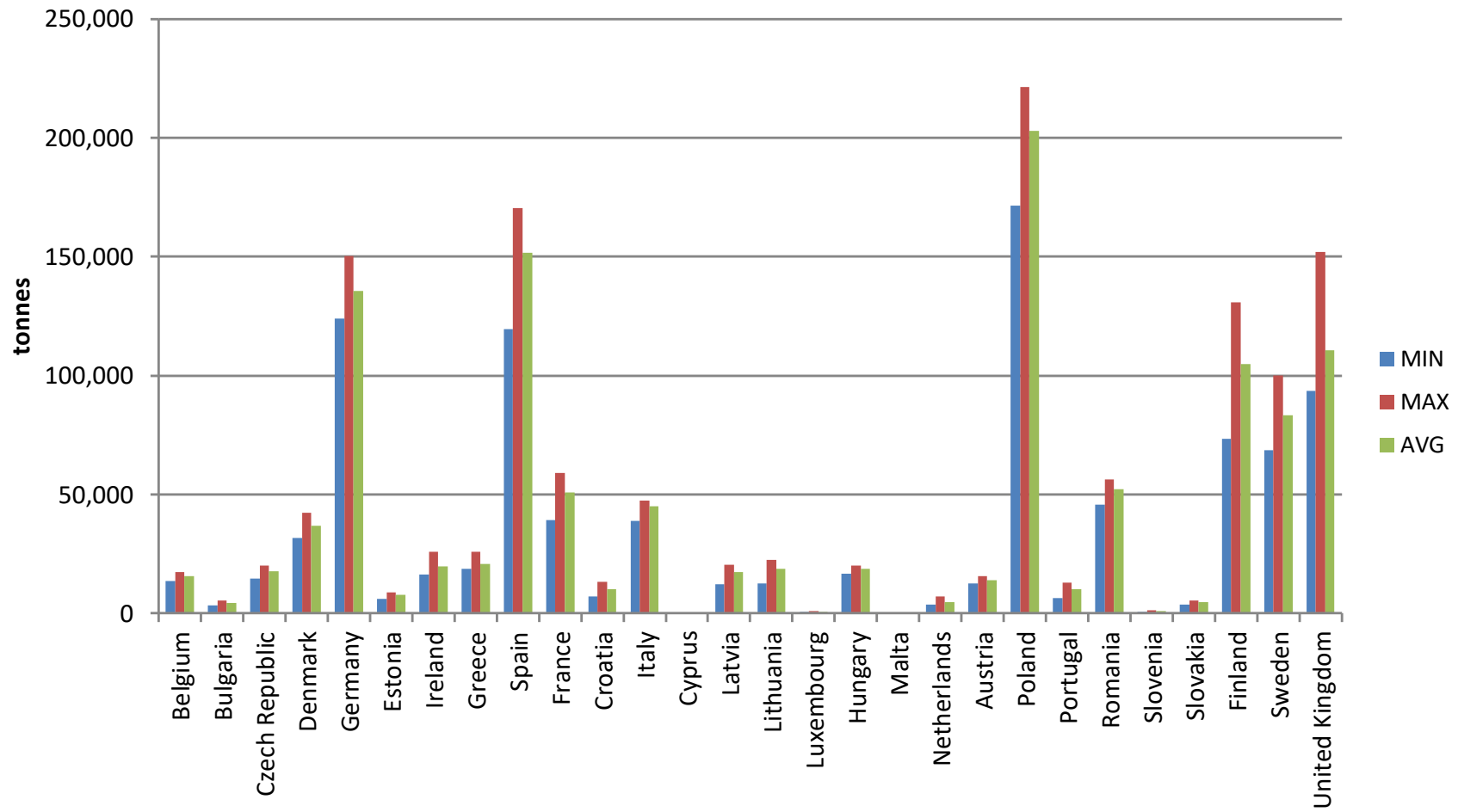


Figure 31 Tonnes of oat bran per country, 2010-2013

Table 26 Tonnes of oat hull per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	33,495	29,345	25,937	31,082	25,937	33,495	29,965
Bulgaria	10,526	6,614	7,930	9,054	6,614	10,526	8,531
Czech Republic	32,001	37,468	38,588	28,265	28,265	38,588	34,081
Denmark	62,346	61,428	80,062	81,658	61,428	81,658	71,374
Germany	239,877	257,890	290,727	260,436	239,877	290,727	262,233
Estonia	11,827	14,443	16,721	16,261	11,827	16,721	14,813
Ireland	37,947	31,463	32,772	49,862	31,463	49,862	38,011
Greece	38,901	49,858	35,900	36,339	35,900	49,858	40,250
Spain	319,439	329,220	231,348	291,690	231,348	329,220	292,924
France	89,857	75,769	112,091	114,041	75,769	114,041	97,939
Croatia	13,718	22,338	25,808	16,692	13,718	25,808	19,639
Italy	91,867	88,960	91,231	74,924	74,924	91,867	86,745
Cyprus	285	227	249	223	223	285	246
Latvia	23,820	35,189	39,179	35,361	23,820	39,179	33,387
Lithuania	24,256	34,387	43,729	41,473	24,256	43,729	35,961
Luxembourg	1,217	1,396	1,661	1,167	1,167	1,661	1,360
Hungary	32,535	36,073	38,543	37,156	32,535	38,543	36,077
Malta	92	86	64	45	45	92	72
Netherlands	9,250	7,370	7,144	13,448	7,144	13,448	9,303
Austria	27,560	30,525	24,044	25,800	24,044	30,525	26,982
Poland	428,007	394,941	413,209	331,642	331,642	428,007	391,950
Portugal	22,795	18,462	12,664	24,969	12,664	24,969	19,722
Romania	88,186	108,607	97,809	107,948	88,186	108,607	100,638
Slovenia	2,283	2,355	2,372	1,432	1,432	2,372	2,110
Slovakia	7,015	10,336	9,586	8,657	7,015	10,336	8,898
Finland	141,951	209,683	204,804	252,986	141,951	252,986	202,356
Sweden	132,761	164,100	154,341	193,152	132,761	193,152	161,088
United Kingdom	183,071	180,788	197,045	293,812	180,788	293,812	213,679

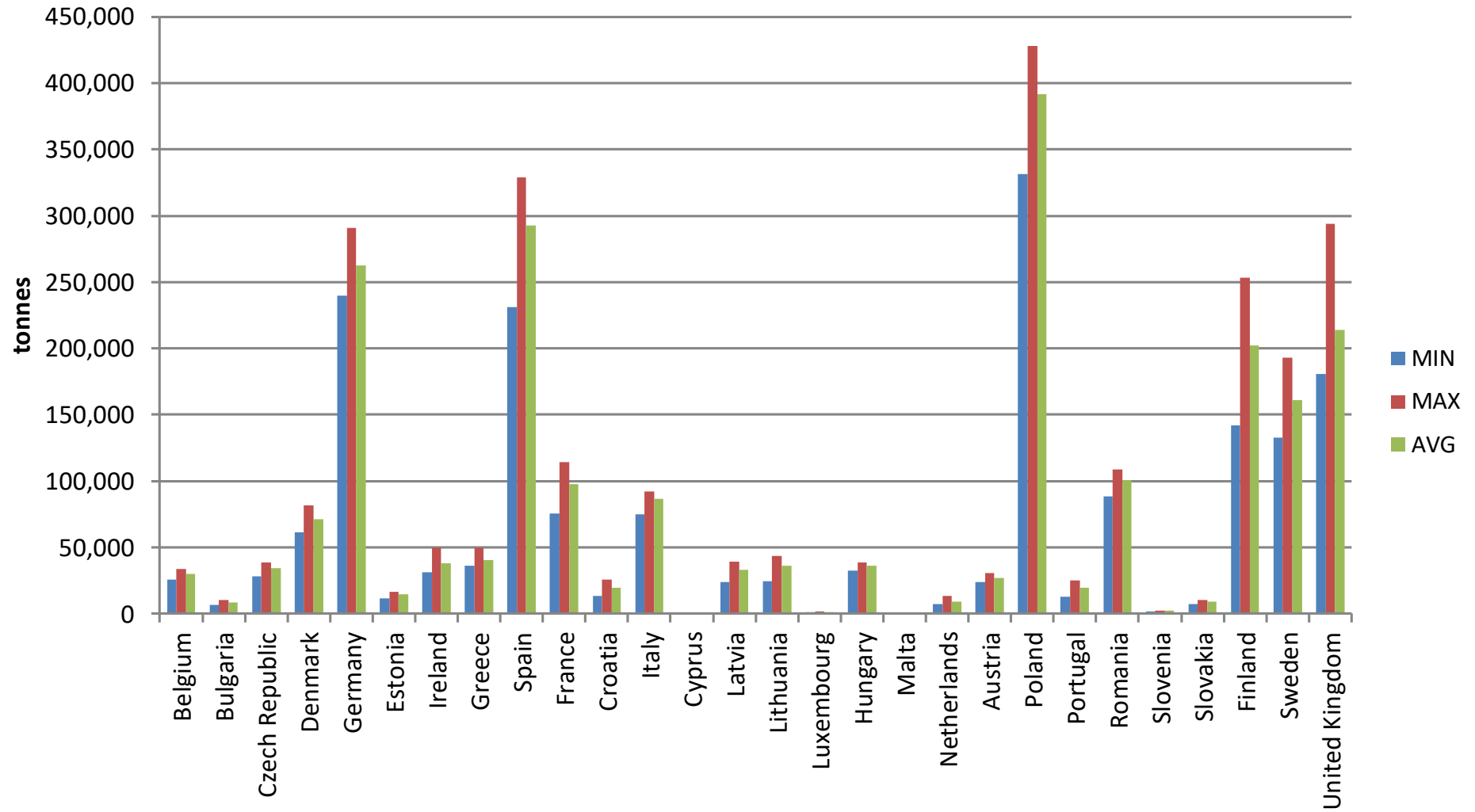


Figure 32 Tonnes of oat hull per country, 2010-2013

2.5 Rice

Rice is a widely consumed cereal, especially in Asia (40). It is an annual plant, mostly cultivated in areas with high rainfall. The traditional method for rice cultivation is flooding the fields, after which the seed is sown. Figure 33 shows a rice field in Romania (41).



Figure 33 Rice field in Romania (41)

During the harvesting step, the main AWCB are straw and husk, between 0.42 and 2.15 kg of straw. After harvesting, the hull needs to be removed from the harvested rice. Between 0.15 and 0.36 kg of husk occur per 1 kg of processed rice. For white rice it is processed further, removing the rice bran, which is thinner than other cereal brans, generating lower amounts during milling. In the consumption step, more than one-fourth of consumed rice goes mouldy and eventually rotten.

The flowchart (Figure 34) presents AWCB value chain for rice and specific AWCB weight factors from Table 2.

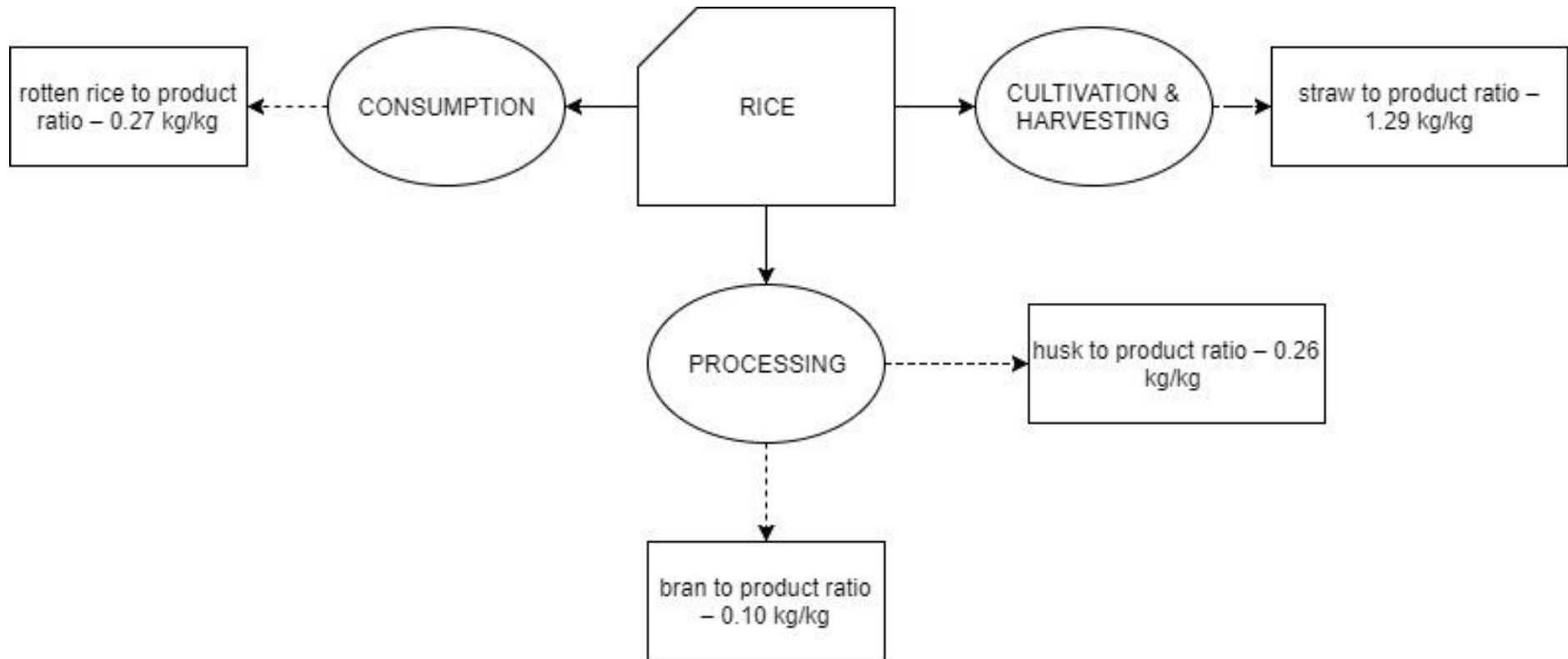


Figure 34 Rice AWCB value chain

Data for cultivated oats is taken from EUROSTAT, and data for imported and exported oats is taken from FAOSTAT. By using relation (I-IX), the amount of processed oats is calculated for every country in each year. Then the amount of AWCB is calculated for every step and every year. An example of the calculations for Spain in 2010:

PRD = 927,820 tonnes

IMP = 57,972 tonnes

EXP = 276,730 tonnes

CON = 109,197 tonnes

$PRC = (927,820 + 57,972) - (276,730 + 109,197) = 304,628$ tonnes

Using the average mass of straw per 1 kg of harvested rice (1.29 kg) the calculated quantity of straw for Spain was 1,196,888 tonnes in 2010, while for rice processing, 30,463 tonnes of bran and 79,203 tonnes of husk were produced. The quantity of rotten rice during consumption takes 27% of total consumed rice or 109,197 tonnes for Spain in 2010. Results for other countries and years are presented in the tables and figures below.

Table 27 Tonnes of harvested rice per country, 2010-2015 (32)

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	0	0	0	0	0	0	0	0	0
Bulgaria	57,430	59,620	54,900	56,120	54,160	67,680	54,160	67,680	58,318
Czech Republic	0	0	0	0	0	0	0	0	0
Denmark	0	0	0	0	0	0	0	0	0
Germany	0	0	0	0	0	0	0	0	0
Estonia	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0	0
Greece	229,490	254,990	215,520	259,490	229,320	251,150	215,520	259,490	239,993
Spain	927,820	927,550	899,600	876,630	861,100	847,030	847,030	927,820	889,955
France	115,050	130,400	123,220	80,860	83,410	80,860	80,860	130,400	102,300
Croatia	0	0	0	0	0	0	0	0	0
Italy	1,671,820	1,497,040	1,594,480	1,433,110	1,415,730	1,518,250	1,415,730	1,671,820	1,521,738
Cyprus	0	0	0	0	0	0	0	0	0
Latvia	0	0	0	0	0	0	0	0	0
Lithuania	0	0	0	0	0	0	0	0	0
Luxembourg	0	0	0	0	0	0	0	0	0
Hungary	5,890	9,020	11,280	8,640	7,920	9,410	5,890	11,280	8,693
Malta	0	0	0	0	0	0	0	0	0
Netherlands	0	0	0	0	0	0	0	0	0
Austria	0	0	0	0	0	0	0	0	0
Poland	0	0	0	0	0	0	0	0	0
Portugal	170,220	185,020	187,030	180,160	167,320	184,920	167,320	187,030	179,112
Romania	61,590	65,260	50,860	54,650	45,160	49,770	45,160	65,260	54,548
Slovenia	0	0	0	0	0	0	0	0	0
Slovakia	0	0	0	0	0	0	0	0	0
Finland	0	0	0	0	0	0	0	0	0
Sweden	0	0	0	0	0	0	0	0	0
United Kingdom	0	0	0	0	0	0	0	0	0

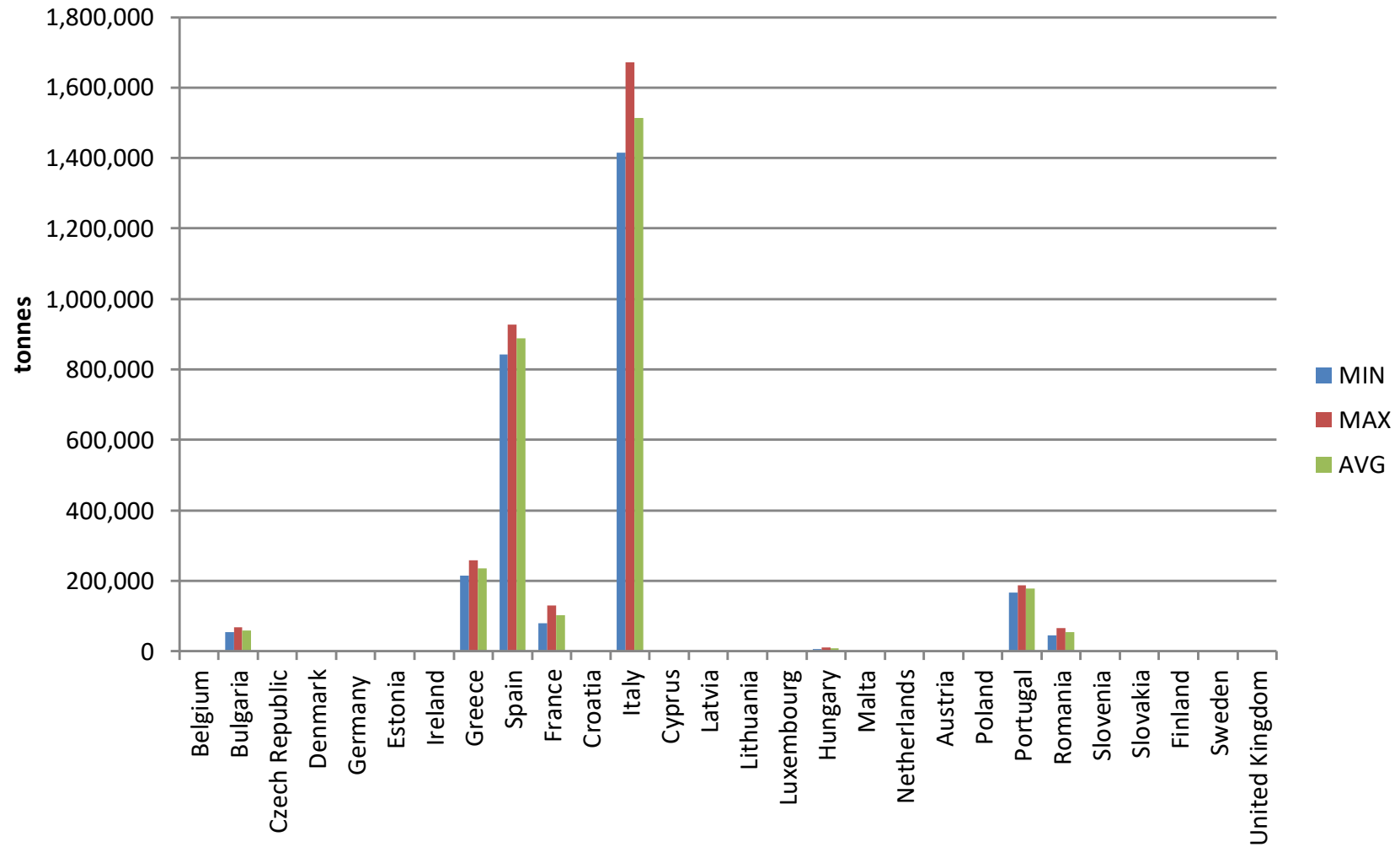


Figure 35 Tonnes of harvested rice per country, 2010-2015

Table 28 Tonnes of rice straw per country, 2010-2015

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	0	0	0	0	0	0	0	0	0
Bulgaria	74,085	76,910	70,821	72,395	69,866	87,307	69,866	87,307	75,231
Czech Republic	0	0	0	0	0	0	0	0	0
Denmark	0	0	0	0	0	0	0	0	0
Germany	0	0	0	0	0	0	0	0	0
Estonia	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0	0
Greece	296,042	328,937	278,021	334,742	295,823	323,984	278,021	334,742	309,591
Spain	1,196,888	1,196,540	1,160,484	1,130,853	1,110,819	1,092,669	1,092,669	1,196,888	1,148,042
France	148,415	168,216	158,954	104,309	107,599	104,309	104,309	168,216	131,967
Croatia	0	0	0	0	0	0	0	0	0
Italy	2,156,648	1,931,182	2,056,879	1,848,712	1,826,292	1,958,543	1,826,292	2,156,648	1,963,042
Cyprus	0	0	0	0	0	0	0	0	0
Latvia	0	0	0	0	0	0	0	0	0
Lithuania	0	0	0	0	0	0	0	0	0
Luxembourg	0	0	0	0	0	0	0	0	0
Hungary	7,598	11,636	14,551	11,146	10,217	12,139	7,598	14,551	11,214
Malta	0	0	0	0	0	0	0	0	0
Netherlands	0	0	0	0	0	0	0	0	0
Austria	0	0	0	0	0	0	0	0	0
Poland	0	0	0	0	0	0	0	0	0
Portugal	219,584	238,676	241,269	232,406	215,843	238,547	215,843	241,269	231,054
Romania	79,451	84,185	65,609	70,499	58,256	64,203	58,256	84,185	70,367
Slovenia	0	0	0	0	0	0	0	0	0
Slovakia	0	0	0	0	0	0	0	0	0
Finland	0	0	0	0	0	0	0	0	0
Sweden	0	0	0	0	0	0	0	0	0
United Kingdom	0	0	0	0	0	0	0	0	0

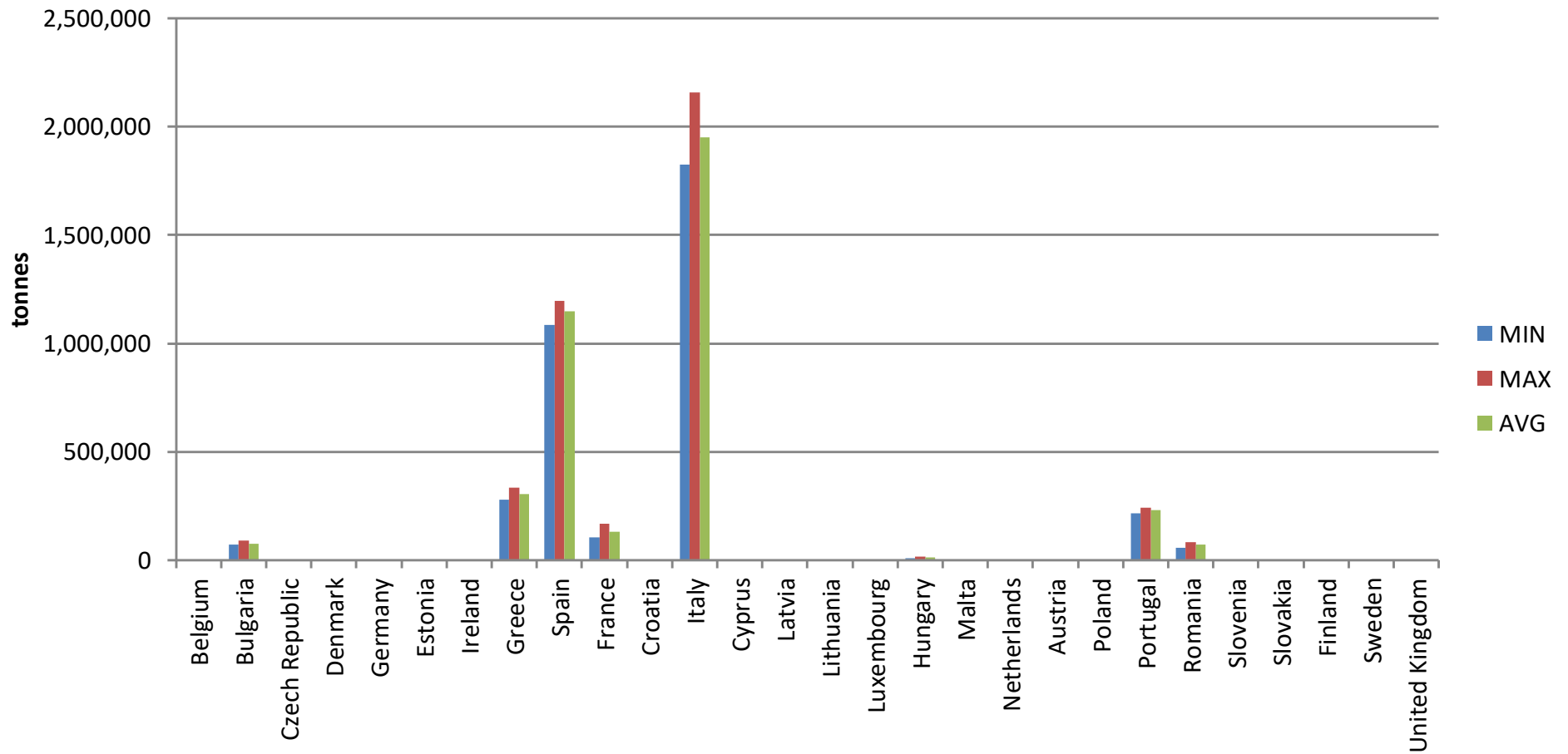


Figure 36 Tonnes of rice straw per country, 2010-2015

Table 29 Tonnes of imported and exported rice per country, 2010-2013 (5)

GEO/POPULATION	Trade	2010	2011	2012	2013
Belgium	Import	408,232	429,922	388,039	433,488
	Export	223,831	272,482	207,970	272,169
Bulgaria	Import	22,085	24,104	17,257	27,057
	Export	43,400	31,036	41,750	40,601
Czech Republic	Import	64,405	63,868	68,123	73,381
	Export	17,245	13,389	15,153	17,281
Denmark	Import	36,861	40,538	36,374	34,426
	Export	3,790	3,417	4,395	4,932
Germany	Import	330,218	386,325	376,437	377,640
	Export	63,916	92,850	78,189	75,581
Estonia	Import	3,728	3,715	3,859	3,870
	Export	357	507	425	596
Ireland	Import	20,585	18,051	18,555	17,812
	Export	319	467	391	259
Greece	Import	22,592	17,899	16,078	19,697
	Export	112,676	124,947	127,128	97,753
Spain	Import	57,972	117,704	85,919	74,651
	Export	276,730	246,382	284,087	255,771
France	Import	445,239	496,238	477,670	496,735
	Export	83,192	74,572	55,838	67,794
Croatia	Import	10,558	10,832	10,461	10,627
	Export	122	167	114	62
Italy	Import	93,751	107,557	96,223	99,647
	Export	805,774	722,136	736,346	718,904
Cyprus	Import	7,117	6,209	5,969	6,316
	Export	145	94	6	62
Latvia	Import	5,229	8,757	5,443	6,262
	Export	717	1,070	1,396	1,830
Lithuania	Import	13,310	12,299	12,682	13,498
	Export	2,995	4,441	3,882	4,248
Luxembourg	Import	2,021	2,717	2,528	2,389
	Export	68	74	84	53

Hungary	Import	29,565	36,385	24,436	16,001
	Export	4,900	7,538	3,526	1,997
Malta	Import	2,134	2,013	2,073	2,305
	Export	19	30	28	7
Netherlands	Import	232,918	242,521	232,299	219,045
	Export	117,152	138,113	138,982	133,824
Austria	Import	36,170	37,552	40,132	36,935
	Export	4,466	4,362	3,702	3,611
Poland	Import	95,194	116,873	112,511	124,357
	Export	8,531	13,636	16,932	17,763
Portugal	Import	98,110	102,648	93,346	94,570
	Export	30,699	25,609	21,129	30,289
Romania	Import	46,042	93,920	41,598	46,532
	Export	36,459	48,363	23,744	20,544
Slovenia	Import	9,010	10,460	9,136	8,875
	Export	2,454	2,730	2,383	2,427
Slovakia	Import	31,962	29,300	28,269	27,154
	Export	5,345	14,291	3,825	3,361
Finland	Import	24,291	25,199	24,354	24,907
	Export	128	233	114	272
Sweden	Import	58,607	60,063	57,661	58,810
	Export	1,055	1,096	1,930	1,272
United Kingdom	Import	614,250	604,422	634,258	592,430
	Export	34,197	39,361	39,242	44,477

Table 30 Tonnes of processed rice per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	87,926	59,534	81,325	61,980	59,534	87,926	72,691
Bulgaria	16,818	7,627	9,476	4,400	4,400	16,818	9,581
Czech Republic	1,127	4,337	6,746	9,829	1,127	9,829	5,510
Denmark	4,290	8,206	2,960	360	360	8,206	3,954
Germany	29,075	60,831	65,297	68,540	29,075	68,540	55,936
Estonia	571	416	651	502	416	651	535
Ireland	4,343	1,586	2,125	1,484	1,484	4,343	2,384
Greece	68,243	76,752	33,517	111,011	33,517	111,011	72,381
Spain	304,628	392,868	294,113	288,977	288,977	392,868	320,147
France	115,007	188,185	179,501	142,439	115,007	188,185	156,283
Croatia	539	798	512	762	512	798	653
Italy	646,089	567,828	639,568	497,521	497,521	646,089	587,752
Cyprus	2,385	1,412	1,136	1,405	1,136	2,385	1,585
Latvia	695	3,953	366	789	366	3,953	1,451
Lithuania	4,974	2,669	3,694	4,198	2,669	4,974	3,883
Luxembourg	45	698	450	295	45	698	372
Hungary	11,528	18,894	13,319	3,817	3,817	18,894	11,890
Malta	252	116	166	402	116	402	234
Netherlands	69,356	57,772	46,472	38,238	38,238	69,356	52,960
Austria	1,638	3,039	6,161	2,897	1,638	6,161	3,434
Poland	52,442	68,981	61,322	72,338	52,442	72,338	63,771
Portugal	68,455	92,895	90,569	76,644	68,455	92,895	82,141
Romania	12,318	52,240	10,436	22,580	10,436	52,240	24,393
Slovenia	2,257	3,425	2,436	2,124	2,124	3,425	2,561
Slovakia	13,680	2,067	11,474	10,807	2,067	13,680	9,507
Finland	2,222	2,927	2,095	2,386	2,095	2,927	2,407
Sweden	5,244	6,240	2,627	4,025	2,627	6,240	4,534
United Kingdom	148,733	130,206	156,898	107,006	107,006	156,898	135,711

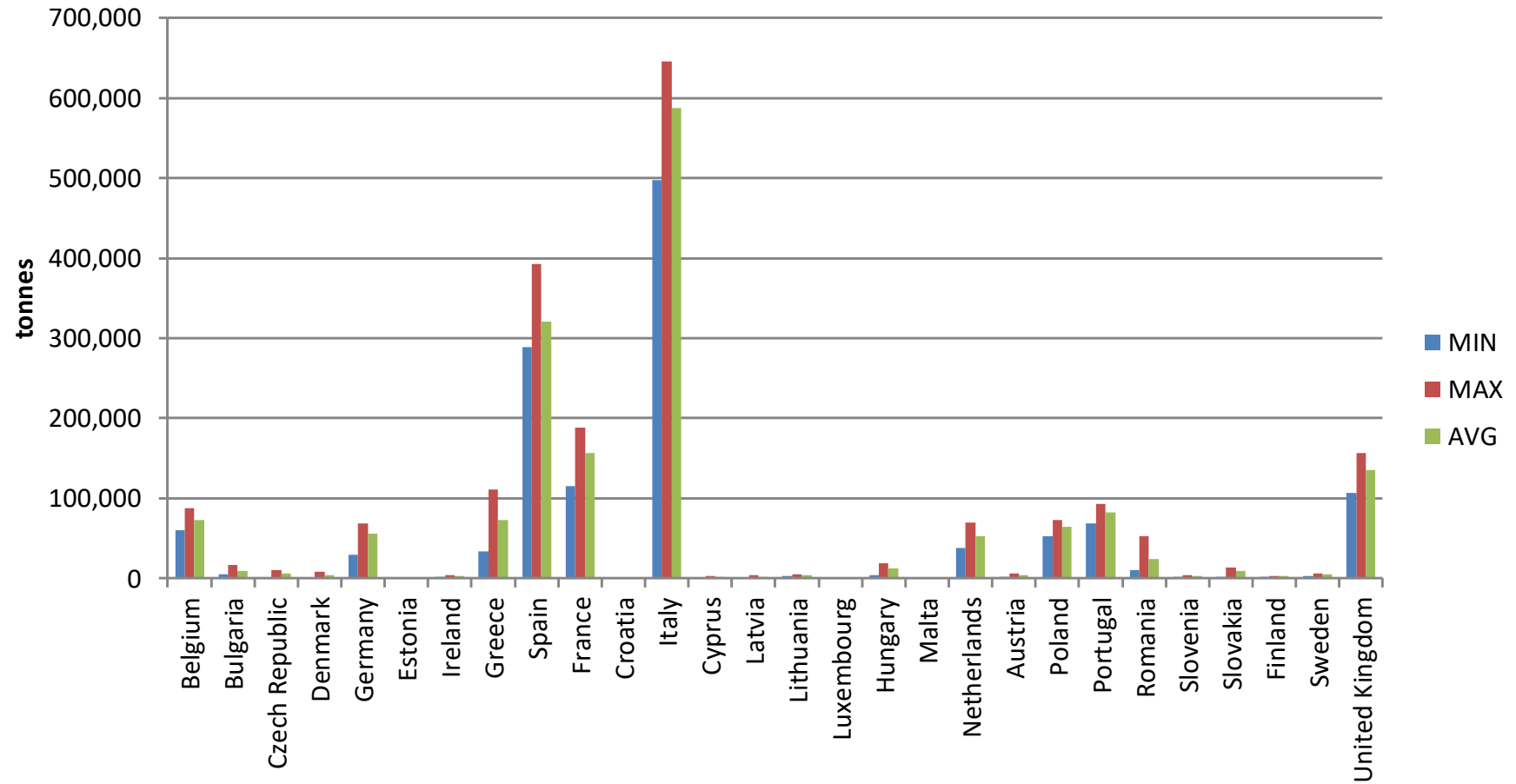


Figure 37 Tonnes of processed rice per country, 2010-2013

Table 31 Tonnes of rice bran per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	8,793	5,953	8,132	6,198	5,953	8,793	7,269
Bulgaria	1,682	763	948	440	440	1,682	958
Czech Republic	113	434	675	983	113	983	551
Denmark	429	821	296	36	36	821	395
Germany	2,908	6,083	6,530	6,854	2,908	6,854	5,594
Estonia	57	42	65	50	42	65	53
Ireland	434	159	212	148	148	434	238
Greece	6,824	7,675	3,352	11,101	3,352	11,101	7,238
Spain	30,463	39,287	29,411	28,898	28,898	39,287	32,015
France	11,501	18,819	17,950	14,244	11,501	18,819	15,628
Croatia	54	80	51	76	51	80	65
Italy	64,609	56,783	63,957	49,752	49,752	64,609	58,775
Cyprus	238	141	114	141	114	238	158
Latvia	70	395	37	79	37	395	145
Lithuania	497	267	369	420	267	497	388
Luxembourg	5	70	45	30	5	70	37
Hungary	1,153	1,889	1,332	382	382	1,889	1,189
Malta	25	12	17	40	12	40	23
Netherlands	6,936	5,777	4,647	3,824	3,824	6,936	5,296
Austria	164	304	616	290	164	616	343
Poland	5,244	6,898	6,132	7,234	5,244	7,234	6,377
Portugal	6,846	9,290	9,057	7,664	6,846	9,290	8,214
Romania	1,232	5,224	1,044	2,258	1,044	5,224	2,439
Slovenia	226	342	244	212	212	342	256
Slovakia	1,368	207	1,147	1,081	207	1,368	951
Finland	222	293	209	239	209	293	241
Sweden	524	624	263	402	263	624	453
United Kingdom	14,873	13,021	15,690	10,701	10,701	15,690	13,571

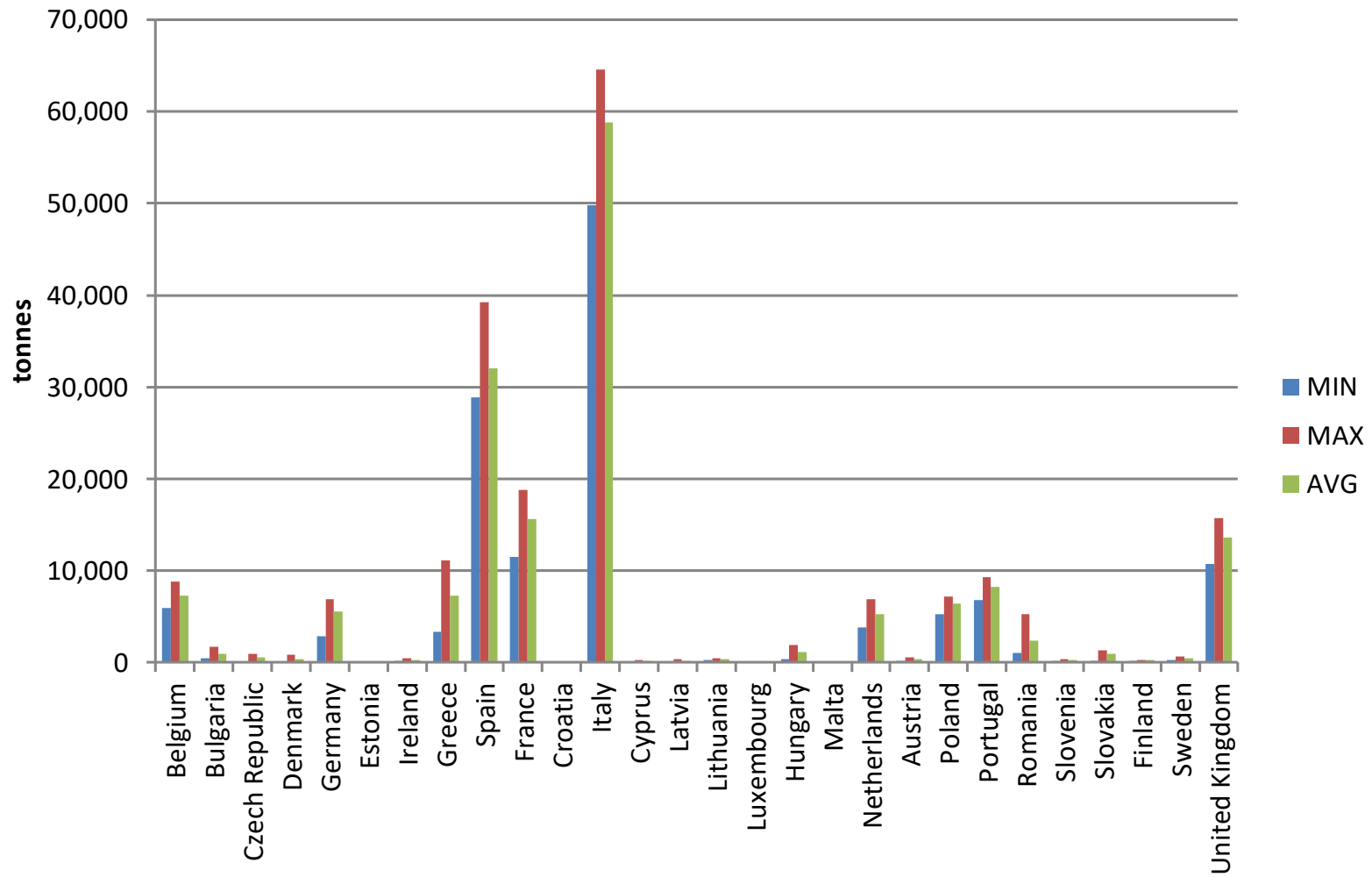


Figure 38 Tonnes of rice bran per country, 2010-2013

Table 32 Tonnes of rice husks per country, 2010-2015

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	22,861	15,479	21,144	16,115	15,479	22,861	15,479	22,861	18,990
Bulgaria	4,373	1,983	2,464	1,144	1,144	4,373	1,144	4,373	2,580
Czech Republic	293	1,128	1,754	2,556	293	2,556	293	2,556	1,430
Denmark	1,115	2,133	770	94	94	2,133	94	2,133	1,057
Germany	7,560	15,816	16,977	17,820	7,560	17,820	7,560	17,820	13,926
Estonia	148	108	169	130	108	169	108	169	139
Ireland	1,129	412	552	386	386	1,129	386	1,129	666
Greece	17,743	19,956	8,714	28,863	8,714	28,863	8,714	28,863	18,809
Spain	79,203	102,146	76,470	75,134	75,134	102,146	75,134	102,146	85,039
France	29,902	48,928	46,670	37,034	29,902	48,928	29,902	48,928	40,227
Croatia	140	208	133	198	133	208	133	208	170
Italy	167,983	147,635	166,288	129,356	129,356	167,983	129,356	167,983	151,433
Cyprus	620	367	295	365	295	620	295	620	427
Latvia	181	1,028	95	205	95	1,028	95	1,028	439
Lithuania	1,293	694	960	1,091	694	1,293	694	1,293	1,004
Luxembourg	12	181	117	77	12	181	12	181	97
Hungary	2,997	4,912	3,463	992	992	4,912	992	4,912	3,045
Malta	65	30	43	104	30	104	30	104	63
Netherlands	18,033	15,021	12,083	9,942	9,942	18,033	9,942	18,033	13,842
Austria	426	790	1,602	753	426	1,602	426	1,602	933
Poland	13,635	17,935	15,944	18,808	13,635	18,808	13,635	18,808	16,461
Portugal	17,798	24,153	23,548	19,928	17,798	24,153	17,798	24,153	21,230
Romania	3,203	13,582	2,713	5,871	2,713	13,582	2,713	13,582	6,944
Slovenia	587	890	633	552	552	890	552	890	684
Slovakia	3,557	537	2,983	2,810	537	3,557	537	3,557	2,330
Finland	578	761	545	620	545	761	545	761	635
Sweden	1,363	1,622	683	1,046	683	1,622	683	1,622	1,170
United Kingdom	38,670	33,853	40,794	27,822	27,822	40,794	27,822	40,794	34,959

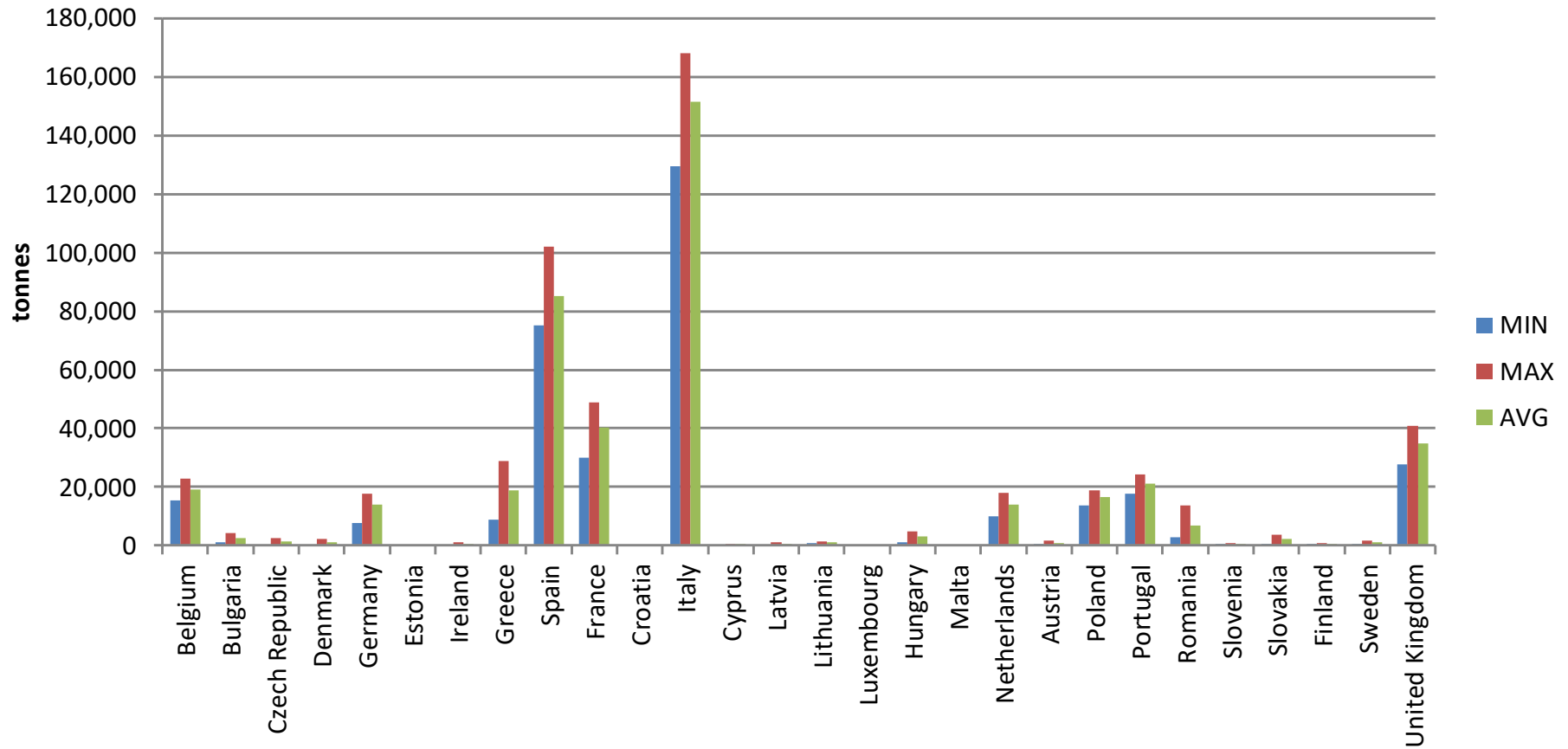


Figure 39 Tonnes of rice husks per country, 2010-2015

Table 33 Consumption of rice (tonnes) per country, 2010-2015

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	96,475	97,906	98,744	99,339	99,509	100,012	96,475	100,012	98,664
Bulgaria	19,297	19,161	19,051	18,940	18,839	18,726	18,726	19,297	19,002
Czech Republic	46,033	46,142	46,224	46,271	46,255	46,368	46,033	46,368	46,215
Denmark	28,781	28,915	29,019	29,134	29,262	29,431	28,781	29,431	29,090
Germany	237,227	232,644	232,951	233,519	234,226	235,473	232,644	237,227	234,340
Estonia	2,800	2,792	2,783	2,772	2,763	2,761	2,761	2,800	2,779
Ireland	15,923	15,998	16,039	16,069	16,119	16,201	15,923	16,201	16,058
Greece	71,163	71,190	70,953	70,423	69,932	69,491	69,491	71,190	70,525
Spain	404,434	406,004	407,319	406,533	404,656	404,111	404,111	407,319	405,509
France	362,090	363,881	365,551	367,362	369,276	372,334	362,090	372,334	366,749
Croatia	9,897	9,867	9,835	9,803	9,768	9,718	9,718	9,897	9,814
Italy	313,708	314,633	314,789	316,332	322,148	322,217	313,708	322,217	317,304
Cyprus	4,587	4,703	4,827	4,849	4,805	4,743	4,587	4,849	4,752
Latvia	3,817	3,734	3,681	3,643	3,603	3,575	3,575	3,817	3,675
Lithuania	5,341	5,189	5,106	5,052	5,004	4,966	4,966	5,341	5,110
Luxembourg	1,908	1,945	1,994	2,041	2,089	2,139	1,908	2,139	2,019
Hungary	19,027	18,973	18,871	18,827	18,767	18,726	18,726	19,027	18,865
Malta	1,863	1,867	1,879	1,896	1,914	1,932	1,863	1,932	1,892
Netherlands	46,410	46,636	46,845	46,983	47,122	47,322	46,410	47,322	46,886
Austria	30,066	30,151	30,269	30,427	30,625	30,875	30,066	30,875	30,402
Poland	34,221	34,256	34,257	34,256	34,216	34,205	34,205	34,257	34,235
Portugal	169,176	169,164	168,678	167,797	166,837	165,997	165,997	169,176	167,941
Romania	58,855	58,577	58,278	58,058	57,847	57,625	57,625	58,855	58,207
Slovenia	4,299	4,305	4,317	4,324	4,328	4,332	4,299	4,332	4,317
Slovakia	12,937	12,942	12,970	12,986	12,998	13,011	12,937	13,011	12,974
Finland	21,941	22,039	22,145	22,249	22,350	22,434	21,941	22,434	22,193
Sweden	52,308	52,727	53,104	53,513	54,011	54,585	52,308	54,585	53,375
United Kingdom	431,320	434,855	438,118	440,947	444,023	447,639	431,320	447,639	439,484

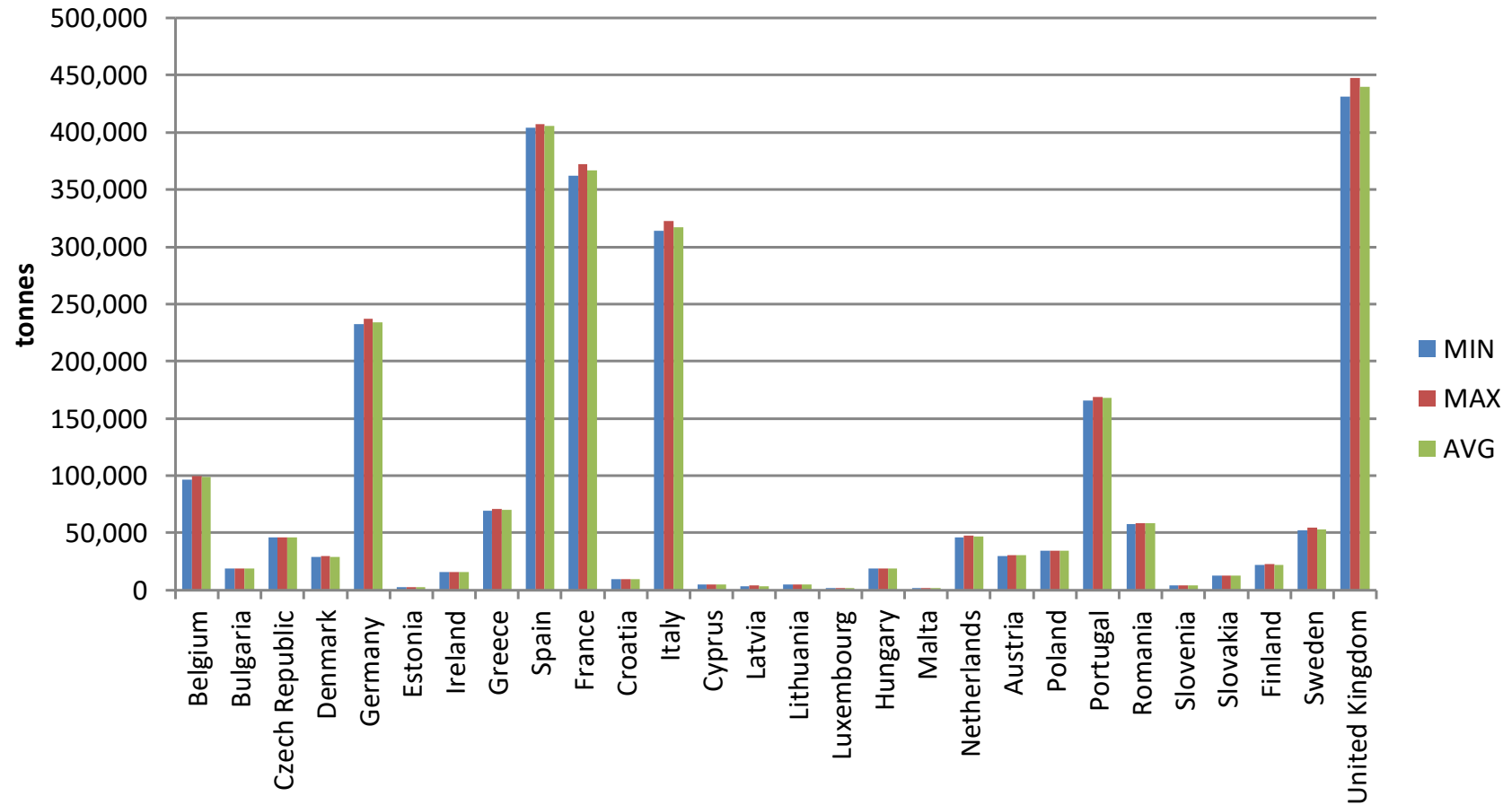


Figure 40 Consumption of rice (tonnes) per country, 2010-2015

Table 34 Tonnes of rotten rice per country, 2010-2015

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	26,048	26,435	26,661	26,821	26,868	27,003	26,048	27,003	26,639
Bulgaria	5,210	5,173	5,144	5,114	5,086	5,056	5,056	5,210	5,131
Czech Republic	12,429	12,458	12,480	12,493	12,489	12,519	12,429	12,519	12,478
Denmark	7,771	7,807	7,835	7,866	7,901	7,946	7,771	7,946	7,854
Germany	64,051	62,814	62,897	63,050	63,241	63,578	62,814	64,051	63,272
Estonia	756	754	751	749	746	746	746	756	750
Ireland	4,299	4,319	4,331	4,339	4,352	4,374	4,299	4,374	4,336
Greece	19,214	19,221	19,157	19,014	18,882	18,763	18,763	19,221	19,042
Spain	109,197	109,621	109,976	109,764	109,257	109,110	109,110	109,976	109,488
France	97,764	98,248	98,699	99,188	99,704	100,530	97,764	100,530	99,022
Croatia	2,672	2,664	2,655	2,647	2,637	2,624	2,624	2,672	2,650
Italy	84,701	84,951	84,993	85,410	86,980	86,999	84,701	86,999	85,672
Cyprus	1,239	1,270	1,303	1,309	1,297	1,281	1,239	1,309	1,283
Latvia	1,031	1,008	994	984	973	965	965	1,031	992
Lithuania	1,442	1,401	1,379	1,364	1,351	1,341	1,341	1,442	1,380
Luxembourg	515	525	538	551	564	578	515	578	545
Hungary	5,137	5,123	5,095	5,083	5,067	5,056	5,056	5,137	5,094
Malta	503	504	507	512	517	522	503	522	511
Netherlands	12,531	12,592	12,648	12,685	12,723	12,777	12,531	12,777	12,659
Austria	8,118	8,141	8,173	8,215	8,269	8,336	8,118	8,336	8,209
Poland	9,240	9,249	9,250	9,249	9,238	9,235	9,235	9,250	9,244
Portugal	45,677	45,674	45,543	45,305	45,046	44,819	44,819	45,677	45,344
Romania	15,891	15,816	15,735	15,676	15,619	15,559	15,559	15,891	15,716
Slovenia	1,161	1,162	1,165	1,167	1,169	1,170	1,161	1,170	1,166
Slovakia	3,493	3,494	3,502	3,506	3,510	3,513	3,493	3,513	3,503
Finland	5,924	5,950	5,979	6,007	6,035	6,057	5,924	6,057	5,992
Sweden	14,123	14,236	14,338	14,449	14,583	14,738	14,123	14,738	14,411
United Kingdom	116,456	117,411	118,292	119,056	119,886	120,862	116,456	120,862	118,661

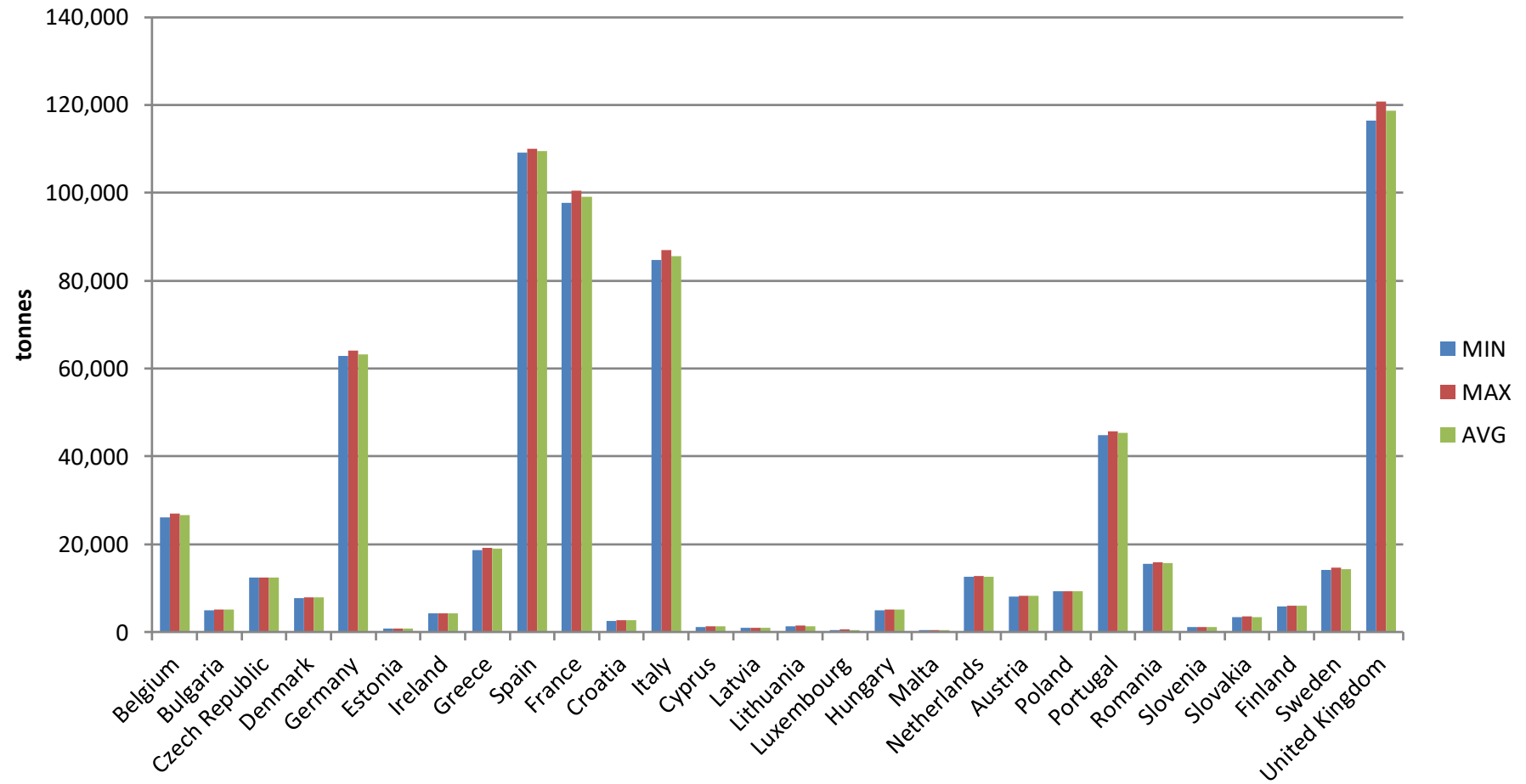


Figure 41 Tonnes of rotten rice per country, 2010-2015

2.6 Rye

Rye is a cereal used to produce flour, bread, beer and other types of alcoholic beverages, as well as for animal fodder (42). In Europe, rye is primarily grown in the eastern, central and northern regions. The world's largest producers of rye are Poland and Russia. Rye can be grown in types of soil that are of lower quality and unsuitable for other cereals. Many farmers grow winter rye that is planted in autumn and harvested in spring. Figure 42 illustrates the harvesting of rye on the field (43).



Figure 42 Harvesting of rye (43)

During the harvesting stage, between 0.90 and 2.00 kg of straw occur per 1 kg of harvested rye. After rye is harvested it is processed which produces bran at a ratio of 0.10-0.15 kg bran per kg of rye.

The flowchart on Figure 44 presents the AWCB value chain for rye and specific AWCB weight factors from Table 2.

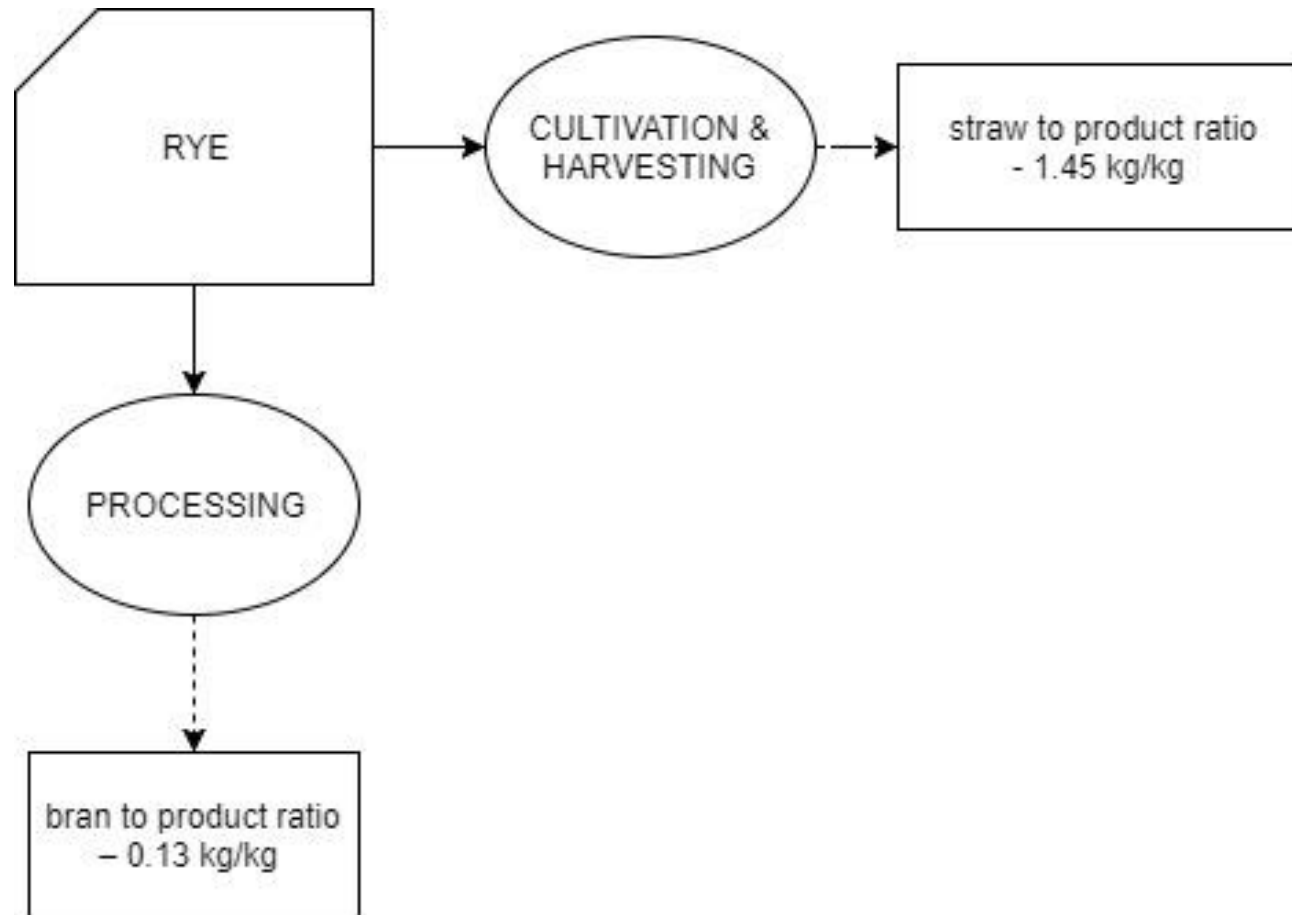


Figure 43 Rye AWCB value chain

Data for cultivated rye is taken from EUROSTAT, and data for imported and exported rye is taken from FAOSTAT. By using relation (I-IX), the amount of processed rye is calculated for every country in each year. Then the amount of AWCB is calculated for every step and every year. An example of the calculations for Poland in 2010:

PRD = 3,270,300 tonnes

IMP = 4,964 tonnes

EXP = 403,450 tonnes

PRC = (3,270,300 + 4,964 - 403,450) = 2,871,814 tonnes

Using the average mass of straw per one kilogram of harvested rye (1.50 kg) the calculated quantity of straw for Poland was 4,905,450 tonnes in 2010. Also, in Poland rye processing facilities 574,363 tonnes of bran occurred in 2010. Results for other countries and years are presented in the tables and figures below.

Table 35 Tonnes of harvested rye per country, 2010-2015 (32)

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	0	0	0	0	0	2,560	0	2,560	427
Bulgaria	17,500	0	0	0	0	11,210	0	17,500	4,785
Czech Republic	118,200	118,460	146,960	176,280	129,060	107,870	107,870	176,280	132,805
Denmark	250,000	0	0	0	0	772,000	0	772,000	170,333
Germany	0	0	0	0	0	0	0	0	0
Estonia	25,000	31,000	57,100	21,900	49,600	54,700	21,900	57,100	39,883
Ireland	0	0	0	0	0	0	0	0	0
Greece	42,190	36,640	27,800	34,050	47,750	48,010	27,800	48,010	39,407
Spain	258,400	0	0	0	0	279,420	0	279,420	89,637
France	151,040	124,410	160,300	0	0	123,490	0	160,300	93,207
Croatia	2,500	0	0	0	0	3,000	0	3,000	917
Italy	0	0	0	14,310	11,530	0	0	14,310	4,307
Cyprus	0	0	0	0	0	0	0	0	0
Latvia	114,000	76,400	0	0	0	159,600	0	159,600	58,333
Lithuania	87,000	85,000	156,600	96,500	85,300	107,840	85,000	156,600	103,040
Luxembourg	6,900	0	0	0	0	5,610	0	6,900	2,085
Hungary	79,400	72,500	0	0	95,940	102,650	0	102,650	58,415
Malta	0	0	0	0	0	0	0	0	0
Netherlands	11,900	0	0	0	0	6,140	0	11,900	3,007
Austria	163,600	202,100	0	0	0	171,070	0	202,100	89,462
Poland	3,270,300	0	0	0	0	2,013,100	0	3,270,300	880,567
Portugal	17,550	18,390	14,780	18,210	17,630	15,490	14,780	18,390	17,008
Romania	34,280	31,380	18,240	23,810	24,360	24,260	18,240	34,280	26,055
Slovenia	2,500	0	0	0	0	0	0	2,500	417
Slovakia	37,600	43,000	0	0	0	42,400	0	43,000	20,500
Finland	69,000	78,400	64,100	0	0	108,600	0	108,600	53,350
Sweden	117,600	144,000	0	142,000	173,600	149,200	0	173,600	121,067
United Kingdom	38,000	0	0	0	0	57,000	0	57,000	15,833

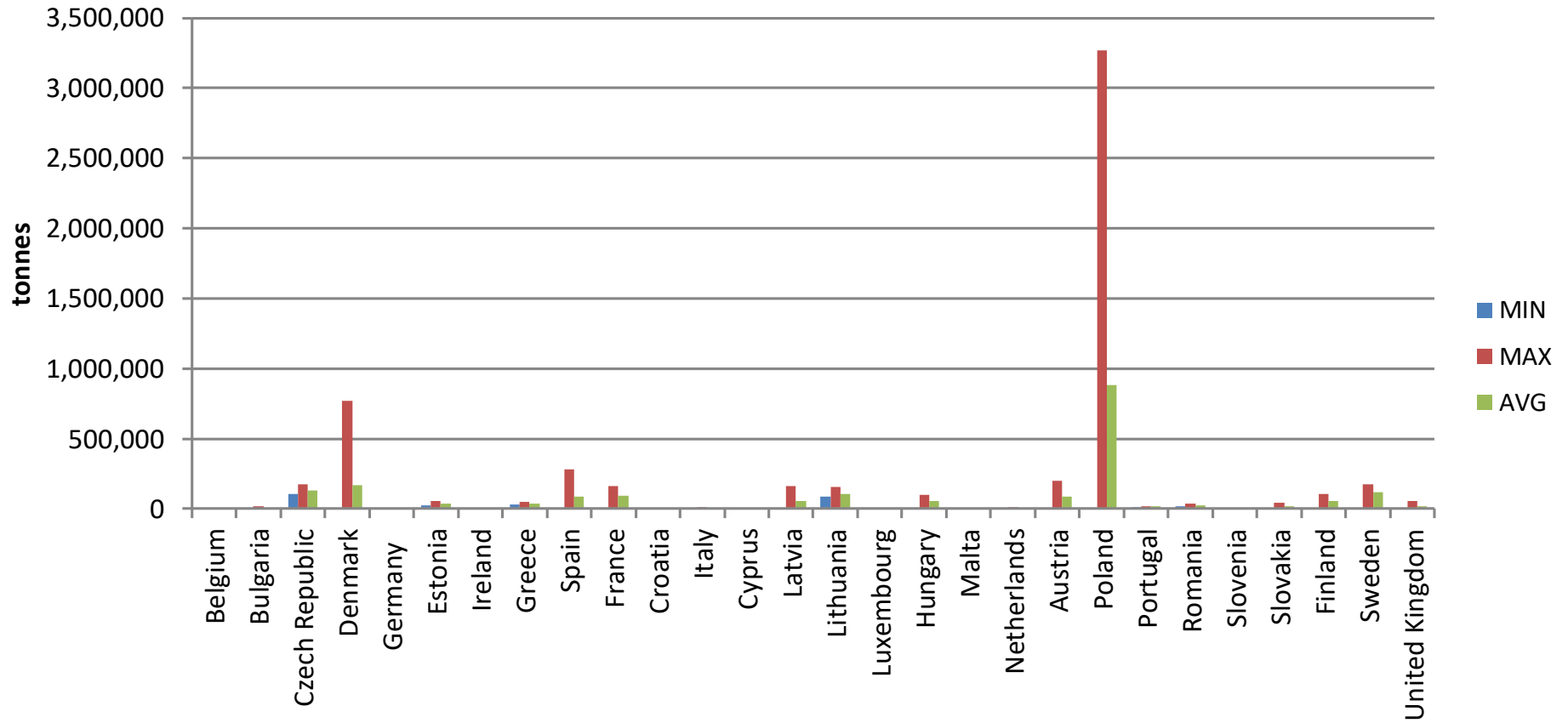


Figure 44 Tonnes of harvested rye per country, 2010-2015

Table 36 Tonnes of rye straw per country, 2010-2015

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	0	0	0	0	0	3,712	0	3,712	619
Bulgaria	25,375	0	0	0	0	16,255	0	25,375	6,938
Czech Republic	171,390	171,767	213,092	255,606	187,137	156,412	156,412	255,606	192,567
Denmark	362,500	0	0	0	0	1,119,400	0	1,119,400	246,983
Germany	0	0	0	0	0	0	0	0	0
Estonia	36,250	44,950	82,795	31,755	71,920	79,315	31,755	82,795	57,831
Ireland	0	0	0	0	0	0	0	0	0
Greece	61,176	53,128	40,310	49,373	69,238	69,615	40,310	69,615	57,140
Spain	374,680	0	0	0	0	405,159	0	405,159	129,973
France	219,008	180,395	232,435	0	0	179,061	0	232,435	135,150
Croatia	3,625	0	0	0	0	4,350	0	4,350	1,329
Italy	0	0	0	20,750	16,719	0	0	20,750	6,245
Cyprus	0	0	0	0	0	0	0	0	0
Latvia	165,300	110,780	0	0	0	231,420	0	231,420	84,583
Lithuania	126,150	123,250	227,070	139,925	123,685	156,368	123,250	227,070	149,408
Luxembourg	10,005	0	0	0	0	8,135	0	10,005	3,023
Hungary	115,130	105,125	0	0	139,113	148,843	0	148,843	84,702
Malta	0	0	0	0	0	0	0	0	0
Netherlands	17,255	0	0	0	0	8,903	0	17,255	4,360
Austria	237,220	293,045	0	0	0	248,052	0	293,045	129,719
Poland	4,741,935	0	0	0	0	2,918,995	0	4,741,935	1,276,822
Portugal	25,448	26,666	21,431	26,405	25,564	22,461	21,431	26,666	24,662
Romania	49,706	45,501	26,448	34,525	35,322	35,177	26,448	49,706	37,780
Slovenia	3,625	0	0	0	0	0	0	3,625	604
Slovakia	54,520	62,350	0	0	0	61,480	0	62,350	29,725
Finland	100,050	113,680	92,945	0	0	157,470	0	157,470	77,358
Sweden	170,520	208,800	0	205,900	251,720	216,340	0	251,720	175,547
United Kingdom	55,100	0	0	0	0	82,650	0	82,650	22,958

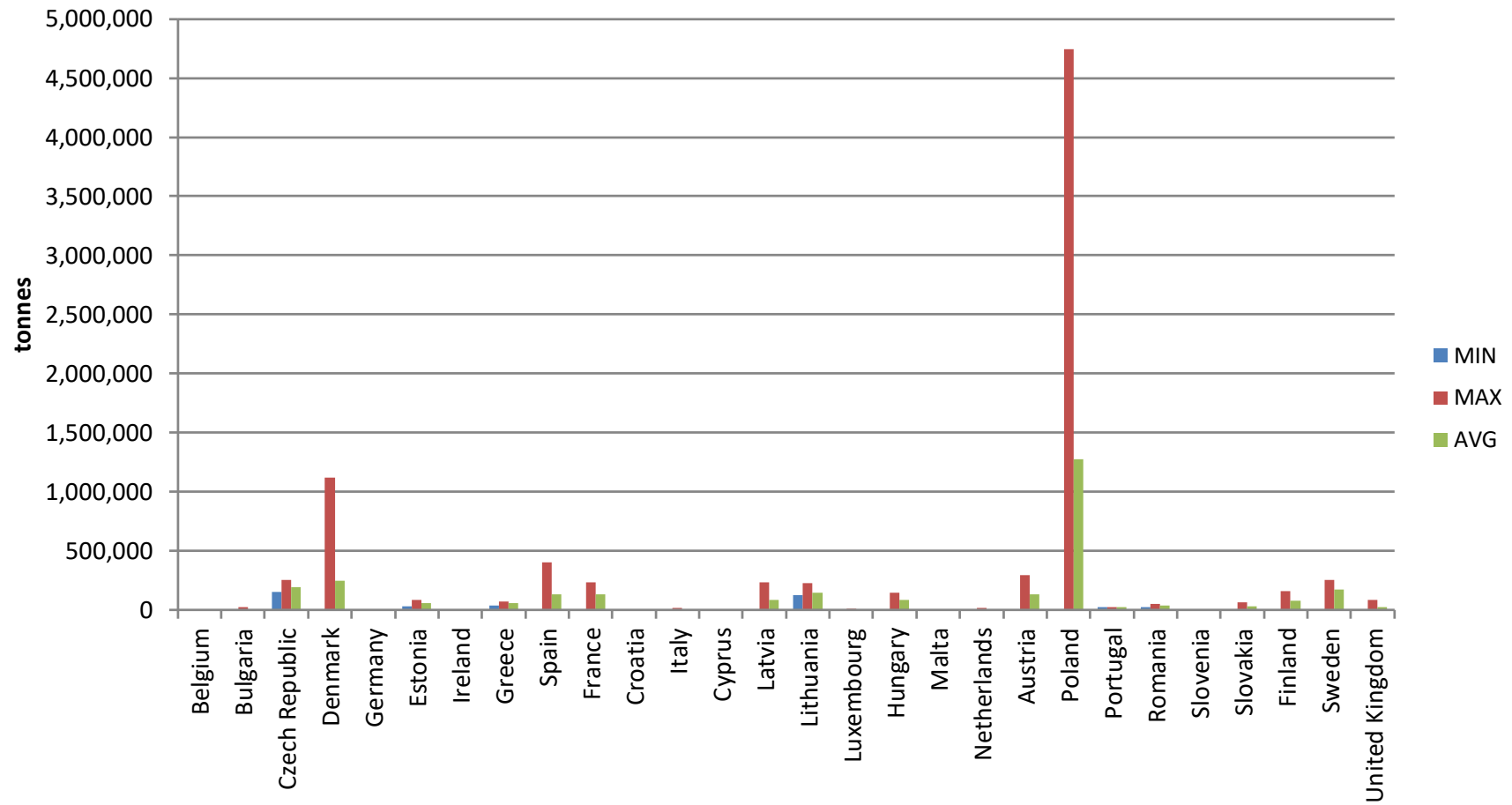


Figure 45 Tonnes of rye straw per country, 2010-2015

Table 37 Tonnes of imported and exported rye per country, 2010-2013 (5)

GEO/POPULATION	Trade	2010	2011	2012	2013
Belgium	Import	26,900	11,358	18,078	72,893
	Export	1,737	342	2,623	997
Bulgaria	Import	18	75	38	9
	Export	904	1,699	717	754
Czech Republic	Import	9,798	27,442	32,088	24,912
	Export	43,741	24,678	33,864	55,153
Denmark	Import	14,815	9,674	18,899	89,999
	Export	48,175	104,756	37,729	6,408
Germany	Import	321,787	267,718	366,485	519,406
	Export	354,543	224,584	214,496	426,276
Estonia	Import	16,178	14,464	15,790	20,417
	Export	1,923	7,628	10,079	17,190
Ireland	Import	5,798	1,438	1,011	27
	Export	0	0	122	0
Greece	Import	516	848	580	1,063
	Export	0	0	0	50
Spain	Import	139,990	11,134	189,380	209,434
	Export	11,016	13,778	13,317	15,861
France	Import	1,474	1,532	1,124	1,477
	Export	21,884	31,685	32,829	34,977
Croatia	Import	2,053	1,593	1,772	1,588
	Export	0	0	0	0
Italy	Import	11,314	12,937	15,743	29,664
	Export	1,144	1,410	1,664	1,798
Cyprus	Import	0	0	0	65
	Export	0	0	0	0
Latvia	Import	12,404	29,248	80,143	9,183
	Export	34,820	24,660	128,982	24,141
Lithuania	Import	23,926	41,316	64,478	11,160
	Export	20,832	28,111	81,333	29,998
Luxembourg	Import	139	724	416	154
	Export	2,489	4,621	3,796	1,043

Hungary	Import	165	388	684	671
	Export	10,344	8,815	11,762	18,738
Malta	Import	0	0	0	0
	Export	0	0	0	0
Netherlands	Import	211,257	109,168	195,239	246,455
	Export	66,664	17,707	69,773	39,366
Austria	Import	56,092	34,639	36,259	39,435
	Export	9,064	11,914	15,807	10,574
Poland	Import	4,964	45,169	69,938	6,362
	Export	403,450	102,936	312,362	864,714
Portugal	Import	27,528	19,232	32,998	31,988
	Export	0	0	103	100
Romania	Import	676	31	110	97
	Export	1,257	1,040	1,404	566
Slovenia	Import	2,469	4,057	3,341	1,175
	Export	24	3	64	7
Slovakia	Import	3,915	2,804	16,849	4,555
	Export	9,727	4,355	4,919	11,757
Finland	Import	44,230	37,818	53,869	56,456
	Export	11	11,888	3,612	249
Sweden	Import	2,887	1,619	2,646	8,143
	Export	54,060	42,084	32,822	24,801
United Kingdom	Import	161	55	11,590	5,304
	Export	250	76	305	95

Table 38 Tonnes of processed rye per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	25,163	11,016	15,455	71,896	11,016	71,896	30,883
Bulgaria	16,614	NA	NA	NA	16,614	16,614	16,614
Czech Republic	84,257	121,224	145,184	146,039	84,257	146,039	124,176
Denmark	216,640	NA	NA	83,591	83,591	216,640	150,116
Germany	NA	43,134	151,989	93,130	43,134	151,989	96,084
Estonia	39,255	37,836	62,811	25,127	25,127	62,811	41,257
Ireland	5,798	1,438	889	27	27	5,798	2,038
Greece	42,706	37,488	28,380	35,063	28,380	42,706	35,909
Spain	387,374	NA	176,063	193,573	176,063	387,374	252,337
France	130,630	94,257	128,595	NA	94,257	130,630	117,827
Croatia	4,553	1,593	1,772	1,588	1,588	4,553	2,377
Italy	10,170	11,527	14,079	42,176	10,170	42,176	19,488
Cyprus	0	0	0	65	0	65	16
Latvia	91,584	80,988	NA	NA	80,988	91,584	86,286
Lithuania	90,094	98,205	139,745	77,662	77,662	139,745	101,427
Luxembourg	4,550	NA	NA	NA	4,550	4,550	4,550
Hungary	69,221	64,073	NA	NA	64,073	69,221	66,647
Malta	0	0	0	0	0	0	0
Netherlands	156,493	91,461	125,466	207,089	91,461	207,089	145,127
Austria	210,628	224,825	20,452	28,861	20,452	224,825	121,192
Poland	2,871,814	NA	NA	NA	2,871,814	2,871,814	2,871,814
Portugal	45,078	37,622	47,675	50,098	37,622	50,098	45,118
Romania	33,699	30,371	16,946	23,341	16,946	33,699	26,089
Slovenia	4,945	4,054	3,277	1,168	1,168	4,945	3,361
Slovakia	31,788	41,449	11,930	NA	11,930	41,449	28,389
Finland	113,219	104,330	114,357	56,207	56,207	114,357	97,028
Sweden	66,427	103,535	NA	125,342	66,427	125,342	98,435
United Kingdom	37,911	NA	11,285	5,209	5,209	37,911	18,135

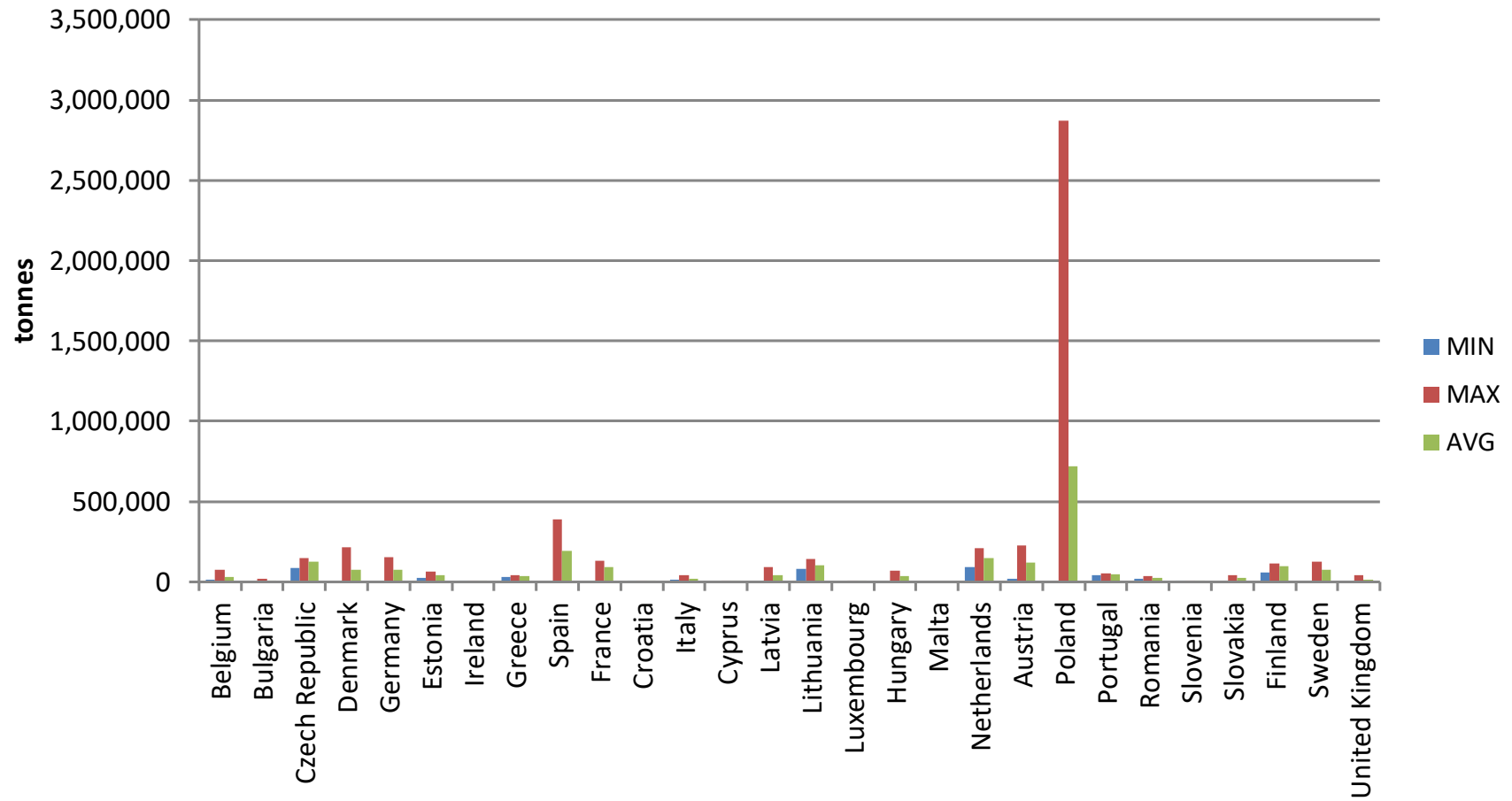


Figure 46 Tonnes of processed rye per country, 2010-2013

Table 39 Tonnes of rye bran per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	3,271	1,432	2,009	9,346	1,432	9,346	4,015
Bulgaria	2,160	0	0	0	0	2,160	540
Czech Republic	10,953	15,759	18,874	18,985	10,953	18,985	16,143
Denmark	28,163	0	0	10,867	0	28,163	9,758
Germany	0	5,607	19,759	12,107	0	19,759	9,368
Estonia	5,103	4,919	8,165	3,267	3,267	8,165	5,363
Ireland	754	187	116	4	4	754	265
Greece	5,552	4,873	3,689	4,558	3,689	5,552	4,668
Spain	50,359	0	22,888	25,164	0	50,359	24,603
France	16,982	12,253	16,717	0	0	16,982	11,488
Croatia	592	207	230	206	206	592	309
Italy	1,322	1,499	1,830	5,483	1,322	5,483	2,533
Cyprus	0	0	0	8	0	8	2
Latvia	11,906	10,528	0	0	0	11,906	5,609
Lithuania	11,712	12,767	18,167	10,096	10,096	18,167	13,185
Luxembourg	592	0	0	0	0	592	148
Hungary	8,999	8,329	0	0	0	8,999	4,332
Malta	0	0	0	0	0	0	0
Netherlands	20,344	11,890	16,311	26,922	11,890	26,922	18,867
Austria	27,382	29,227	2,659	3,752	2,659	29,227	15,755
Poland	373,336	0	0	0	0	373,336	93,334
Portugal	5,860	4,891	6,198	6,513	4,891	6,513	5,865
Romania	4,381	3,948	2,203	3,034	2,203	4,381	3,392
Slovenia	643	527	426	152	152	643	437
Slovakia	4,132	5,388	1,551	0	0	5,388	2,768
Finland	14,718	13,563	14,866	7,307	7,307	14,866	12,614
Sweden	8,636	13,460	0	16,294	0	16,294	9,597
United Kingdom	4,928	0	1,467	677	0	4,928	1,768

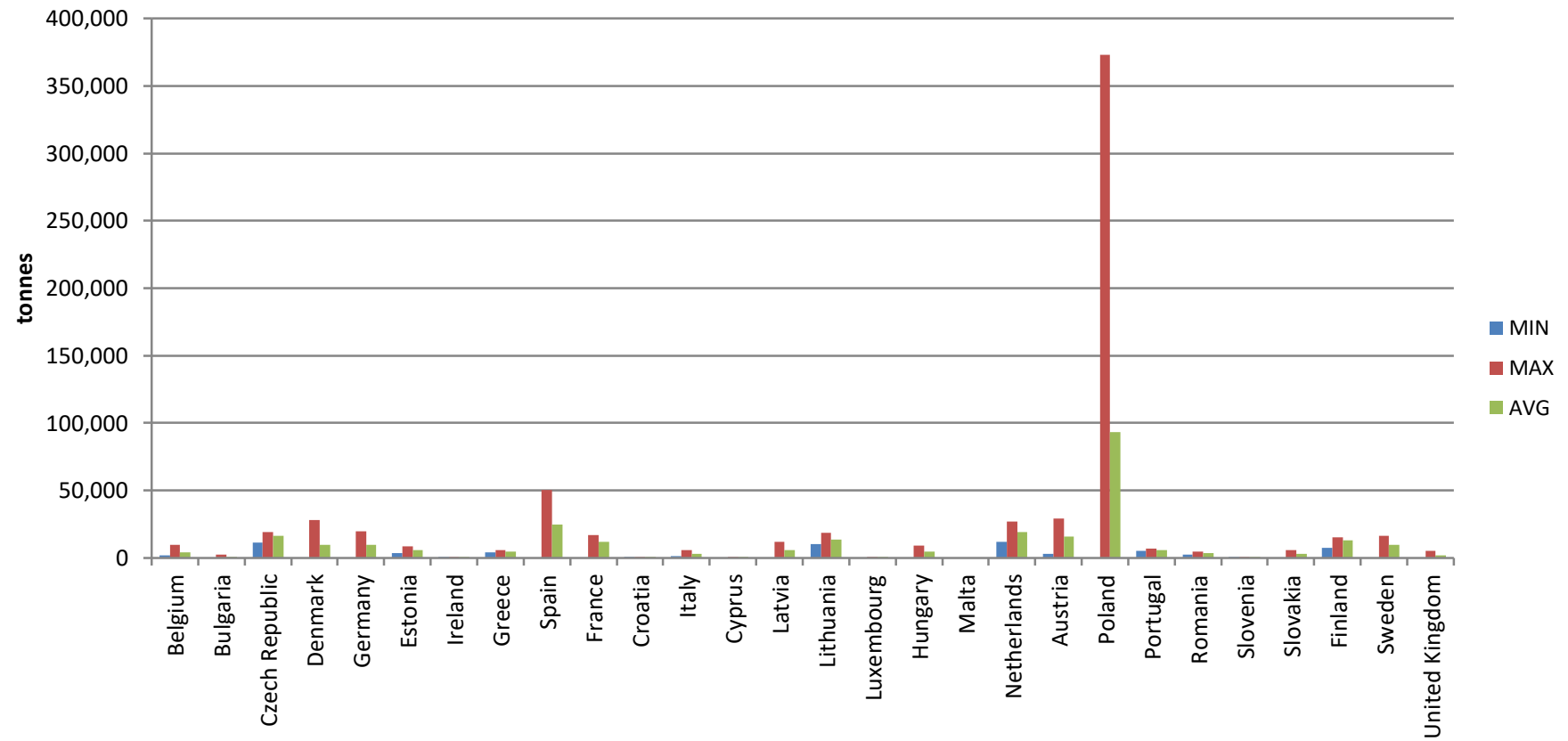


Figure 47 Tonnes of rye bran per country, 2010-2013

2.7 Wheat and spelt

Wheat is a cereal grain, one of top three produced worldwide, together with rice and maize (44). On a global level, wheat is the leading source of vegetable proteins in human food. Many types of products are derived from the wheat: bulgur, flour, wheat bran, wheat germ and pasta (45). Figure 48 shows wheat grains (46).



Figure 48 Wheat grains (46)

When 1 kg of wheat is harvested, between 0.5 kg and 2.37 kg of straw is left in the field. After the harvesting straw, it is collected and pressed into straw bales. The next step in the value chain is the processing of wheat, where between 0.13 and 0.20 kg of bran occur per kg of processed barley.

The flowchart (Figure 49) presents the AWCB value chain for wheat and specific AWCB weight factors from Table 2.

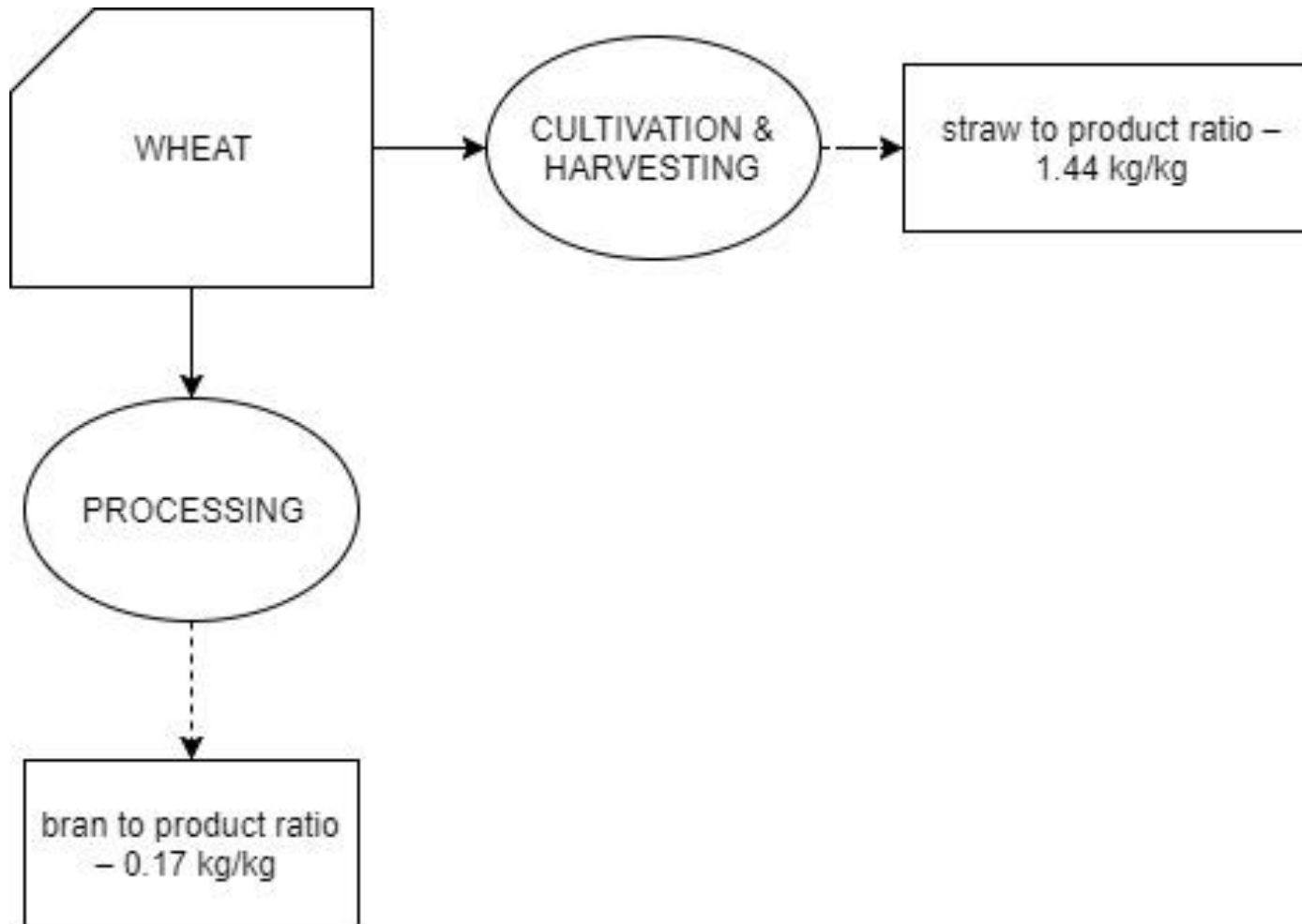


Figure 49 Wheat AWCB value chain

Data for cultivated wheat is taken from EUROSTAT, and data for imported and exported wheat is taken from FAOSTAT. By using relation (I-IX), the amount of processed wheat is calculated for every country in each year. Then the amount of AWCB is calculated for every step and every year. An example of the calculations for Austria in 2010:

PRD = 1,517,800 tonnes

IMP = 568,585 tonnes

EXP = 710,045 tonnes

PRC = (1,517,800 + 568,585 - 710,045) = 1,376,340 tonnes

Using the average mass of straw per 1 kg of harvested wheat (1.44 kg) the calculated quantity of straw for Austria was 2,185,632 tonnes in 2010. Also, in Austrian wheat processing facilities, 233,978 tonnes of bran was produced in 2010. Results for other countries and years are presented in the tables and figures below.

Table 40 Tonnes of harvested wheat and spelt per country, 2010-2015 (32)

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	1,912,800	1,687,730	1,834,600	1,843,600	1,918,980	2,075,000	1,687,730	2,075,000	1,878,785
Bulgaria	4,094,590	4,458,490	4,455,100	5,504,940	5,347,080	5,132,100	4,094,590	5,504,940	4,832,050
Czech Republic	4,161,550	4,913,050	3,518,900	4,700,700	5,442,350	5,274,270	3,518,900	5,442,350	4,668,470
Denmark	5,059,900	4,831,400	4,525,100	4,145,200	5,153,300	5,029,000	4,145,200	5,153,300	4,790,650
Germany	23,782,960	22,782,800	22,409,200	25,019,100	27,784,800	26,549,500	22,409,200	27,784,800	24,721,393
Estonia	327,600	360,200	484,700	406,800	615,500	812,600	327,600	812,600	501,233
Ireland	669,160	929,230	707,900	545,330	716,950	696,600	545,330	929,230	710,862
Greece	1,661,100	1,701,010	1,567,570	1,686,410	1,618,770	1,609,770	1,567,570	1,701,010	1,640,772
Spain	5,941,190	7,777,000	5,189,830	7,744,800	6,471,400	6,331,540	5,189,830	7,777,000	6,575,960
France	38,035,510	35,992,790	37,920,800	38,637,490	38,991,620	42,715,920	35,992,790	42,715,920	38,715,688
Croatia	681,020	782,500	999,680	998,940	650,800	761,500	650,800	999,680	812,407
Italy	6,777,260	6,622,000	7,654,250	7,312,020	7,141,920	0	0	7,654,250	5,917,908
Cyprus	18,890	23,740	22,920	15,180	4,440	35,360	4,440	35,360	20,088
Latvia	989,400	939,500	1,539,800	1,435,000	1,467,500	2,250,100	939,500	2,250,100	1,436,883
Lithuania	1,710,400	1,869,300	2,998,900	2,871,300	3,230,600	4,380,330	1,710,400	4,380,330	2,843,472
Luxembourg	83,470	76,840	79,200	91,060	77,940	91,060	76,840	91,060	83,262
Hungary	3,745,190	4,106,630	4,010,990	5,058,300	5,261,890	5,283,840	3,745,190	5,283,840	4,577,807
Malta	0	0	0	0	0	0	0	0	0
Netherlands	1,370,000	1,175,000	1,302,000	1,335,000	1,304,000	1,287,780	1,175,000	1,370,000	1,295,630
Austria	1,517,800	1,781,840	1,275,500	1,597,710	1,804,020	1,725,740	1,275,500	1,804,020	1,617,102
Poland	9,408,100	9,339,200	8,607,600	9,485,200	11,628,700	10,957,800	8,607,600	11,628,700	9,904,433
Portugal	82,580	51,000	58,990	92,010	98,790	80,390	51,000	98,790	77,293
Romania	5,811,810	7,131,590	5,297,750	7,296,370	7,584,810	7,962,420	5,297,750	7,962,420	6,847,458
Slovenia	153,480	153,580	188,070	138,240	173,240	0	0	188,070	134,435
Slovakia	1,185,290	1,631,100	1,275,300	1,684,270	2,072,410	2,097,500	1,185,290	2,097,500	1,657,645
Finland	724,400	974,800	887,100	869,400	1,088,200	0	0	1,088,200	757,317
Sweden	2,143,000	2,226,700	2,289,300	1,868,600	3,086,400	3,300,400	1,868,600	3,300,400	2,485,733
United Kingdom	14,878,000	15,257,000	13,261,000	11,921,000	16,606,000	16,444,000	11,921,000	16,606,000	14,727,833

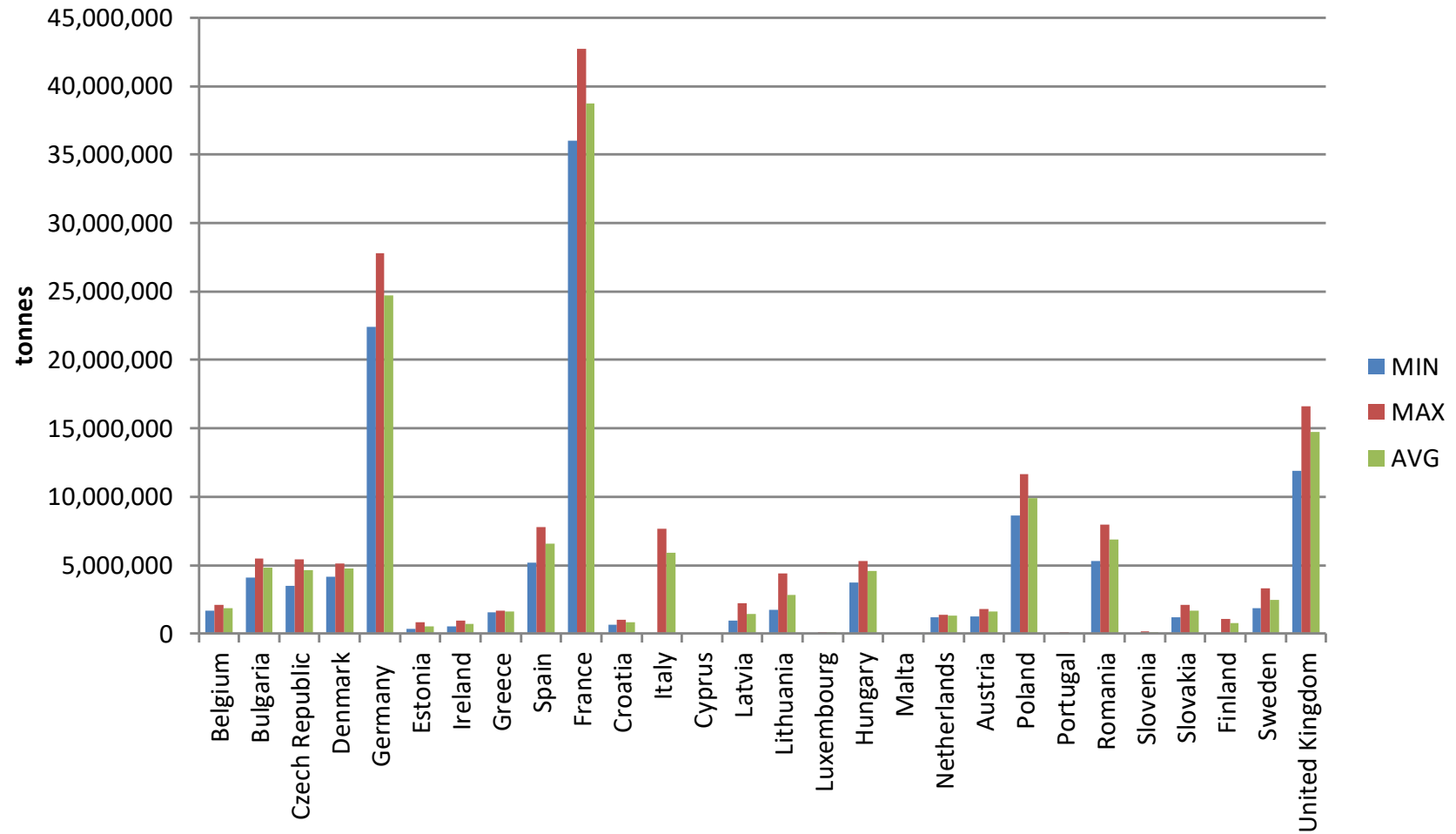


Figure 50 Tonnes of harvested wheat and spelt per country, 2010-2015

Table 41 Tonnes of wheat and spelt straw per country, 2010-2015

GEO/TIME	2010	2011	2012	2013	2014	2015	MIN	MAX	AVG
Belgium	2,754,432	2,430,331	2,641,824	2,654,784	2,763,331	2,988,000	2,430,331	2,988,000	2,705,450
Bulgaria	5,896,210	6,420,226	6,415,344	7,927,114	7,699,795	7,390,224	5,896,210	7,927,114	6,958,152
Czech Republic	5,992,632	7,074,792	5,067,216	6,769,008	7,836,984	7,594,949	5,067,216	7,836,984	6,722,597
Denmark	7,286,256	6,957,216	6,516,144	5,969,088	7,420,752	7,241,760	5,969,088	7,420,752	6,898,536
Germany	34,247,462	32,807,232	32,269,248	36,027,504	40,010,112	38,231,280	32,269,248	40,010,112	35,598,806
Estonia	471,744	518,688	697,968	585,792	886,320	1,170,144	471,744	1,170,144	721,776
Ireland	963,590	1,338,091	1,019,376	785,275	1,032,408	1,003,104	785,275	1,338,091	1,023,641
Greece	2,391,984	2,449,454	2,257,301	2,428,430	2,331,029	2,318,069	2,257,301	2,449,454	2,362,711
Spain	8,555,314	11,198,880	7,473,355	11,152,512	9,318,816	9,117,418	7,473,355	11,198,880	9,469,382
France	54,771,134	51,829,618	54,605,952	55,637,986	56,147,933	61,510,925	51,829,618	61,510,925	55,750,591
Croatia	980,669	1,126,800	1,439,539	1,438,474	937,152	1,096,560	937,152	1,439,539	1,169,866
Italy	9,759,254	9,535,680	11,022,120	10,529,309	10,284,365	0	0	11,022,120	8,521,788
Cyprus	27,202	34,186	33,005	21,859	6,394	50,918	6,394	50,918	28,927
Latvia	1,424,736	1,352,880	2,217,312	2,066,400	2,113,200	3,240,144	1,352,880	3,240,144	2,069,112
Lithuania	2,462,976	2,691,792	4,318,416	4,134,672	4,652,064	6,307,675	2,462,976	6,307,675	4,094,599
Luxembourg	120,197	110,650	114,048	131,126	112,234	131,126	110,650	131,126	119,897
Hungary	5,393,074	5,913,547	5,775,826	7,283,952	7,577,122	7,608,730	5,393,074	7,608,730	6,592,042
Malta	0	0	0	0	0	0	0	0	0
Netherlands	1,972,800	1,692,000	1,874,880	1,922,400	1,877,760	1,854,403	1,692,000	1,972,800	1,865,707
Austria	2,185,632	2,565,850	1,836,720	2,300,702	2,597,789	2,485,066	1,836,720	2,597,789	2,328,626
Poland	13,547,664	13,448,448	12,394,944	13,658,688	16,745,328	15,779,232	12,394,944	16,745,328	14,262,384
Portugal	118,915	73,440	84,946	132,494	142,258	115,762	73,440	142,258	111,302
Romania	8,369,006	10,269,490	7,628,760	10,506,773	10,922,126	11,465,885	7,628,760	11,465,885	9,860,340
Slovenia	221,011	221,155	270,821	199,066	249,466	0	0	270,821	193,586
Slovakia	1,706,818	2,348,784	1,836,432	2,425,349	2,984,270	3,020,400	1,706,818	3,020,400	2,387,009
Finland	1,043,136	1,403,712	1,277,424	1,251,936	1,567,008	0	0	1,567,008	1,090,536
Sweden	3,085,920	3,206,448	3,296,592	2,690,784	4,444,416	4,752,576	2,690,784	4,752,576	3,579,456
United Kingdom	21,424,320	21,970,080	19,095,840	17,166,240	23,912,640	23,679,360	17,166,240	23,912,640	21,208,080

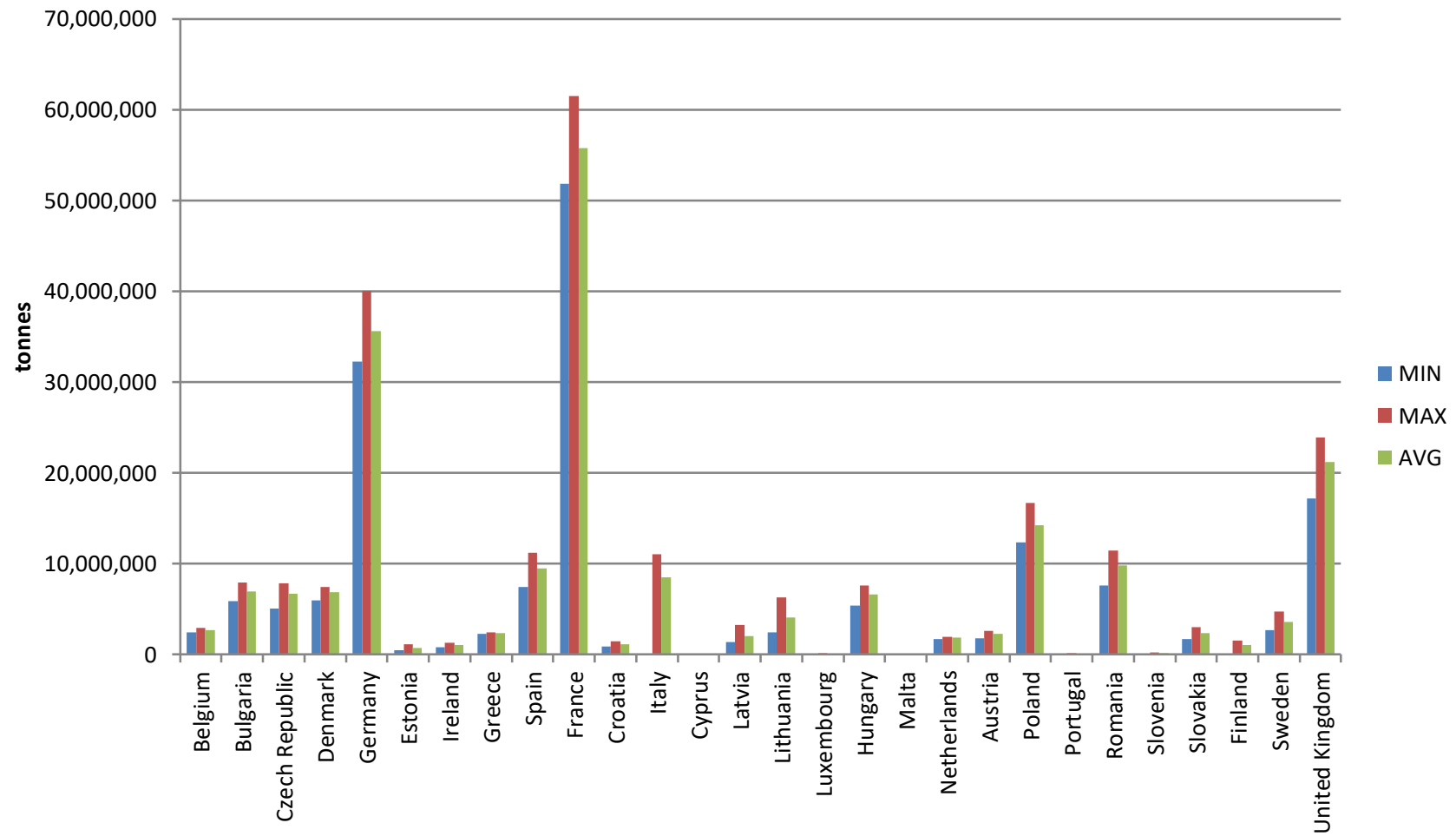


Figure 51 Tonnes of wheat and spelt straw per country, 2010-2015

Table 42 Tonnes of imported and exported wheat per country, 2010-2013 (5)

GEO/POPULATION	Trade	2010	2011	2012	2013
Belgium	Import	3,813,394	3,377,584	3,995,298	3,514,945
	Export	717,596	577,528	648,583	622,055
Bulgaria	Import	31,772	27,180	21,644	26,693
	Export	2,293,123	2,137,202	2,452,535	3,660,608
Czech Republic	Import	31,382	27,626	62,919	51,012
	Export	1,296,430	1,414,881	1,521,103	1,487,854
Denmark	Import	425,182	354,545	370,639	221,105
	Export	1,578,127	886,924	653,005	716,339
Germany	Import	3,992,310	4,410,957	3,534,904	3,836,075
	Export	8,915,328	6,168,890	6,993,096	8,223,838
Estonia	Import	23,700	9,387	12,707	28,379
	Export	124,301	70,214	251,253	226,394
Ireland	Import	289,424	217,395	304,772	226,755
	Export	50,614	120,118	50,881	46,646
Greece	Import	847,844	939,021	888,870	848,521
	Export	512,476	342,058	337,504	208,487
Spain	Import	4,595,206	4,355,655	5,467,687	3,401,941
	Export	438,080	567,885	283,463	592,564
France	Import	682,484	519,412	284,858	311,601
	Export	21,081,540	20,345,934	16,469,022	19,638,502
Croatia	Import	3,772	791	1,149	26,017
	Export	292,703	108,720	394,215	402,005
Italy	Import	7,477,216	7,321,062	6,108,562	5,792,798
	Export	395,284	570,009	256,616	188,164
Cyprus	Import	101,873	103,793	101,487	111,608
	Export	28	36	10	5
Latvia	Import	314,214	112,551	251,370	204,590
	Export	1,043,413	468,663	1,489,974	1,091,812
Lithuania	Import	95,250	64,287	160,446	49,110
	Export	1,123,107	808,963	1,680,302	1,931,515
Luxembourg	Import	67,524	78,152	113,474	113,239

	Export	35,138	16,517	32,000	22,769
Hungary	Import	77,450	66,888	65,090	73,992
	Export	2,110,818	1,246,456	1,324,686	2,412,684
Malta	Import	8,055	27,337	60,399	52,945
	Export	0	0	41,662	0
Netherlands	Import	5,262,085	3,906,390	3,689,624	3,576,135
	Export	525,519	549,447	528,889	586,773
Austria	Import	568,585	565,923	512,434	581,813
	Export	710,045	619,754	587,833	543,329
Poland	Import	683,524	816,653	735,149	570,886
	Export	940,295	825,288	1,060,554	1,641,747
Portugal	Import	1,505,231	1,256,394	1,389,895	1,071,862
	Export	47,242	35,678	44,759	9,467
Romania	Import	719,955	559,139	531,876	679,828
	Export	2,480,144	1,568,735	2,314,889	4,773,295
Slovenia	Import	105,128	155,870	111,993	204,225
	Export	40,054	17,578	76,937	113,151
Slovakia	Import	55,239	120,054	84,381	22,053
	Export	327,601	274,902	296,793	561,107
Finland	Import	13,410	7,446	10,094	11,448
	Export	142,402	194,365	214,182	163,454
Sweden	Import	179,127	258,815	288,061	200,110
	Export	386,270	406,748	343,039	238,729
United Kingdom	Import	1,110,861	901,511	1,784,946	2,963,404
	Export	3,334,768	2,287,100	1,503,413	447,822

Table 43 Tonnes of processed wheat per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	5,008,598	4,487,786	5,181,315	4,736,490	4,487,786	5,181,315	4,853,547
Bulgaria	1,833,239	2,348,468	2,024,209	1,871,025	1,833,239	2,348,468	2,019,235
Czech Republic	2,896,502	3,525,795	2,060,716	3,263,858	2,060,716	3,525,795	2,936,718
Denmark	3,906,955	4,299,021	4,242,734	3,649,966	3,649,966	4,299,021	4,024,669
Germany	18,859,942	21,024,867	18,951,008	20,631,337	18,859,942	21,024,867	19,866,789
Estonia	226,999	299,373	246,154	208,785	208,785	299,373	245,328
Ireland	907,970	1,026,507	961,791	725,439	725,439	1,026,507	905,427
Greece	1,996,468	2,297,973	2,118,936	2,326,444	1,996,468	2,326,444	2,184,955
Spain	10,098,316	11,564,770	10,374,054	10,554,177	10,098,316	11,564,770	10,647,829
France	17,636,454	16,166,268	21,736,636	19,310,589	16,166,268	21,736,636	18,712,487
Croatia	392,089	674,571	606,614	622,952	392,089	674,571	574,057
Italy	13,859,192	13,373,053	13,506,196	12,916,654	12,916,654	13,859,192	13,413,774
Cyprus	120,735	127,497	124,397	126,783	120,735	127,497	124,853
Latvia	260,201	583,388	301,196	547,778	260,201	583,388	423,141
Lithuania	682,543	1,124,624	1,479,044	988,895	682,543	1,479,044	1,068,777
Luxembourg	115,856	138,475	160,674	181,530	115,856	181,530	149,134
Hungary	1,711,822	2,927,062	2,751,394	2,719,608	1,711,822	2,927,062	2,527,472
Malta	8,055	27,337	18,737	52,945	8,055	52,945	26,769
Netherlands	6,106,566	4,531,943	4,462,735	4,324,362	4,324,362	6,106,566	4,856,402
Austria	1,376,340	1,728,009	1,200,101	1,636,194	1,200,101	1,728,009	1,485,161
Poland	9,151,329	9,330,565	8,282,195	8,414,339	8,282,195	9,330,565	8,794,607
Portugal	1,540,569	1,271,716	1,404,126	1,154,405	1,154,405	1,540,569	1,342,704
Romania	4,051,621	6,121,994	3,514,737	3,202,903	3,202,903	6,121,994	4,222,814
Slovenia	218,554	291,872	223,126	229,314	218,554	291,872	240,717
Slovakia	912,928	1,476,252	1,062,888	1,145,216	912,928	1,476,252	1,149,321
Finland	595,408	787,881	683,012	717,394	595,408	787,881	695,924
Sweden	1,935,857	2,078,767	2,234,322	1,829,981	1,829,981	2,234,322	2,019,732
United Kingdom	12,654,093	13,871,411	13,542,533	14,436,582	12,654,093	14,436,582	13,626,155

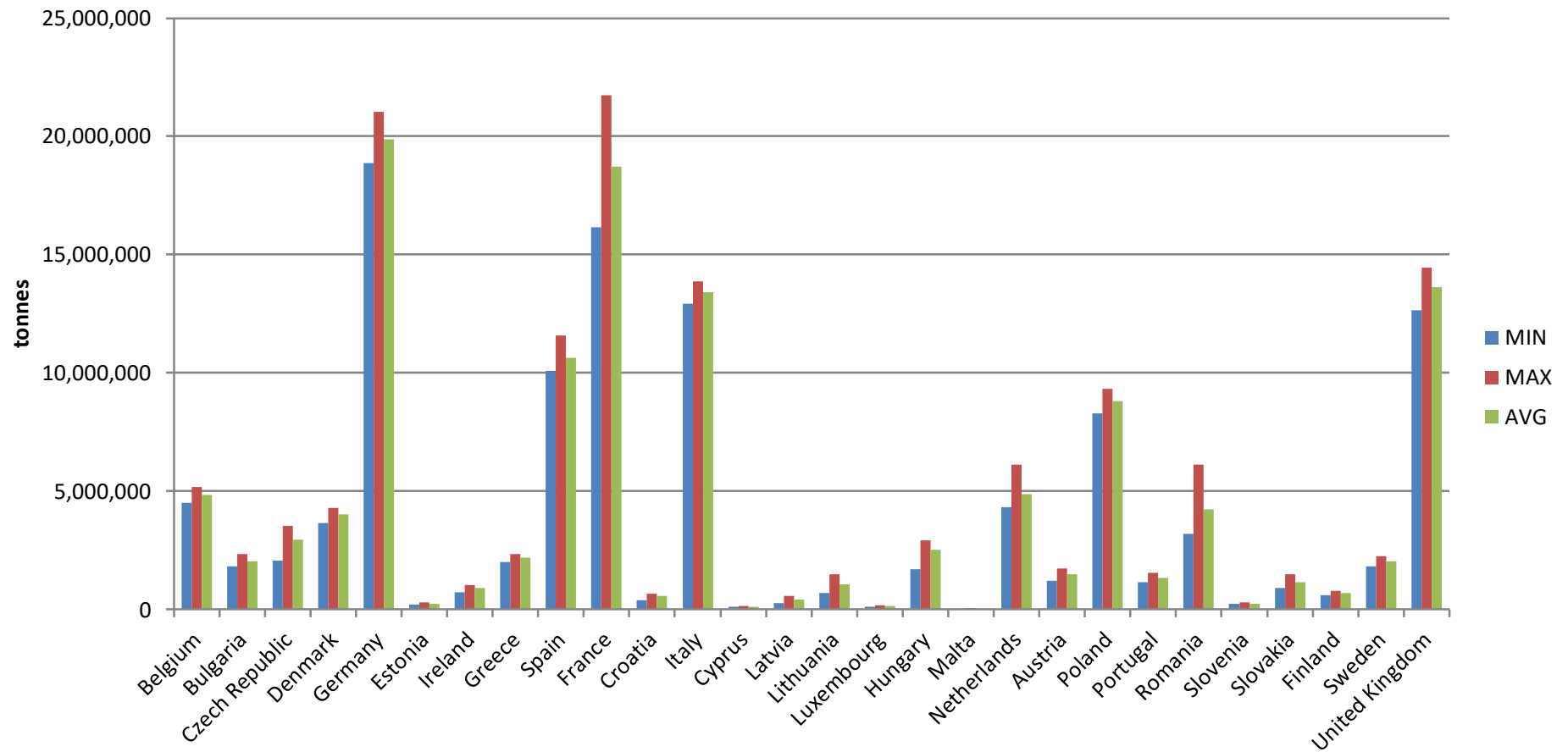


Figure 52 Tonnes of processed wheat per country, 2010-2013

Table 44 Tonnes of wheat bran per country, 2010-2013

GEO/TIME	2010	2011	2012	2013	MIN	MAX	AVG
Belgium	851,462	762,924	880,824	805,203	762,924	880,824	825,103
Bulgaria	311,651	399,240	344,116	318,074	311,651	399,240	343,270
Czech Republic	492,405	599,385	350,322	554,856	350,322	599,385	499,242
Denmark	664,182	730,834	721,265	620,494	620,494	730,834	684,194
Germany	3,206,190	3,574,227	3,221,671	3,507,327	3,206,190	3,574,227	3,377,354
Estonia	38,590	50,893	41,846	35,493	35,493	50,893	41,706
Ireland	154,355	174,506	163,504	123,325	123,325	174,506	153,923
Greece	339,400	390,655	360,219	395,495	339,400	395,495	371,442
Spain	1,716,714	1,966,011	1,763,589	1,794,210	1,716,714	1,966,011	1,810,131
France	2,998,197	2,748,266	3,695,228	3,282,800	2,748,266	3,695,228	3,181,123
Croatia	66,655	114,677	103,124	105,902	66,655	114,677	97,590
Italy	2,356,063	2,273,419	2,296,053	2,195,831	2,195,831	2,356,063	2,280,342
Cyprus	20,525	21,674	21,147	21,553	20,525	21,674	21,225
Latvia	44,234	99,176	51,203	93,122	44,234	99,176	71,934
Lithuania	116,032	191,186	251,437	168,112	116,032	251,437	181,692
Luxembourg	19,696	23,541	27,315	30,860	19,696	30,860	25,353
Hungary	291,010	497,601	467,737	462,333	291,010	497,601	429,670
Malta	1,369	4,647	3,185	9,001	1,369	9,001	4,551
Netherlands	1,038,116	770,430	758,665	735,142	735,142	1,038,116	825,588
Austria	233,978	293,762	204,017	278,153	204,017	293,762	252,477
Poland	1,555,726	1,586,196	1,407,973	1,430,438	1,407,973	1,586,196	1,495,083
Portugal	261,897	216,192	238,701	196,249	196,249	261,897	228,260
Romania	688,776	1,040,739	597,505	544,494	544,494	1,040,739	717,878
Slovenia	37,154	49,618	37,931	38,983	37,154	49,618	40,922
Slovakia	155,198	250,963	180,691	194,687	155,198	250,963	195,385
Finland	101,219	133,940	116,112	121,957	101,219	133,940	118,307
Sweden	329,096	353,390	379,835	311,097	311,097	379,835	343,354
United Kingdom	2,151,196	2,358,140	2,302,231	2,454,219	2,151,196	2,454,219	2,316,446

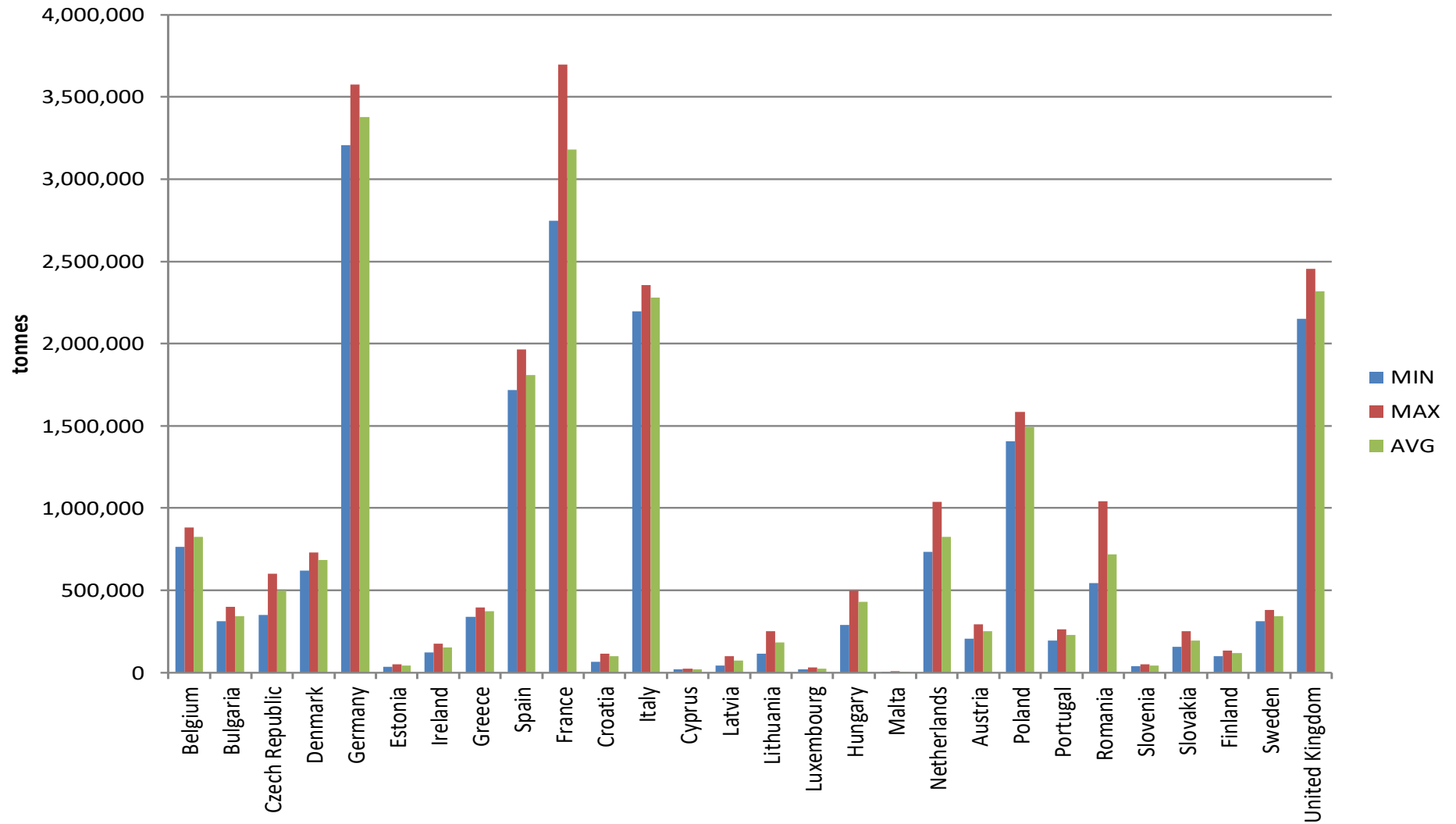


Figure 53 Tonnes of wheat bran per country, 2010-2013

3 Total quantity of AWCB

Figure 54 presents cumulative data for average, minimum and maximum AWCB mass that occurred in the period 2010-2015 for every EU-28 country. Different colours were used in order to specify the type of AWCB.

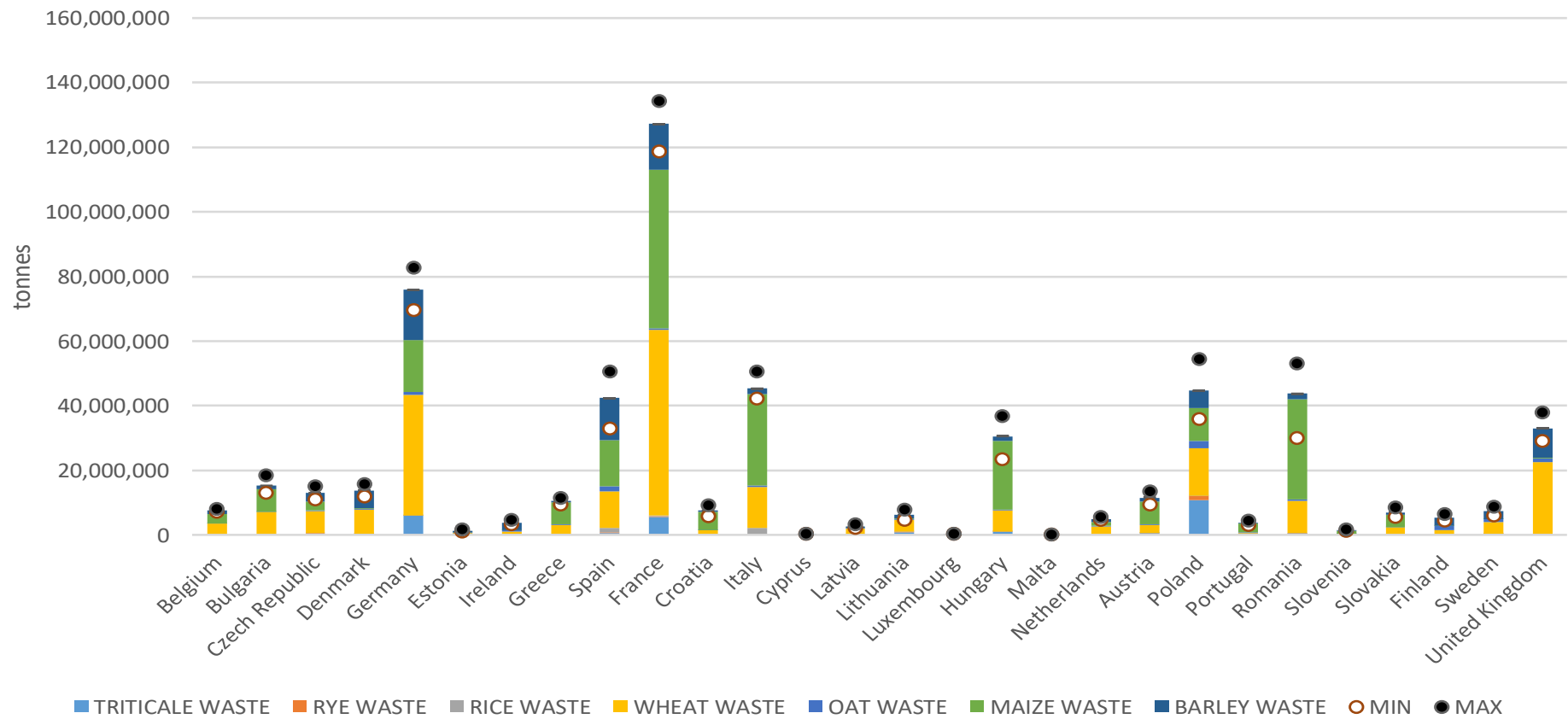


Figure 54 Total quantity of cereal AWCB in the period 2010-2013

4 Current practices of commodity AWCB valorisation

The AWCB that is generated during processing of cereal is usually used in some way. For an example, straw collected on the field and pressed into bales is an effective use for construction material for building houses (47).



Figure 55 Use of straw bales for building walls (48)

Straw has a low thermal conductivity, which means it can provide good isolation when used as a building material. However, straw bales have some disadvantages when considering their use in building houses (49). The durability of walls depends on the quantity of pesticides applied when cereals were grown. Only straw from organic farmers should be used for building. Maize stalks can be used as material in anaerobic composting (50).



Figure 56 Maize stalks in anaerobic composting (50)

Also rice by-products such as husk; bran and straw can be used in anaerobic composting. Furthermore, rice straw can be used as a substrate in the production of bioethanol, due to high carbohydrate content (51). Maize husk contains fibres that can be used in the production of R-LDPE (recycled low-density polyethylene) (52).

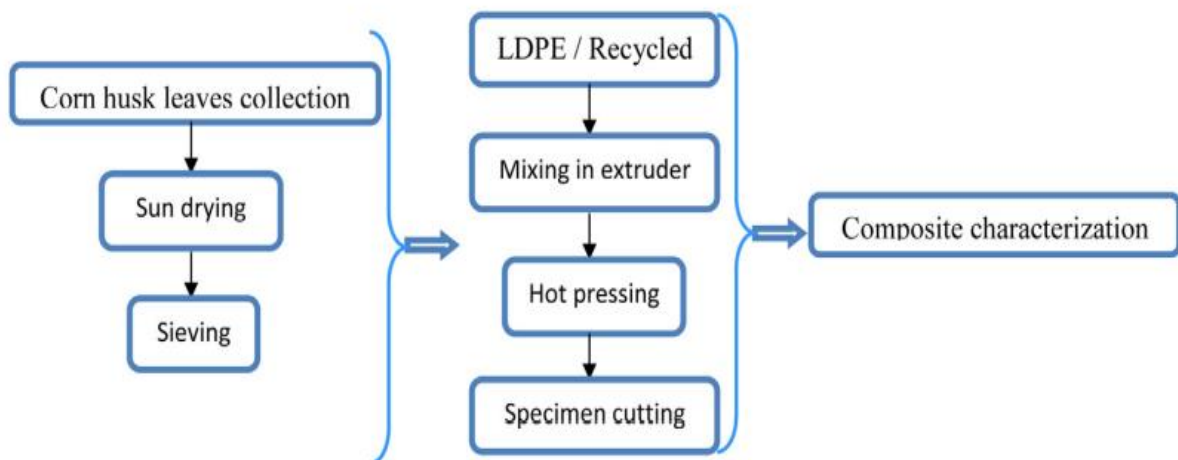


Figure 57 Use of fibres in corn husk (52)

Straw can be used in the production of biohydrogen by photo-fermentation pathway (53), and can be also used in bioethanol production (54). Figure 58 shows a schematic of bioethanol production from rice straw (55).

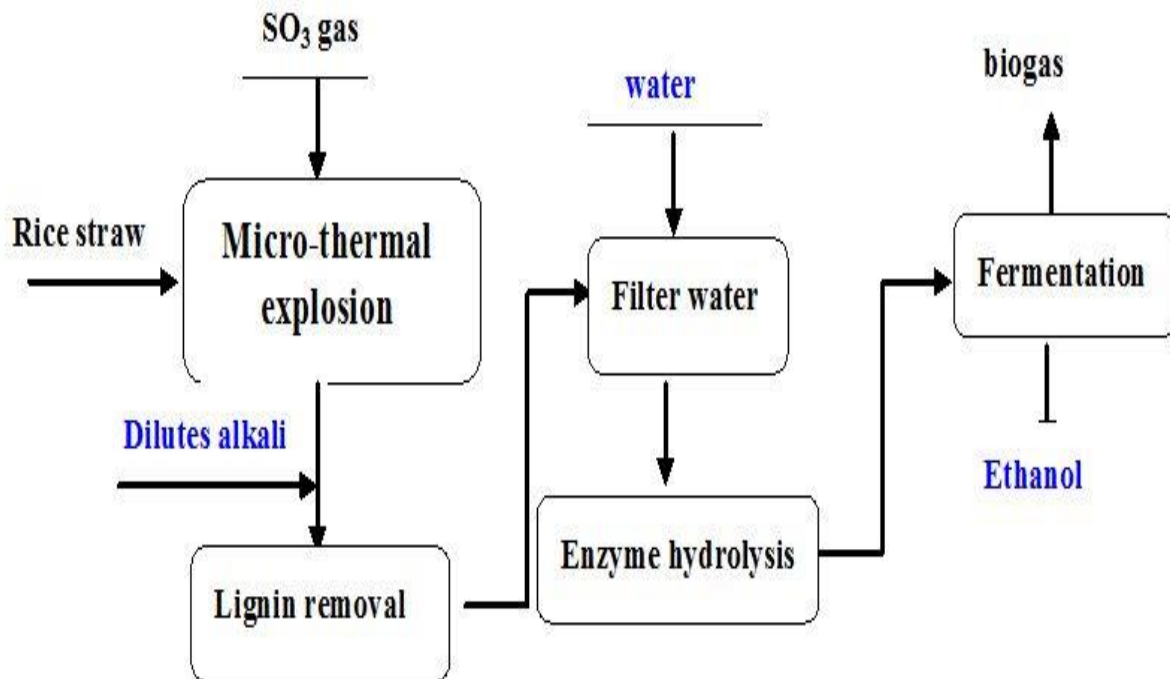


Figure 58 Bioethanol production from rice straw (55)

Furthermore, rice husks and maize cobs can be used in the production of fuel briquettes (56). Wheat bran can be used in the preparation of eco-friendly superabsorbent in combination with clay (57). Also, calcined rice bran can be used in cationic dye removal (58). Rye bran is a source of saturated and unsaturated 5-n-alk(en)ylresorcinols that can be used in pharmaceutical industry. They can also be used as a feedstock for anaerobic digestion.

Table 45 Characteristics, potential use and developed patents of cereal AWCB

AWCB	Characteristics	Potential use	Patents
Straw	Straw has complex chemical composition: monosaccharides, disaccharides, oligosaccharides, sugar alcohols, uronic acids, lignin, and metal elements (59); it provides good thermal isolation due to low thermal conductivity (60); straw is a material with a great water absorption coefficient (61)	Construction material for building houses (47); direct combustion power generation, gasification, power generation, methanol production, flash pyrolysis, acid hydrolysis, ethanol fermentation, co-firing (62); biofuel/bio liquids, bioelectricity and heat (51), (53), (63)	Crop straw fibre used as making material (64); Activated carbons from low-density agricultural waste (65)
Stalks	Stalks are primarily composed from: cellulose fibres, lignin and moisture (66); their mechanic properties depend on the purpose of use (67)	Production of pulp and paper (66); production of biomass briquettes (68); preparation of activated carbon (69), (70); material for adsorption of heavy metals (71)	Maize stalks as one of the material for fermenting stalks of the Poaceae family (72)
Cobs	Maize cobs contain (in weight %) according to (73): cca. 73% of holocellulose, cca. 28% of pentosane, 16% of lignin, around 4% of ethanol-benzene soluble matter and more than 6% of other matter (73); physical properties of cobs depend on moisture content (crushing strength and elastic modulus) (74)	Production of fuel briquettes (56); food in animal diet (75), (76); adsorption material (77)	Production of ethanol from biomass that includes cobs (78)
Husks	Rice husk contains: oxygen, carbon, ash, moisture, hydrogen, nitrogen and sulphur (79), (80); wheat husk chemical composition in presented in (81) assumes that almost 80% of husk is an organic material, around 10% are residues and cca. 10% is moisture	Production of R-LDPE (recycled low-density polyethylene) (52); production of fuel briquettes (56); production of pulp and paper due to fibre characteristics (82)	Rice husk ash used as a material for binding silver nanoparticles (83)
Bran	Bran is primarily composed from: moisture, proteins, fat, carbohydrates, crude fibre, etc. (84), (85)	Eco-friendly absorbent (57); cationic dye removal (58); production of biofuels (86); preparation of Biochemicals and biomolecules (87), (88)	A rice bran-like composition for use in reducing or suppressing an increase in visceral fat (89)

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6 ANNEX - Consumption per capita

Table 46 Rice consumption per capita in kg/year

Country	Average (PC)	Reference
Belgium	8.9	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Bulgaria	2.6	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Czech Republic	4.4	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Denmark	5.2	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Germany	2.9	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Estonia	2.1	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Ireland	3.5	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Greece	6.4	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Spain	8.7	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
France	5.6	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Croatia	2.3	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Italy	5.3	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Cyprus	5.6	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Latvia	1.8	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Lithuania	1.7	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Luxembourg	3.8	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Hungary	1.9	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Malta	4.5	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Netherlands	2.8	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Austria	3.6	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Poland	0.9	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Portugal	16.0	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Romania	2.9	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Slovenia	2.1	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Slovakia	2.4	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Finland	4.1	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
Sweden	5.6	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)
United Kingdom	6.9	http://www.helgilibrary.com/indicators/rice-consumption-per-capita/world (accessed October 31, 2016)