

AN OVERVIEW OF GLOBAL MAIZE MARKET COMPARED TO ROMANIAN PRODUCTION

Vili Dragomir¹, Ioan Sebastian Brumă^{2*}, Alina Butu³, Victor Petcu^{4*},
Lucian Tanasă², Daniela Horhocea⁴

¹Institute of Research for Agriculture Economy and Rural Development, 61 Mărăști Blvd, District 1,
Bucharest, Romania

²Romanian Academy, "Gh. Zane" Institute for Economic and Social Research, 2 Codrescu str., Iași,
Iași County, Romania

³National Institute of Research and Development for Biological Sciences, 296 Splaiul Independenței, District 6,
Bucharest, Romania

⁴National Agricultural Research and Development Institute Fundulea, 915200 Fundulea, Călărași County, Romania

*Corresponding authors. E-mail: sebastianbruma1978@gmail.com; victor.petcu@incda-fundulea.ro

ABSTRACT

Maize is one of the most important crops cultivated around the world and can be easily grown in various climate conditions, under conventional and organic system. Maize cultivation has many advantages, such as: high yield, strong stability, great potential for increasing yield, strong disaster resistance, wide application range, and high economic benefits. It plays an important role in food production, and it is also due to the growth of animal husbandry and the food processing industry. This article is an overview of global maize market and maize market and production in Romanian economy, related to trade indicators, with a special target on organic production and analysis on territorial profile of organic maize cultivation.

Keywords: maize, cereal crops, Romania, organic production.

INTRODUCTION

Maize (*Zea mays*) is considered in many countries one of the most important crops and is cultivated in almost every part of the world. It is a vital cereal crop for human and animal consumption and for industrial uses, as well (Kandil et al., 2020; Revilla et al., 2022). Together with rice and wheat, it delivers minimum 30 percent of the food calories and is a source of protein for more than four and a half billion people in over 90 developing countries (Shiferaw et al., 2011; Amegbor et al., 2022). Apart from bringing significant nutrient intake for humans and animals, maize is used as raw material for the production of various other key products such as starch, oil, alcoholic beverages, food sweeteners, and fuel (Butnariu et al., 2014; Chen et al., 2019). The economic importance of maize is given by its great productive potential and the diversity of products that can be obtained from the

cultivation of this crop, from food to biofuels.

Maize crop has a number of particularities, which justify its special importance among crop plants (Petcu and Petcu, 2008; Barşon et al., 2021), such as: it has a great ecological plasticity; has a good resistance to drought and heat; it can be cultivated without special problems in monoculture for several years; it is a good precursor for most crops, leaving the soil relatively clean of weeds; can be sown as a second crop, after the plants with early harvest; has a high multiplication coefficient (between 150 and 400), achieving high yields (about 50% larger compared to other cereals); has a low number of diseases and pests.

In the last decade, according to FAOSTAT data, the average yearly world production of maize was around 1,036 billion tonnes. There are 4 main worldwide regions producing maize, namely North America (over 30% of global production); China (over 20% of

global production); Europe, which includes both the producing countries of the European Union and Eastern Europe (notably Ukraine), accounts for about 12% of the world's maize production while South America produces 15% of the world's maize, thanks to Brazil, Argentina and Mexico (Erenstein et al., 2021; Grote et al., 2021; Eurostat data).

Therefore, maize is grown in a wide variety of growing conditions ranging from tropical to temperate climates, from sea level to 3,000 meters above sea level. Grown on all continents, maize is adapted to a subsistence farming scheme as is the case in sub-Saharan Africa, or on the contrary more intensive as in the United States.

In Romania's cereal economy, maize holds the one of the top positions (Popescu et al., 2021). It occupies half of the total area cultivated with cereals and has the largest contribution to the total agricultural production of our country. It is cultivated in all geographical areas of the country, from latitudes of 40-50 m in the plain areas to 500-800 m in the sub-Carpathian areas.

This article is an overview of global maize market and maize market and production in Romanian economy, related to trade indicators, with a special target on organic production and analysis on territorial profile of organic maize cultivation.

MATERIAL AND METHODS

The research study used open data available on official website of Ministry of

Agriculture and Rural Development (MARD, 2022), The National Institute of Statistics, Eurostat and Trademap database.

The analysis related to world market and national production covers a five years period, from 2016-2020.

The search criteria for Trademap database was using four digits code from Harmonized system for maize (1005 Maize or corn).

For export potential investigation, a six digit code was used in search query on in traced website, namely, 100590 Maize (excluding seed for sowing) and 100510 Maize seed for sowing.

Areas under conversion and certified in organic system occupied by maize were also highlighted, for a four year period, between 2017-2020. Data retrieved from specialized and scientific literature were used to complete the analysis.

Related to organic farming production system, a territorial assessment was accomplished, going up to county level, regarding the areas cultivated with maize in ecological system. For the representation in territorial profile the data were plotted on Romania's map, by county, using QGIS 3.16.0 "Hannover" software.

RESULTS AND DISCUSSION

Maize production is cornerstone for the economy of many countries. The main maize exporters of the world are Unites States of America, Brazil, Argentina and Ukraine (Figure 1).

VILI DRAGOMIR ET AL.: AN OVERVIEW OF GLOBAL MAIZE MARKET COMPARED TO ROMANIAN PRODUCTION

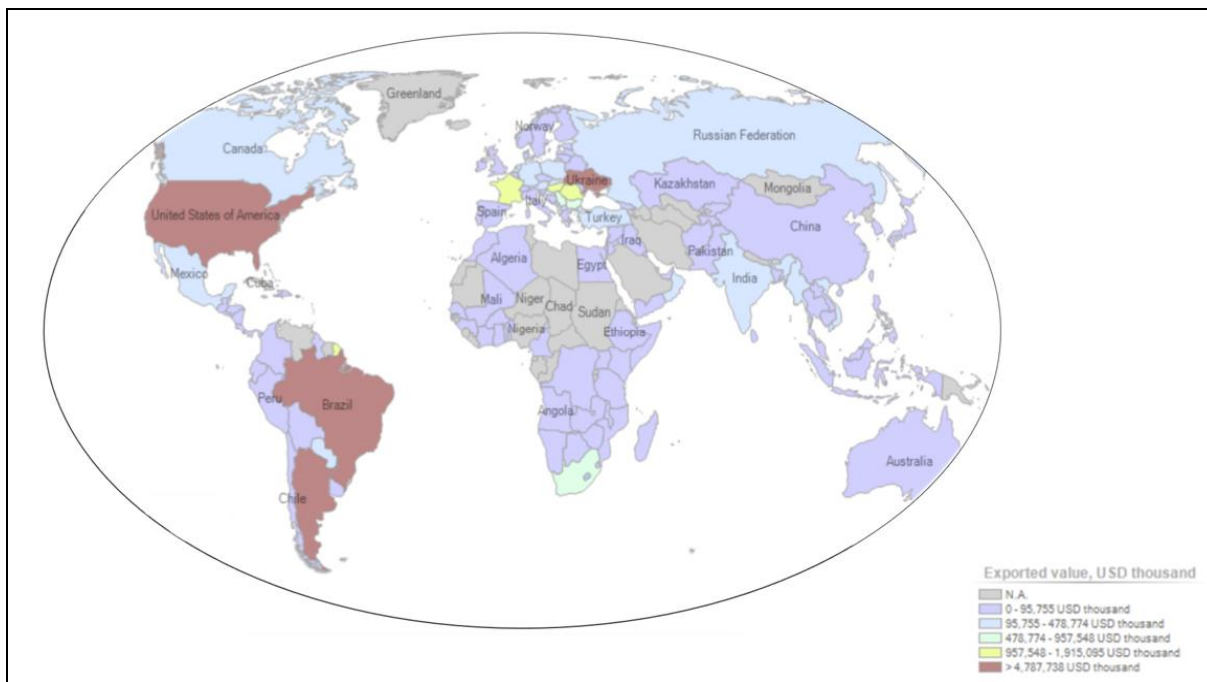
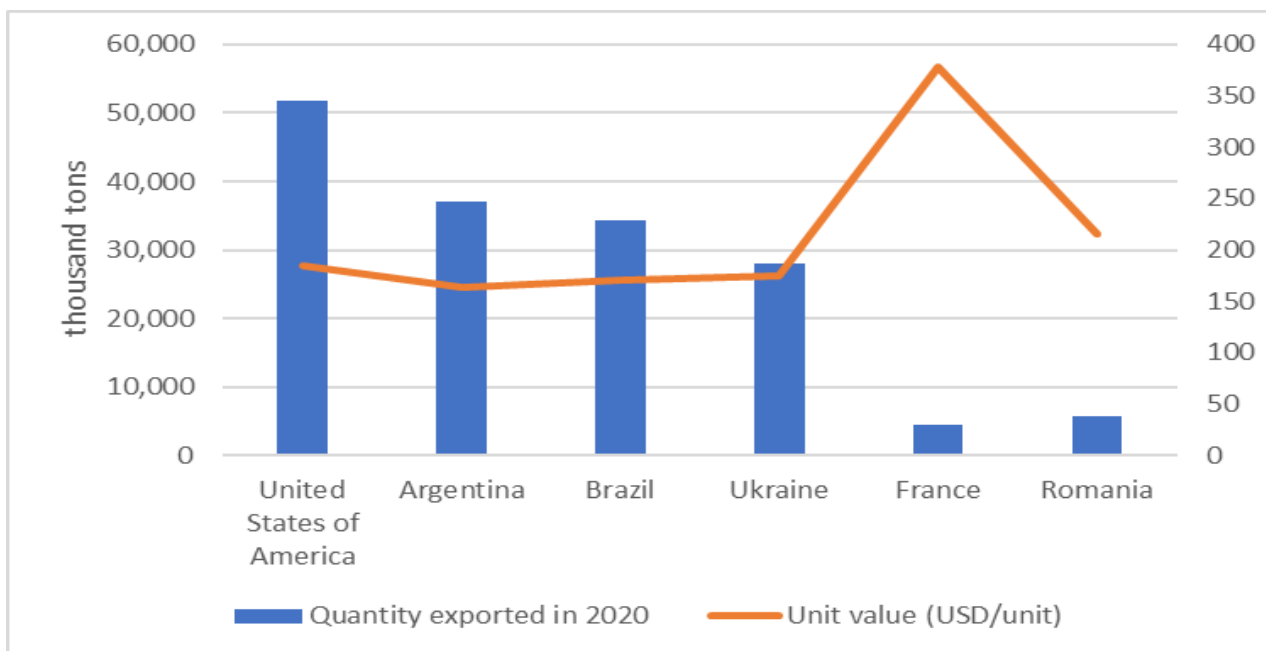


Figure 1. Main worldwide exporters for maize (corn), in 2020

However, the unit value of worldwide sales does not follow the same trend, France being the country that is marketing the maize with highest price, being followed by Romania, United States of America and

Ukraine. This could be probably due to superior quality of harvest, and the commercialization of important quantities of originating from organic production.



*Trademap data

Figure 2. Quantities and unit value for main worldwide exporters for maize (corn), in 2020

We furthermore detail the trade market export for the period 2016-2020 for maize harvest for one country per continent among

the top worldwide exporters (Table 1). For USA, data are presented for 2021 due to data availability.

The United States of America is by far the largest exporter of maize worldwide, with a total volume of trade in a five-year period decade exceeding the next largest exporter by over twofold. It is to be noted that while the exported quantity of maize of this state has increased from 55,905 thousand tons in 2016 to 70,041 thousand tons in 2021, the export to China have boosted from around 230

thousand tons in 2016 to 7053 thousand tons in 2020 and over 18800 thousand tons in 2021 (trade map data). Other importing countries for American maize were neighboring states such as Mexico, Japan and Colombia. The number of importing countries decreased from 130 in 2016 to 115 in 2020 and 111 in 2021.

Table 1. Global Import and export value and quantity for a five year period

Country	Imported value	Imported Quantity	Country	Exported value	Exported quantity
Japan	14,398.64	78,220.26	USA	44,286.39	272,703.10
Mexico	13,296.85	46,539.84	Argentina	21,473.33	144,671.77
Iran	6,763.55	32,702.66	Brazil	22,715.96	152,419.38
China	4,906.00	25,598.68	Ukraine	16,952.16	118,402.66
Viet Nam	8,798.17	49,464.30	France	6,909.84	22,896.80
Korea	9,283.46	52,307.56	Romania	4,616.05	24,367.50
Egypt	8,176.25	8,516.79	Hungary	3,753.10	0.00
Spain	7,262.14	32,995.73	Serbia	1,866.47	11,391.28
Netherlands	5,279.47	27,971.51	South Africa	1,854.31	9,225.33
Colombia	4,581.71	26,848.24	Bulgaria	1,469.25	8,906.34
Italy	5,005.53	28,216.26	Rusia	3,181.85	20,695.86
Germany	3,967.66	16,847.14	India	944.58	4,217.56
Taipei, Chinese	3,838.46	22,076.24	Myanmar	1,219.93	4,377.18
Algeria	3,493.47	22,692.96	Paraguay	1,351.25	10,631.05
Malaysia	3,395.59	18,799.34	Poland	1,053.34	5,798.45
Peru	3,121.87	17,776.99	Austria	948.55	2,130.57
Saudi Arabia	2,508.56	13,463.47	Canada	1,356.28	7,890.84
UK	2,343.20	9,306.08	Croatia	593.03	3,557.63
Chile	1,782.70	10,352.62	Mexico	1,504.58	4,183.82
Morocco	2,166.32	12,366.71	Netherlands	905.61	3,928.61

*Trademap data; quantitative data for Hungary were not available.

Argentinian exported maize quantities increased from 24,504 thousand tons to 37,045 thousand tons in 2020. The main importing countries for Argentina's maize were Vietnam, Korea and Egypt. The trade market of maize for this state included 65 countries in 2020.

The quantity of maize exported from Ukraine has increased from 17,275 thousand

tons in 2016 to 27,945 thousand tons in 2020. Main importers of maize from this country were China (2,680 thousand tons in 2016 to 7,712 tons in 2020), Netherlands and Egypt. In 2020, a share of over 27 percent of Ukrainian maize was marketed to China, 10% to Nederland and Egypt, each, and 9% to Egypt. The number of importing countries for this product, from Ukraine, in 2020, was 66.

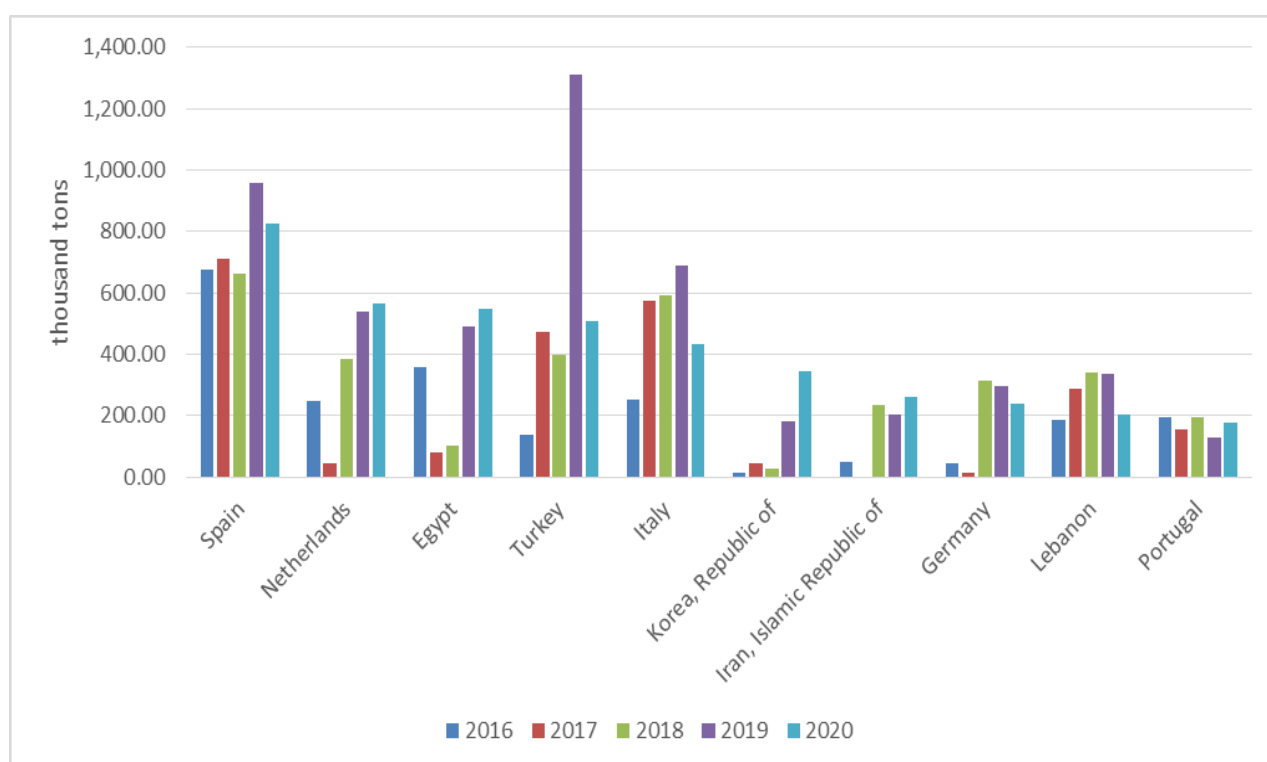
VILI DRAGOMIR ET AL.: AN OVERVIEW OF GLOBAL MAIZE MARKET
COMPARED TO ROMANIAN PRODUCTION

On the other side, in the period 2016-2020, the main maize importers were countries with high demands for food, such as Japan, Mexico, Iran, China and Vietnam (Table 1). Although, Mexico belongs a huge biodiversity potential and millennial tradition of maize cultivation (Donovan et al., 2022), the request for livestock and food industry overcomes the local production.

Japan is mainly covering the national maize needs from United States of America (63% in 2020), Brazil (35% in 2020) and South Africa (1% in 2020).

Data for Mexico were only available for up to 2018, but still ranks among top importers worldwide mainly importing from United States of America (over 90% of national imports of maize) and Brazil.

Romania's maize exports represent 3.3% of world exports for this product, its ranking in world exports being 6. For Romanian production, the largest importing markets for maize were Spain, Netherlands, Egypt, Turkey and Italy (Figure 3). A total number of 53 countries were partners for maize export from Romania in 2020.

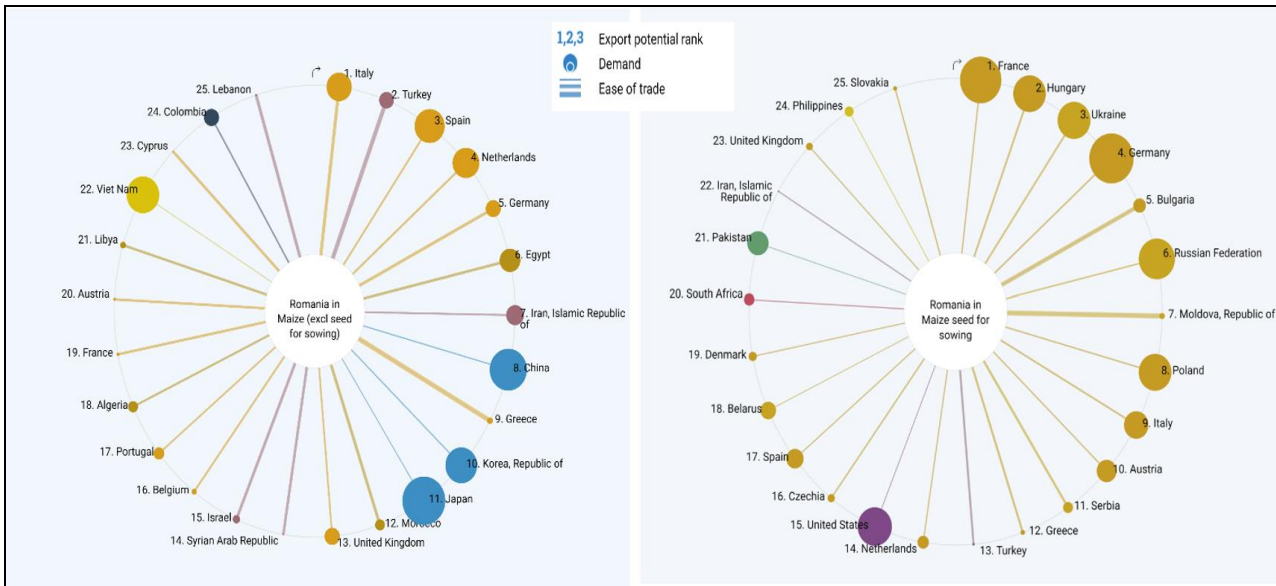


*Trademap data

Figure 3. Importing markets for maize marketed from Romania

The top three markets with greatest potential for export from Romania (Figure 4) of the product 100590 Maize (excluding seed for sowing) are Italy, Turkey and Spain. In the same time, Romania has neighboring export activity with Greece. Regarding the demand potential, Japan is the country with the highest rank for the product 100590 Maize (excluding seed for sowing).

The top three markets with greatest potential for export from Romania of the product 100510 Maize seed for sowing are France, Hungary and Ukraine. The closest export links of Romania for maize seed is Moldova. Regarding the demand potential, Germany is ranking highest as market for maize seed for sowing from Romania (Figure 4).

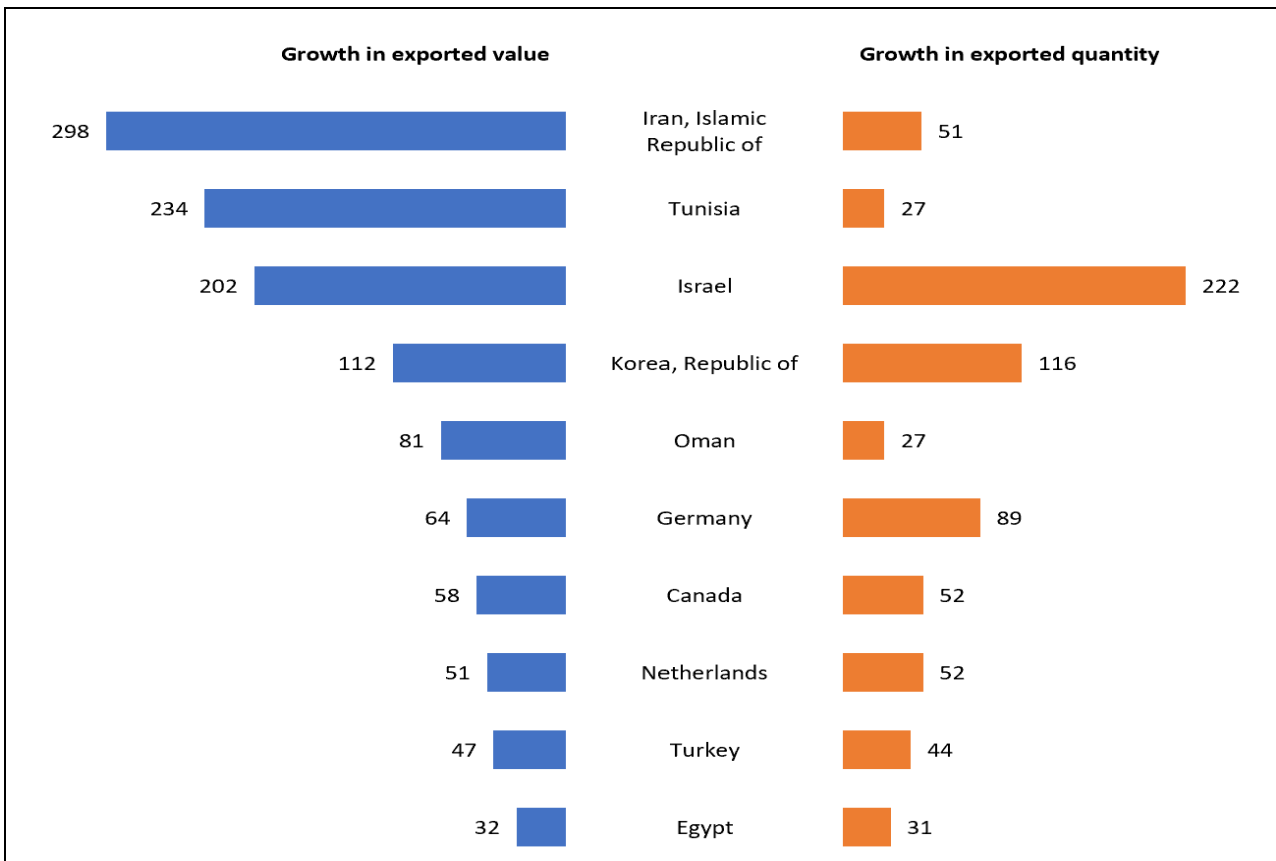


*Intracena data

Figure 4. Export potential for maize from Romania
a) 100590 Maize (excl seed for sowing); b) 100510 Maize (seed for sowing)

In 2020, according to Trademap data, regarding the dynamics of the market, it can be observed (Figure 5) that for the analysed period (2016-2020) the greatest growth in exported value was reported for Iran (298%)

Tunisia (234%) and Israel (202%). However, the top listed countries when looking at growth in exported quantities for the same period, includes Israel (222%), Republic of Korea (116%) and Germany (89%).



*Trademap data

Figure 5. Growth in exported value and exported quantity %, 2016-2020

VILI DRAGOMIR ET AL.: AN OVERVIEW OF GLOBAL MAIZE MARKET
COMPARED TO ROMANIAN PRODUCTION

In Romania, there are three areas of favor for the cultivation of corn, depending on thermal potential, which is represented by the sum of biologically active temperatures ($>10^{\circ}\text{C}$), which are equivalent to useful thermal units (UT) (Roman, 2011). Thus, although we have the largest cultivated area of corn in the EU, the yield per hectare is twice lower compared to France or Belgium (Petcu and Martura, 2018).

An important opportunity for Romanian market, in addition to increasing the yield per hectare, is expanding the organic sector, which has great potential in our country due

to soil characteristics (Popovici et al., 2018). Organic farming promotes sustainable, diversified and balanced production systems in order to prevent crop and environmental pollution. Organic production in plant cultivation, without the use of harmful traditional products, has been a special concern for several decades in economically developed countries.

The area cultivated with maize in organic system (conversion period and certified production), for 2020 is graphically represented in Figure 6.

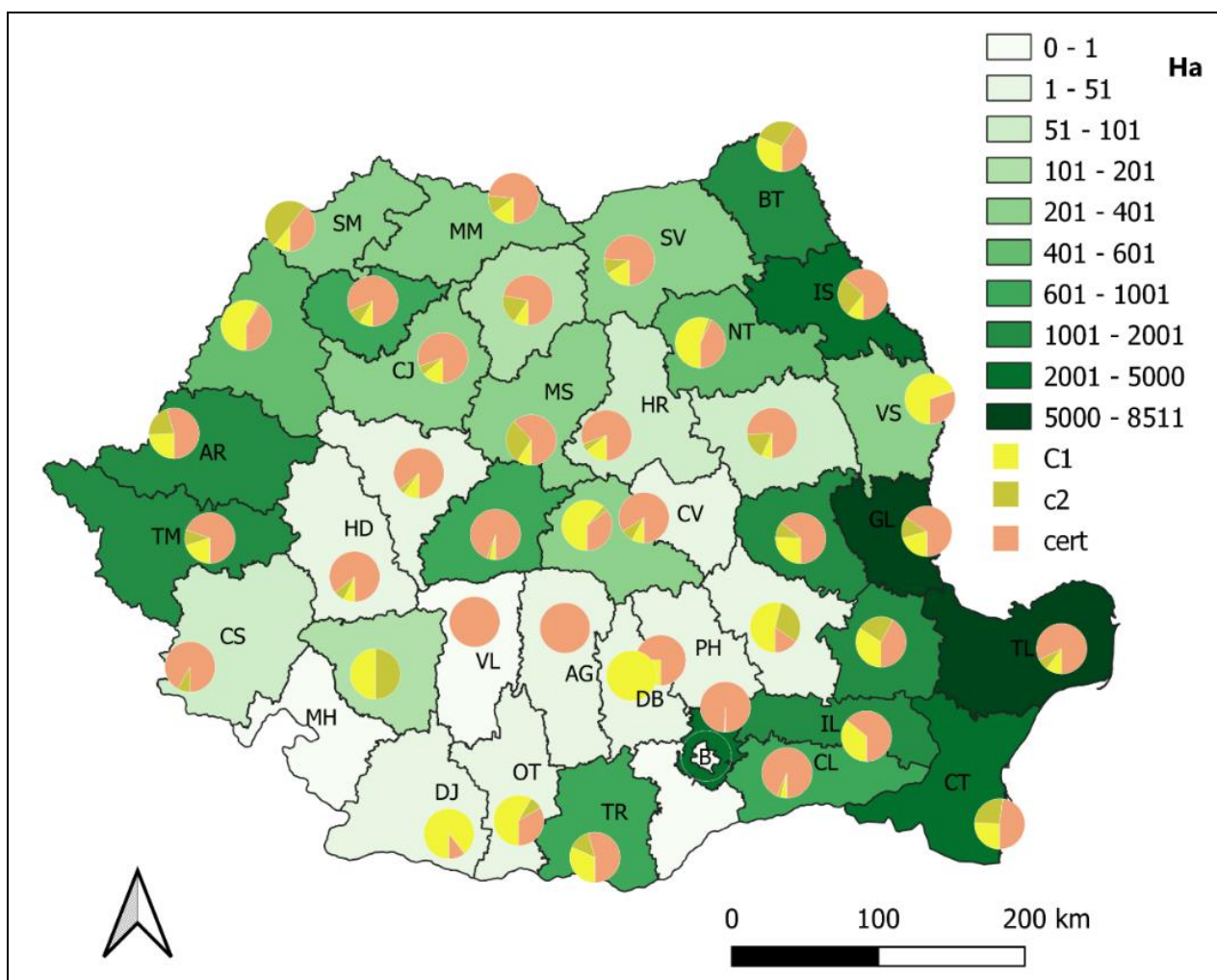


Figure 6. Area under organic production cultivated with maize, by county

Galați, Tulcea and Ilfov county rank first among the regions with maize cultivated under organic practices (Table 2). Tulcea region is somehow logic due to the presence

of Danube Delta Reserve and specific cultivation conditions that this area must comply with.

ROMANIAN AGRICULTURAL RESEARCH

Table 2. a) total area (ha) under organic farming, 2017-2020, by county;
b) certified area (ha) under organic farming, 2017-2020, by county

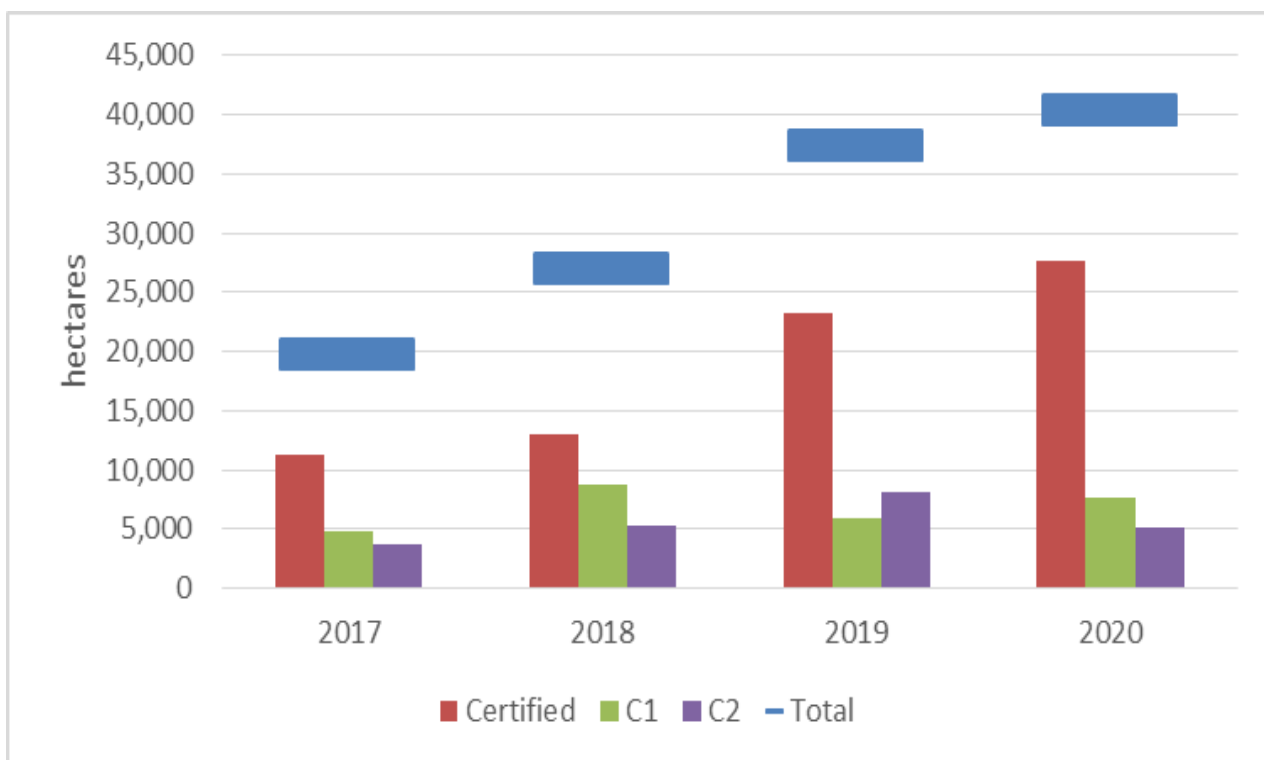
a)					b)				
County	2017	2018	2019	2020	County	2017	2018	2019	2020
AB	33	13	13	29	AB	25	8	11	25
AG	45	35	82	4	AG	8	26	54	4
AR	997	1,888	924	1,546	AR	495	908	410	842
B	0	0	0	0	B	0	0	0	0
BC	18	47	144	86	BC	6	14	3	66
BH	186	165	142	419	BH	123	120	89	170
BN	124	111	89	107	BN	64	65	67	77
BR	225	153	557	1,096	BR	145	32	226	461
BT	874	1,208	1,548	1,542	BT	762	1,093	1,030	628
BV	139	109	119	298	BV	49	60	67	105
BZ	27	13	145	25	BZ	26	1	1	4
CJ	118	316	378	340	CJ	32	203	224	274
CL	402	415	694	717	CL	390	378	628	671
CS	196	142	268	85	CS	133	114	159	79
CT	926	2,075	3,452	3,334	CT	507	1,119	2,062	1,599
CV	37	59	28	38	CV	12	25	22	32
DB	50	15	101	17	DB	2	15	0	0
DJ	55	22	27	19	DJ	23	22	27	2
GJ	0	8	11	181	GJ	0	0	0	0
GL	1,770	4,062	6,819	8,511	GL	1,422	2,324	5,056	5,591
GR	173	14	4	0	GR	88	2	3	0
HD	14	29	15	14	HD	11	13	8	12
HR	67	78	68	97	HR	3	7	52	79
IF	196	2,807	3,910	4,709	IF	118	77	618	4,675
IL	1,666	992	1,424	1,477	IL	774	319	1,151	949
IS	852	820	1,849	2,069	IS	635	384	998	1,318
MH	3	0	3	0	MH	0	0	0	0
MM	51	53	220	233	MM	17	20	91	171
MS	302	220	264	331	MS	125	151	145	205
NT	34	111	110	417	NT	5	6	6	178
OT	1	11	19	12	OT	0	1	6	3
PH	1	18	3	4	PH	0	0	3	3
SB	530	642	712	609	SB	371	440	694	576
SJ	883	640	951	689	SJ	613	482	652	563
SM	200	94	384	264	SM	185	49	195	105
SV	56	58	251	217	SV	34	8	142	161
TL	5,624	7,155	8,176	6,559	TL	1,840	2,679	5,850	5,403
TM	2,314	1,275	2,116	1,834	TM	1,662	1,079	1,492	1,278
TR	64	531	3	886	TR	64	287	3	481
VL	1	0	1	1	VL	1	0	1	1
VN	283	510	956	1,203	VN	265	377	694	772
VS	193	76	293	298	VS	183	69	289	90
Total	19,730	26,991	37,271	40,316	Total	11,219	12,977	23,226	27,650

*MARD Data

The maize organic farming sector presented an increasing trend for the analyzed period,

doubling its cultivated area from 19,730 ha in 2017 to 40,316 ha in 2020 (Figure 7).

VILI DRAGOMIR ET AL.: AN OVERVIEW OF GLOBAL MAIZE MARKET
COMPARED TO ROMANIAN PRODUCTION

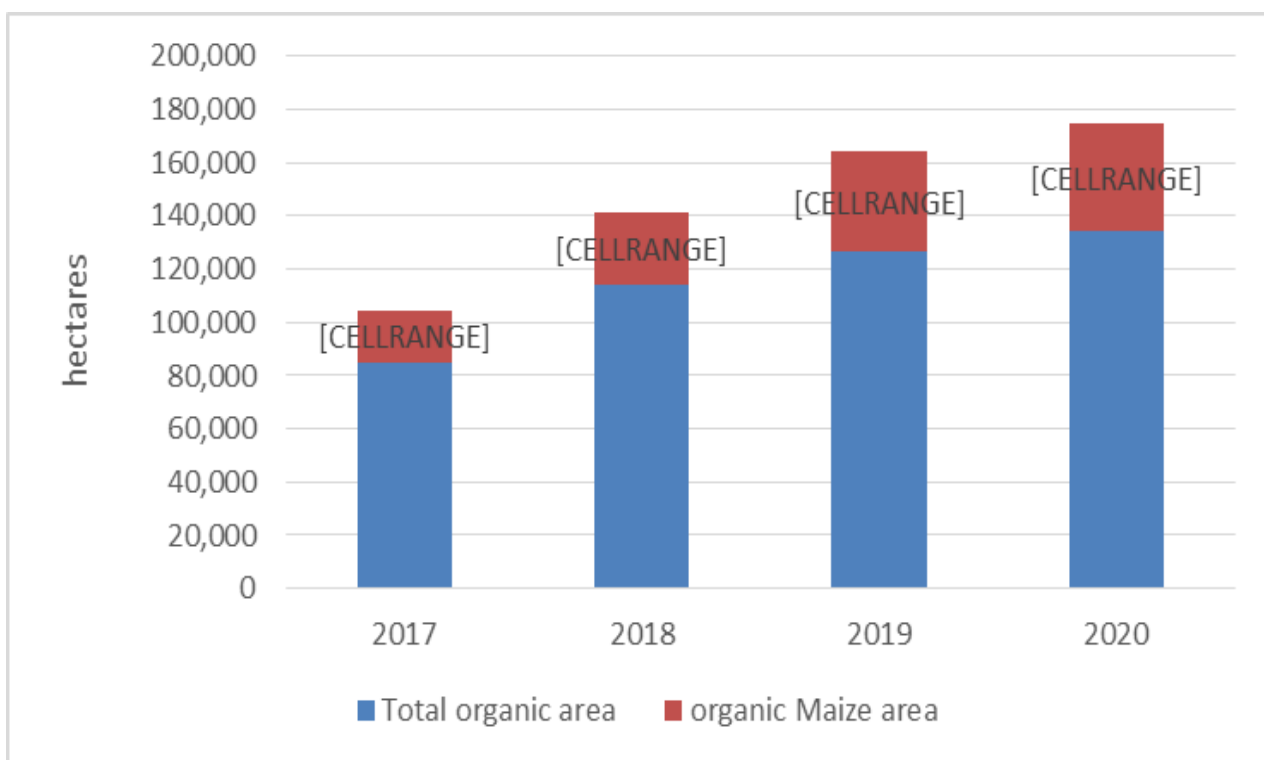


*NIS data

Figure 7. Evolution of Romanian maize cultivated areas, by certification stage

However, a slow increase may be observed in the share or area cultivated with maize

over the total organic area in Romania, as seen in Figure 8.



*MARD Data

Figure 8. Area under organic farming cultivated with maize compared with total area under organic farming, Romania, 2017-2020

CONCLUSIONS

The United States of America is by far the largest exporter of maize worldwide, with a total volume of trade in a five-year period decade exceeding the next largest exporter by over twofold. In 2020, the United States export of maize was 51.8 million tonnes (26% of world exports), ahead of Argentina (16.5%), Brazil (15.9%), Ukraine (13.2%) and France (4.7%). From Asian continent, China is the largest trade player for maize, while France and Romania, despite their relatively smaller geographic area size compared with the top exporters, also place on the market a large share of maize.

Romania's maize exports represent 3.3% of world exports for this product, its ranking in world exports being 6. The largest importing markets for Romanian maize harvest between (2016-2020) were Spain, Netherlands, Egypt, Turkey and Italy. An important opportunity for Romanian market is expanding the organic sector, which has great potential in our country due to soil characteristics. The maize organic farming sector presented an increasing trend for the analyzed period, doubling its cultivated area.

FUNDING

This work was co-funded by Rural Development Research Platform, Iași, Romania, www.rdrp.ro.

REFERENCES

- Amegbor, I., van Biljon, A., Shargie, N., Tarekegne, A., Labuschagne, M., 2022. *Identifying quality protein maize inbred lines for improved nutritional value of maize in southern Africa*. Foods, 11: 898. <https://doi.org/10.3390/foods11070898>
- Barșon, G., Șoptorean, L., Suciu, L.A., Crișan, I., Duda, M.M., 2021. *Evaluation of agronomic performance of maize (Zea mays L.) under a fertilization gradient in Transylvanian Plain*. Agriculture, 11: 896. <https://doi.org/10.3390/agriculture11090896>
- Butnariu, M., Rodino, S., Petrache, P., Negoescu, C., Butu, M., 201. *Determination and quantification of maize zeaxanthin stability*. Digest Journal of Nanomaterials and Biostructures, 9(2): 745-755.
- Chen, L., McClements, D.J., Zhang, H., Zhang, Z., Jin, Z., Tian, Y., 2019. *Impact of amylose content on structural changes and oil absorption of fried maize starches*. Food Chem., 287: 28-37. doi: 10.1016/j.foodchem.2019.02.083
- Donovan, J., Rutsaert, P., Domínguez, C., Peña, M., 2022. *Capacities of local maize seed enterprises in Mexico: Implications for seed systems development*. Food Security: 1-21.
- Erenstein, O., Chamberlin, J., Sonder, K., 2021. *Farms worldwide: 2020 and 2030 outlook*. Outlook Agric., article 00307270211025539.
- Grote, U., Fasse, A., Nguyen, T.T., Erenstein, O., 2021. *Food security and the dynamics of wheat and maize value chains in Africa and Asia*. Front. Sustain. Food Syst., 4: 617009. <https://doi.org/10.3389/fsufs.2020.617009>
- Kandil, E.E., Abdelsalam, N.R., Mansour, M.A., Ali, H.M., Siddiqui, M.H., 2020. *Potentials of organic manure and potassium forms on maize (Zea mays L.) growth and production*. Sci. Rep., 10: 8752. <https://doi.org/10.1038/s41598-020-65749-9>
- MARD, 2022. *Evolution of areas under organic farming and number of enterprises*. Available at: <https://www.madr.ro/docs/agricultura/agricultura-ecologica/2022/Dinamica-operatorilor-%C8%99i-a-suprafe%C8%9Belor-%C3%AEn-agricultura-ecologic%C4%83.pdf>
- Petcu, Gh., and Petcu, E., 2008. *Technology guide for wheat, maize and sunflower*. Domino Publishing House, Bucharest, Romania.
- Petcu, E., and Martura, T., 2018. *Physiology and breeding of maize in climate change*. Total Publishing House, Bucharest, Romania.
- Popescu, M., Mureșan, C., Horhocea, D., Cindea, M., Cristea, S., 2021. *The genetic potential for the grain yield of some maize hybrids, studied in different conditions of environment, in Romania*. Romanian Agricultural Research, 38: 21-29.
- Popovici, E.-A., Grigorescu, I., Mitrică, B., Mocanu, I., Dumitrașcu, M., 2018. *Farming practices and policies in shaping the organic agriculture in Romania. A showcase of southern Romania*. Romanian Agricultural Research, 35: 163-175.
- Revilla, P., Alves, M.L., Anđelković, V., Balconi, C., Dinis, I., Mendes-Moreira, P., Redaelli, R., Ruiz de Galarreta, J.I., Vaz Pato, M.C., Žilić, S., Malvar, R.A., 2022. *Traditional foods from maize (Zea mays L.) in Europe*. Front. Nutr., 8: 683399. doi: 10.3389/fnut.2021.683399
- Roman, V., 2011. *Fitotehnie, vol. 1*. Edit. Universală, Bucharest, Romania.
- Shiferaw, B., Prasanna, B.M., Hellin, J., Bänziger, M., 2011. *Crops that feed the world 6. Past successes and future challenges to the role played by maize in global food security*. Food Sec., 3: 307-327.
- *** madr.ro
- *** intracen.org
- *** trademap.org