

Review

Not peer-reviewed version

Sustainable corn consumption and production in Kazakhstan and the worldwide

[Zhansaya Bolatova](#)^{*} and Sait Engindeniz

Posted Date: 26 June 2023

doi: 10.20944/preprints202306.1771.v1

Keywords: corn, corn production, corn consumption, corn trade, corn price.



Preprints.org is a free multidiscipline platform providing preprint service that is dedicated to making early versions of research outputs permanently available and citable. Preprints posted at Preprints.org appear in Web of Science, Crossref, Google Scholar, Scilit, Europe PMC.

Copyright: This is an open access article distributed under the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Review

Sustainable Corn Consumption and Production in Kazakhstan and the Worldwide

Zhansaya Bolatova ^{1*}, Sait Engindeniz ²

¹ Kazakh National Agrarian Research University, 050010, Almaty/Kazakhstan; 72311jan@gmail.com

² Ege University, 35100 Bornova-Izmir/Turkiye; saitengindeniz@gmail.com, sait.engindeniz@ege.edu.tr

* Correspondence: 72311jan@gmail.com; Tel.: +77026172791

Abstract: Corn is the main agricultural product and has been produced in Kazakhstan as important nutrition in human and animal food. The research results shown in the article, the fact of increasing the sustainability of corn production is formulated, methodological approaches to assessing the level of sustainability are developed, and criteria are defined for the main indicators of sustainability and efficiency of corn production. The world's corn production was 1,223 million tons in the 2021/22 season. Kazakhstan's corn production average was 1,1 million tons and the production area are 206,870 in the 2021/22 season. The yield per hectare was 5,985 kg in the 2021/22 season. Corn consumption was 1170.5 million tons and exported was 180.1 m.tons of corn in the 2021/22 season in Kazakhstan. The purpose of this study is a determination of sustainable developments of corn consumption and production in Kazakhstan and worldwide between the 2011/12 and 2021/22 seasons. Statistical data have been obtained from the International Grain Council, FAOSTAT, USDA, PhD diploma thesis of the article's author, Bureau of National Statistics. Data obtained have been shown in the tables issued by the use of percentage and index calculations. The study analyzed a major factor affecting supply and demand, sustainable development of corn production and market prices.

Keywords: corn, corn production, corn consumption, corn trade, corn price

1. Introduction

The main originated and cultivated area of corn (*Zea Mays*) is the Andean region of Central America. It is one of the most important grains for both human and animal consumption. Corn is the third most important food crop after rice and wheat in terms of global production. Demand for corn is increasing, both as a fresh and processed food. Corn is also currently grown for the biodiesel market with many ethanol plants. Corn, which has a very important place in the market with agricultural products, production and trade, is an important food source due to its valuable nutrients.

The goal of sustainable agriculture in Kazakhstan is to meet society's needs for food and textiles in the present without compromising the ability of future generations to meet their own needs. Sustainable agriculture professionals strive to integrate three main goals into their work: a healthy environment, economic profitability, and social and economic equity. Kazakhstan implemented the Action Plan for the transition to a "Green Economy" for 2013-2020, which included the rational use of water resources, the development of sustainable and highly productive agriculture; development, conservation and sustainable use of biological resources. Due to sustainability politics Kazakhstan works with the "Green Bridge Partnership Programme", "Green Growth Plans" and programs related to Climate Change for the years 2011-2020. The Green Bridge Affiliate Program exists in a variety of industries and organizations. By combining actions and programs aiming to develop a sustainable economy, a mechanism has been made depending on the promotion of sustainable development of agriculture and the economy. Kazakhstan has a different project for sustainable development with UNDP, FAO, WB and other organizations. For example, a joint project of the United Nations Development Program and the Ministry of Environment and Water Resources, entitled "Strengthening sustainable development capacities in the Republic of Kazakhstan by

incorporating climate change issues into strategic planning” was carried out. Significantly, the state has several sustainability programs in the agricultural sector, including humanitarian, economic and environmental, such as the development of rural areas for the years 2004-2015; Drinking water supply program in 2002-2010; "Ak bulak" program in 2011-2020; Agro-industrial complex development program; "Agrobizness 2020"; "Green development" program for 2010-2014. In 2014-2040, the drafted state program of 2013 "Water Resources Management" was developed in Kazakhstan and provided water security for the Republic of Kazakhstan. Climate change impact agriculture and the economy through drought and climate condition.

Corn is the world's third-largest crop in terms of crop cultivation area and the first in grain yield. Corn has an important economic value as it ranks third among the most produced cereal products. It is traditionally used for various purposes, mainly as a raw material for industry, including household consumption, livestock, biofuel production, and as a staple food in different regions. The total agricultural land worldwide is approximately 1.5 billion hectares and is cultivated on 188 million hectares. 1.1 billion tons of corn is produced in the world. World production and consumption of corn have increased every year. The scientific literature has written that these increases from consumption as a feed for animals. It is a main component of livestock feed. The average corn consumption as a feed depends on the supply and price of the crop, and the amount of corn additional ingredients, used in feed rations. Corn, which plays a very important role in production and trade, is an important food source due to the valuable nutrients it contains. It is stated that corn in the world provides 11% of daily calories in human consumption, increasing up to 27% in developed countries [1-3].

According to data from the IGC, the world's corn production was 1129.2 million tons in the 2018/19 season. The world's corn production was 1,223 million tons in the 2021/22 season. Kazakhstan's corn production average was 1,1 million tons and the production area are 206,870 in the 2021/22 season. The yield per hectare was 5,985 kg in the 2021/22 season. Corn consumption was 1170.5 million tons and exported was 180.1 m.tons of corn in the 2021/22 season in Kazakhstan. World corn production in the 2014/2015 season amounted to 1,026.9 million tons. In the 2015/16 season, it reached 983.3 million tons [4].

The acceleration of globalization and sustainability has increased the market share struggle between businesses and their products in the current market. In this case, it has become important to offer the newest and most functional products to the global markets at the lowest possible cost. When the globalization and sustainability movement in the world and the renewed competition conditions are evaluated, it is seen that even a small technological change creates added value in enterprises on a large scale. While the process is so innovative and fast, as a result of the inability of the sectors to be included in the appropriate technological conditions, there is a weakening of the competitive conditions and a decrease in production efficiency. However, studies on the technical and economic aspects of corn cultivation should be done continuously. Kazakhstan promoting farmers' income and access to credit appears to improve their use of climate change adaptation strategies in sustainable corn productivity and food security.

2. Materials and Methods

The statistics of corn production and consumption have increased in Kazakhstan and the world, in recent years. Corn is of great importance in terms of direct production and consumption and the creation of raw materials for the industry of Kazakhstan.

In recent years, many studies have been carried out on the economic and sustainable aspects of corn production in Kazakhstan and worldwide [5-12]. But research on the sustainable development of technical and economic aspects of corn cultivation should be carried out. In Kazakhstan is needed research, especially at the farmer's level.

The purpose of this study is the determination of sustainable developments of corn production and consumption in Kazakhstan and worldwide between the 2011/12 and 2021/22 seasons.

Statistical data have been obtained from the IGC, FAOSTAT, USDA, Ministry of Agriculture of the Republic of Kazakhstan, Bureau of National Statistics, and Agency for Strategic Planning and

Reforms of the Republic of Kazakhstan. Some data takes from a survey of the main corn producers of Kazakhstan in PhD diploma thesis of the article's author. Data obtained have been shown in the tables issued by the use of percentage and index calculations.

3. Results

The movement of globalization and the new conditions of competition in the world shows that even a small technological change creates added value in a sustainable business on a large scale. As long as the process is so innovative and fast, as a result of the inability to include industries in the appropriate technological conditions, there is a weakening of competitive conditions and a decrease in production efficiency. Therefore, ensuring the sustainable efficient use of agricultural resources will create an increase in agricultural income. The value of the gross output of corn is increasing year by year, which means that sustainable production and consumption are on the rise. According to FOASTAT, gross corn production was \$50 million in 1991, but in 2021 it was \$300 million, and in 2010 there was a decline in corn production due to drought, indicating a sharp decline in gross production of corn (Figure 1).

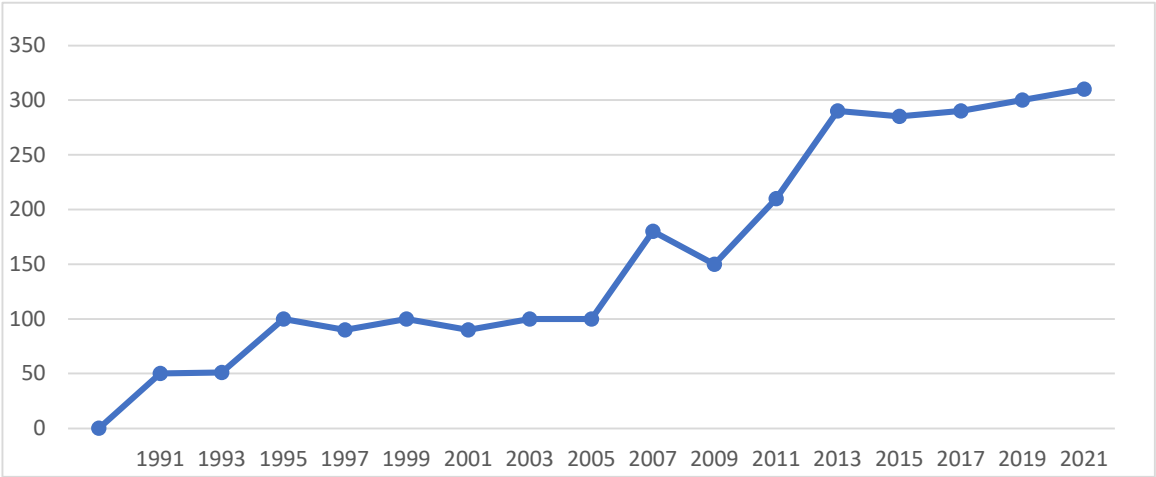


Figure 1. World gross production value of corn (1000 \$)

The highest value of gross crop production is at corn enterprises - 78.60% in Kazakhstan. In total, 93.98% of the gross output received at enterprises is the cost of livestock products and 6.02% is the cost of vegetable production. The value of the gross domestic product of developed and developing countries varies from country to country. Although livestock in Kazakhstan is developing along with corn production, it is clear that livestock harms the economic efficiency of corn production.

Supply and demand for corn from 2021/22 to 2023/24 are projected to increase globally. Increasing income will increase the competitiveness of the sector and will directly contribute to the global economy and the national economy. Costs are increasing due to the use of climate, irrigation and other resources to increase corn yields. However, when selling corn, the producer's income increases. Large corn farms earn higher returns through optimization. The total consumption in the world is increasing every year, and production must cover all consumption. The demand and supply of corn is increasing by 10-20% every year in the world. Maize leads the feed industry and in the total 692 Mt in 2019/20, the forecast for 2023/24 was 723.8 Mt. Exports and imports of corn move along the same diagonal in the same state, which guarantees the sustainable development of the economy (Table 1).

Table 1. Supply and demand of corn in the world (m.tons)

M. tons	2014/ 15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22 (est.)	2022/23 (f' cast)	2023/24 (proj.)
Opening Stocks	272.5	302.6	325.3	369.7	343.8	326.4	298.0	279.0	283.5	265.6
Production	1061.2	1023.1	1135.8	1094.6	1134.4	1131.9	1137.0	1222.6	1152.6	1217.3
Imports	125.1	136.3	137.4	153.3	164.8	175.1	188.2	180.1	170.1	172.5
Total Availability	1333.8	1325.6	1461.0	1464.3	1478.2	1458.3	1435.0	1501.6	1436.1	1482.9
Food	118.1	113.7	123.7	129.0	130.3	135.2	136.7	137.5	133.7	133.7
Feed	593.1	570.4	634.1	651.0	675.7	692.4	677.8	722.1	690.0	723.8
Industrial	277.9	281.4	292.8	303.6	304.4	293.4	297.6	308.4	305.8	308.7
Other	42.1	34.9	40.8	36.8	41.4	39.4	43.9	50.1	41.1	44.3
Total Consumption	1031.2	1000.4	1091.3	1120.5	1151.8	1160.4	1156.0	1218.1	1170.5	1210.6
Exports	125.1	136.3	137.4	153.3	164.8	175.1	188.2	180.1	170.1	172.5
Ending Stocks	302.6	325.3	369.7	343.8	326.4	298.0	279.0	283.5	265.6	272.3

Corn is widely consumed and produced sustainably in the world, approximately 60% of the world's corn production is consumed by the feed industry. Indeed, demand for feed production is projected to increase in developing countries and Kazakhstan, but industrial consumption has increased in recent years. Consumption of corn for industrial purposes, including bioethanol, stands out among alternatives to petroleum products and is gradually increasing.

Countries are increasing the share of renewable energy in their energy needs and supporting alternative fuels such as ethanol with tax breaks, a sign that this increase will continue into a sustainable future. World corn consumption has increased to 1.3 billion tons in the last two marketing years. In addition to the growing demand for livestock products in many developing countries, as well as countries with high populations such as China and India, and countries developing meat exports such as Brazil, the weight of the feed is one of the factors determining the demand for animal products. Brazil and Argentina have seasonal market advantages due to being in different hemispheres, and countries such as Ukraine and Russia are also active in regional markets. Increased use of alternative products other than corn, which has a cost advantage. However, the positions of Japan, Mexico, the EU and South Korea, which are the most important importing countries, do not change, and the reduction in China's imports continues. Globally, South Korea is the second largest importer of corn but is price sensitive, trying to switch to other similar products or buying corn from the cheapest sources. In addition to increased production from the United States, which is the largest exporter and producer, prices for wheat and other alternative corn products fell in 2016/2017. Due to the high supply in the Black Sea Basin, which has a significant share of the export market, it can be seen that the indicated price volatility has decreased and the average price has fallen below 167-170 USD/ton.

The sustainability of food production and consumption is the basis for the development of specific countries and territories. Corn in the production and consumption of food products plays a key role in the development of the country and the region. The global challenges to achieving sustainable development are becoming more and more serious, such as rapid population growth, environmental destruction and threats to food security. The production of corn increased in recent years, but consumption of corn in 2016/17 was 1 m.tons and mainly had been utilized for feeds (0.8 m.tons). It estimates and forecasts that production and consumption will increase to 1 m.tons in 2021-

2024. Industrial and other consumption of corn will not exchange and demand for corn as food will increase to 20 % in 2023-2024 (Figure 2).

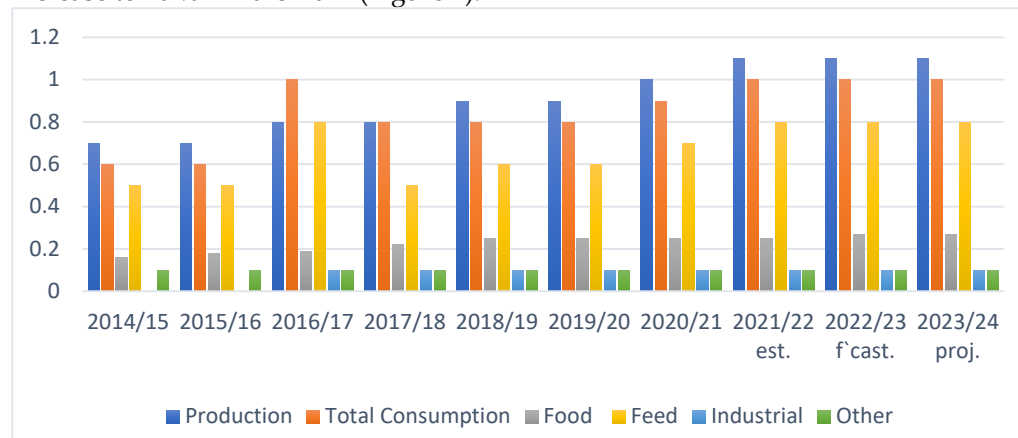


Figure 2. Kazakhstan corn production and consumption (m.tons)

3.1. Corn Production of Kazakhstan and the World

The average corn yield is 7.5 tons/ha in the world and the corn yield in Kazakhstan was 6.0 tons/ha (2021/22). The main producer and consumers of corn are the USA, China, Brazil and the EU. According to the data of IGC, China consumed 209.7 million tons of corn in the 2015/16 season. China is followed by EU countries with 70.9 million tons, Brazil with 57 million tons, Mexico with 37.8 million tons and India with 23.3 million tons. Corn consumption in Kazakhstan is increasing year by year. Corn is sufficient for the domestic market and is also sold abroad. In the 2018/19 season, consumption increased by 14% and 840000 tons was a consumption average [4].

The most important country that changed the volume of maize consumption is China in the 2015/16 marketing season. The majority of agricultural products are exported to China, including meat exports, based on a small grain export in the 2017/18 season. Changes in maize support and policy in Kazakhstan in 2015/16 resulted in lower domestic corn prices and increased feed consumption. In 2016/17, while maize consumption declined significantly as production hit a record high, animal feed consumption accounted for the largest share at 633 million tons. Consumption has remained fairly stable over the last 5 years. As the supply decreased and exports decreased too. High prices will be attractive to exporters as production is estimated to have fallen by 30% to 11.8 m.ton in the 2010/11 season, but the political risk that allows prices to rise means that domestic supplies will be robust. Over the last 5 years, consumption has been steadily declining. As consumption shifts to other feeds as farmers demand, supply dynamics tighten and corn prices increased.

From the data of FAOSTAT, index calculations were analyzed for seasons between 2011 and 2022. The corn production, which was 886 million tons in the 2011/12 season, has reached the level of 1,210.2 million tons in the season 2021/22 and it means that production increased to 36.5% in the last 10 years in the world. Estimated and projected that corn production will increase to 1,223.4 million tons in the world. The production quantity of corn decreased to 2 - 3 % in the 2012/13 and 2015/16 seasons. The data of IGC is different from the FAOSTAT data. According to data from FAOSTAT, the world corn production area was 171,207 thousand ha in 2011/12 and in 2021/22 was 206,870 thousand ha (Table 2).

Table 2. Corn production in the world

Seasons	Production area (1000 ha)	Index (2011=100)	Production quantity (1000 tons)	Index (2011=100)	Yield (kg/ha)	Index (2011=100)
2011/12	171,207	100	886,007	100	5,175	100
2012/13	178,808	104.4	874,240	98.6	4,889	94.5
2013/14	185,934	108.6	1,015,400	115.1	5,461	105.5
2014/15	184,662	107.8	1,038,331	117.1	5,623	108.6
2015/16	182,490	106.5	1,010,609	114.1	5,538	107.0
2016/17	187,959	109.7	1,060,107	119.6	5,640	110.0
2017/18	198,506	116.4	1,139,705	128.6	5,846	113.0
2018/19	195,424	114.1	1,124,172	127.1	5,741	111.0
2019/20	195,552	114.2	1,137,617	128.4	5,752	111.2
2020/21	199,994	117.2	1,163,975	131.4	5,847	112.9
2021/22	206,870	120.1	1,210,235	136.5	5,815	112.4

It means that the production area has increased to 20% in the last 10 years. Corn production area decreased to 2% in several years such as in 2012/13, 2015/16 and between 2018-2020 seasons. Corn yield has decreased in the same years of production area, because of climate change impact and economic issues (Table 2).

The US produces 40% of the world's crop and determines the world price of corn. In trade year 2021/22, global trade shipments of corn amounted to almost 194 million metric tons. According to the report, the United States and Brazil are each forecast to export 51 million metric tons of corn in 2022/23, together accounting for more than half of total corn exports worldwide. Other notable countries include China, Brazil, Mexico, Indonesia, India, France and Argentina. Corn is widely grown, especially in the US Midwest, which produces some of the highest yields in the world. While the US produces about 392 million tons of corn, this product certainly plays a very important role in the country's economy. The US is the world leader in corn production and 20% of the annual corn production is exported. In the United States, 33 million hectares of land are devoted to corn. China is the second largest producer of corn after the United States. China produces an average of 257 million tons. Although rice is the staple food for the Chinese population, corn has been the most produced and displaced in the country in the past few years. The reason for this change is not the change in Chinese eating patterns, but the growing demand for livestock feed in the country. As a result of government support for low prices to prevent small-area production in China, the reduction in corn acreage resulting from producers shifting to products they perceive as more profitable also reduced production by 5 million tons.

Among the exporting countries of Europe is France. Corn is grown throughout the country, but most of the production is in the southern part of the country. It produces 21% of all corn in the country in the Aquitaine region and 13% in the French province of Midi-Pyrenees. France produces about 13 million tons of corn per year. Most of the corn produced in the country is exported due to high levels of production and low levels of consumption, making France the third largest exporter of corn in the world. Brazil is one of the largest corn-producing countries (82 million tons). The NE list of corn-producing countries includes Argentina (43 million tons), Ukraine (36 million tons), India (28 million tons), Mexico (27 million tons) and France (13 million tons).

Kazakhstan is one of the three main players responsible for the production of corn in the Black Sea region. Ukrainian producers annually produce 36 million tons of corn. In 2013, 46% of Ukrainian corn is exported to other markets of the European Union. The most important crop is grown in Mexico, accounting for nearly 60% of the country's arable land. Corn production in South America is

Brazil with 82 million tons, Argentina with 43 million tons and Mexico with 27 million tons. Countries in the southern hemisphere, such as Brazil and Argentina, receive two productions and are in an advantageous position due to seasonal and climatic differences.

Corn is the main staple food in the world and has first place in the cereal production area. Kazakhstan's corn production was 1,129.5 thousand tons and world corn production was 1,210.2 thousand tons in 2021/22. The corn yield was 5815 kg/ha on the land of 206,870 thousand ha in the world and Kazakhstan was 5,985 kg/ha on the land of 188,703 ha in the 2021/22 season. The yield per hectare was 4,986 kg in the 2011/12 season which reached 5,985 kg in the 2021/22 season in Kazakhstan. It means that the production area of corn increased by 95%, production quantity by 135% and yield by 20 % in the last 10 years. Kazakhstan's corn production area and production increased because of the demand for food and feed. The corn production in Kazakhstan increases and production and consumption sustainability developed, which covers demand and supply (Table 3).

Table 3. Corn production in Kazakhstan

Seasons	Production area (ha)	Index (2011=100)	Production quantity (tons)	Index (2011=100)	Yield (kg/ha)	Index (2011=100)
2011/12	96,654	100	481,960	100	4,986	100
2012/13	100,320	104	520,430	108	5,188	104
2013/14	107,857	112	569,262	118	5,278	106
2014/15	125,710	130	663,994	138	5,282	106
2015/16	137,737	142	734,093	152	5,330	107
2016/17	135,116	140	762,360	158	5,642	113
2017/18	136,677	141	784,695	163	5,741	115
2018/19	150,062	155	862,094	179	5,745	115
2019/20	156,280	161,6	895,978	186,1	5,733	115
2020/21	162,812	168,4	958,106	198,7	5,885	118
2021/22	188,703	195	1,129,508	234	5,985	120

Corn yield is below the world average corn yield (5985 kg/ha). Kazakhstan cultivates and produces corn mainly in the North, Northeast, South and Southern regions, Almaty (94384 ha) and Jambil (73123 ha) regions have the highest corn production (Figure 3). Climate change affects corn production by drought in 66% and critical water scarcity is observed in the southern regions (2010/12). It was established that the average volume of corn production at the surveyed enterprises was 961192.91 centners, and the yield of corn per hectare was 8534.07 centners [16]. The yield of corn per hectare increases as the production area increases. The climate of Kazakhstan is continental and has cold winters and hot summers.

Kazakhstan is experiencing a shortage of rainfall and irrigation is mainly carried out in the south-eastern and southern regions. If water basins and dams shrink, agricultural land will not be irrigated, field crop yields will decrease due to drought, and producer incomes will fall. Climate change can also impact corn yields and affect sustainable economies and adaptation to situations. A decline in corn yields could lead to an increase in the supply price of corn, and producers will have to invest more in production to increase corn yields. The climatic factor affects the decrease in the efficiency of corn production (Kerimray, 2016).

Producers consider the decrease in groundwater reserves to be the most important problem in irrigation. This is followed by insufficient rainfall and high fuel prices. They believe that the state should support producers in irrigation and that producers should be organized in irrigation.

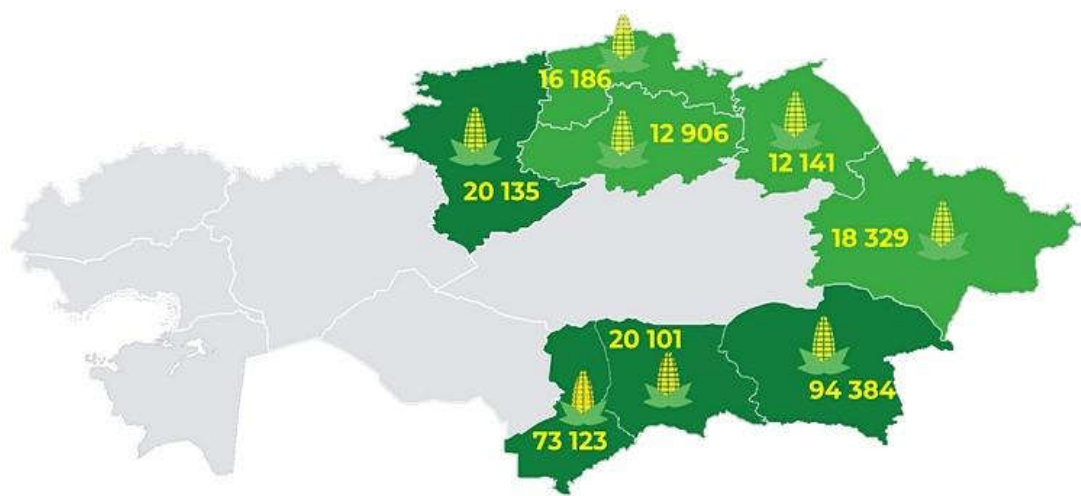


Figure 3. Corn Production Areas in Kazakhstan

3.2. Corn trade of Kazakhstan

Corn cultivation is one of the most preferred production sectors in agriculture in Kazakhstan. Farmers sell corn either at agricultural exchanges, canneries and starch factories, or enter into supply contracts with the feed industry. The farm corn price was 185\$/t in 2011/12 and 235 \$/t domestic in 2022/23, respectively (Table 4). According to FAO, farm prices for corn in Kazakhstan are lower than in the world and other countries. Producers leave part of the corn for animal feed and part for the needs of the family. However, the vast majority of corn produced is sold. It has been established that 97.01% of the total amount of corn produced at the enterprises sold out. It has been determined that producers sell 89.17% of corn to exporters and 10.49% to corn processing plants. It has been found that producers sell 89.17% of corn to exporters and 10.49% to corn processors [13-14].

It evaluated that the average price of corn received by producers at the surveyed enterprises is 0.2 \$/kg. Since large enterprises produce products for export, the average price of corn that the producer receives is higher. It has been determined that the most important criterion for manufacturers in the selection and use of resources is the price of materials. In second place is the impact of investments on the environment and human health, in third is the impact on product quality, and in fourth is the impact on increasing productivity. Small businesses in developing countries choose resources based on price.

Table 4. Corn prices in Kazakhstan and the world (\$/tons)

Seasons	Kazakhstan	World
2011/12	185	189
2012/13	194	193
2013/14	201	170
2014/15	164	159
2015/16	156	155
2016/17	114	164
2017/18	115	170
2018/19	114	165

2019/20	250	260
2020/21	302	319
2021/22	250	270
2022/23	235	240

Export activity is significantly limited compared to import activity. The export of corn from Kazakhstan in 2011/12 amounted to 13,012 tons. Export activity floating level over the years remained at 42.016 tons in 2021/22 (Table 4). Kazakhstan exports corn to China (\$11.5 million), Uzbekistan (\$12.5 million), Tajikistan (\$5.03 million), Russia (\$807 thousand), Kyrgyzstan (\$714 thousand), Mongolia (17.6 thousand dollars) and Afghanistan (907 thousand dollars). It can also be seen that Kazakhstan has been importing corn for several years. For several years, domestic corn production has been insufficient in terms of feed and oil production. Corn imports have seen ups and downs over the years.

The state subsidy for corn production reaches one-third, which increases budget expenditures. As income levels rise, the income of the agricultural sector rises, and hence economic stability increases, and consumption also increases, causing consumers to tend to have high marginal consumption.

Maize support and policy change in Kazakhstan in 2015/16 lowered domestic corn prices and increased feed consumption. In 2016/17, while maize consumption fell significantly as production hit a record high, animal feed consumption accounted for the largest share at 633 million tons. It is obtained in markets, especially corn and soybeans when dry weather affects the crops of large producers. Consumption has remained fairly stable over the last 5 years. As the supply decreased, exports decreased. High prices will be attractive to exporters as production is estimated to have fallen by 30% to 11.8mt in 2010/11, but a political risk that allows prices to rise means that domestic supplies will be robust. Downside risks are shown in our corn consumption forecasts. Consumption has steadily declined over the past five years. As consumption shifts to other types of feed when purchased by farmers, supply dynamics have tightened and prices have risen. Corn and estimated consumption dynamics in 2012 increased by 5.5% compared to 2012 and reached 473.9 thousand tons. The demand for barley and corn by 2016 is estimated at 2 million tons and 702,250 tons, respectively. However, corn consumption in 2016 amounted to 604 thousand tons [16-18].

4. Discussion

The main economic directions for increasing the sustainability and efficiency of corn production are the optimization of production areas and the improvement of the cost structure for growing corn. According to Ranum et al. (2014), maize production is the most productive and profitable, but unstable over the years, because the sustainability and efficiency of corn production are not high enough. Therefore, it is necessary to find ways and use reserves to increase them. Corn has been used for food, feed and industrial. It is the main component of livestock feed. The amount of corn used as feed also depends on the supply and price of the crop, the amount of additional ingredients used in feed rations, and supply and prices.

5. Conclusions

The world and Kazakhstan's corn production have been increased in recent years, but food consumption has remained stable. Production increase has been believed to be due to the increased consumption of corn as animal feed and biofuel. Corn is of great importance in terms of direct consumption and the creation of raw materials for the industry of Kazakhstan.

Analyzes show that corn prices should be determined according to the level of prices in the international corn market and should be supported by farmers for sustainable production. The efforts that need to be made in the short and medium term to solve the problems of regional producers, as well as to support and encourage them, will be important in terms of increasing the income of the region and the country and possibly increasing the export of corn.

In conclusion, corn is of great importance in terms of direct consumption and the creation of raw materials for industry in the world and Kazakhstan. An analysis of the demand in the domestic market and the characteristics of enterprises is necessary, although the application of an enterprise support policy is considered. When determining customs duties, one should take into account the balance of supply and demand, natural and climatic conditions and market conditions. It is seen that corn production in enterprises can be sustained economically. Corn farmers have been trying to increase the yield by using hybrid varieties in recent years. Corn producers have not preferred to use chemical inputs and try to keep the efficiency high with more maintenance work. Farmers in the survey consider that climate change negatively affects production.

References

1. Ranum, P., Pena-Rosas, J.P., Garcia-Casal, M.N. Global Corn Production, Utilization, and Consumption, *Annals of the New York Academy of Sciences*, 2014, 1312:105-112.
2. Bolatova, Z., Engindeniz, S. Recent Developments in Corn Production and Marketing of Turkey and the World, *Proceeding of 29th International Scientific-Expert Congress of Agriculture and Food Industry*, 26-28 September 2018, Izmir-Turkey, pp.353-364.
3. Bolatova, Z., Engindeniz, S. Sustainable Corn Production and Marketing in Turkey, *Proceeding of II. International Symposium on Multidisciplinary Academic Studies*, 16-17 November 2018, Istanbul-Turkey, pp.611-621.
4. International Grain Council (IGC). Corn Supply and Demand Statistics, 2022. <http://www.igc.int>, Access: April 2020.
5. Lioubimtseva, E., Henebry, G.M. Grain Production Trends in Russia, Ukraine and Kazakhstan: New Opportunities in an Increasingly Unstable World? *Frontiers in Earth Science*, 2012, 6(2):157-166.
6. Umarov, I. State Regulation of Export Grain Production in Kazakhstan, *International Journal of Economics and Finance Studies*, 2013, 5(1):192-201.
7. Umarov, I. Substantiation of Innovative Development Prospects for Grain Production in Kazakhstan, *Journal of Advanced Research in Law and Economics*, 2016, 3(13): 691-698.
8. Fellmann, T., Hélaine, S., Nekhay, O. Harvest Failures, Temporary Export Restrictions and Global Food Security: The Example of Limited Grain Exports from Russia, Ukraine and Kazakhstan, *Food Security*, 2014, 6:727-742.
9. Makhonov, K.. New Prospects of Grain Exports of Kazakhstan, Akhmet Yassawi University, e-Bulletin of Eurasian Research Institute, 2016, 53:1-3.
10. Seitova, V., Stamkulaova, K. Agricultural Knowledge and Innovation System in South Kazakhstan Region: Sustainable Agricultural Intensification of Innovation Enterprises, 2017, 38(47):35-55.
11. Tokanova, S., Kadrinov, M., Alpysova, V. Progress of Grain Production Development in Kazakhstan and Mongolia, *Earth and Environmental Science*, 2019, 341:1-6.
12. Bolatova, Z., Engindeniz, S. The Economics of Climate Change in Agriculture: A Review on Kazakhstan and Turkey, Springer Chapter 1 in *Sustainable Food Chains and Ecosystems*, 2020, pp. 1-15.
13. FAO. Socio-Economic Context and Role of Agriculture in Kazakhstan, Country Fact Sheet on Food and Agriculture Policy Trends, 2017, I7676EN/1/08.17, pp.1-6.
14. FAO. World Food and Agriculture – Statistical Yearbook 2022, 2022, <https://www.fao.org/documents/card/en/c/cc2211en>
15. Kerimray, A. Climate Change Mitigation Scenarios and Policies and Measures: The Case of Kazakhstan, *Climate Policy*, 2016, 16(3):332-352.
16. The Agency of the Republic of Kazakhstan on Statistics. Agricultural Statistics, 2020, <http://www.stat.gov.kz>, Access: April 2020.
17. The Ministry of Agriculture of the Republic of Kazakhstan, Agricultural Statistics, 2020, <http://minagri.gov.kz>, Access: April 2020.
18. USDA, 2019. Kazakhstan Grain and Feed Annual, GAIN Report Number: KZ-1903.