

Impacts of Decreasing Ukrainian Wheat Supply, Agricultural Investments, and Labor Force on Global Wheat Market

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This study examines how decreasing wheat production and exports in 2022/23 and 2023/24, and agricultural knowledge & innovation systems and labor force in Ukraine, due to Russian aggression against Ukraine, will impact global wheat markets by considering future climate change. The simulation results show that the decrease in wheat production and exports, agricultural knowledge & innovation systems, and agricultural labor force in Ukraine will impact the global wheat market. This study concludes that the early recovery of agricultural knowledge & innovation systems, and the agricultural labor force in Ukraine will contribute to stabilizing international wheat price in the long term.

Key words: Ukraine, agricultural knowledge & innovation system, agricultural labor force

1. Introduction

Global wheat market has been affected by the Russian aggression against Ukraine as well as maize, sunflower oil, fertilizers, fossil fuels and others. Ukraine and Russia play a crucial role in supplying to global wheat markets, especially for the Near East and North African regions, where wheat is used for main staple food. Ukraine accounted for 9.3% of global wheat exports in 2021 (USDA-FAS, 2023) and these importing countries rely on wheat supply from Ukraine. Therefore, the aggression threatens global wheat supply and food security.

FAO estimated that the sudden and steep reduction in grain and sunflower seed exports by Russia and Ukraine can increase international food and feed prices by 8 to 22% above their already elevated levels (FAO, 2022b). OECD-FAO (2022) examined how reductions from Ukrainian and Russian wheat exports would impact the global wheat markets in the short term. The full loss of Ukrainian wheat exports and 50% loss of Russian wheat exports would lead to a 34% higher than baseline projection without the aggression. The wheat exports in Ukraine decreased by 20.4% in 2022/23. Contrary to initial estimates, the wheat exports in Russia increased by 22.4% in 2022/23 (USDA-FAS, 2023). OECD-FAO conducted this simulation in April 2022 and an updated study is required. Furthermore, there is global concern how decreasing agricultural investments and labor force in Ukraine will impact the global wheat market in the long term.

Deininger *et al.* (2023) estimated effects of the aggression

on area and expected yield of winter crops in Ukraine. Götz *et al.* (2013) found that export restrictions in Russia and Ukraine decreased price transmission between the domestic and the world market. An *et al.* (2016) found that the transmission elasticity between wheat and flour decreased during periods of export control on Ukraine, while price volatility increased in both markets. The first study conducted panel data analysis, and the others examined the change of transmission elasticity. This study examines how aggression will impact on global wheat market, by using partial equilibrium model. Koizumi (2019) examined how agricultural investments, based on OECD data, will impact wheat price volatility under climate change. However, none of these previous studies conducted simulation on how agricultural investments and labor force in Ukraine will impact the global wheat market after the aggression.

Koizumi (2019) examined how agricultural investments, based on OECD data, will impact wheat price volatility under climate change. However, none of these previous studies conducted simulation on how agricultural investments and labor force in Ukraine will impact the global wheat market after the aggression. Therefore, this study covers them in the model. On the other hand, price volatility has a strong impact on food security in developing countries (FAO, 2011). Moreover, the coefficient of variation (CV) of international wheat price was 0.1664 from 1985 to 1995; 0.2425 from 1996 to 2005; 0.2645 from 2006 to 2015; and 0.3728 from January 2016 to April 2023.¹⁾ The CV of wheat price is

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1) Calculated from monthly wheat price (Wheat, No. 1 Hard Red Winter, ordinary protein, Kansas City) from World Bank (2022).

increasing. Wheat is a staple food for many countries, and it is concerning that volatile wheat price will have a negative impact on food security in developing countries.

This study examines how decreasing wheat production and exports in 2022/23 and 2023/24, attributable to Russian aggression in Ukraine, will affect the global wheat market. Furthermore, this study examines how recovery of agricultural knowledge & innovation systems,²⁾ and labor force in Ukraine due to the aggression will contribute to the stabilization of global wheat market by considering future climate change.

2. Analytical Framework

1) Model and data

The Wheat Economy Climate Change (WECC) model covers the wheat markets in 10 countries and 2 regions (EU27, China, India, the USA, Russia, Ukraine, Canada, Australia, Argentina, Indonesia, Egypt, and the rest of the world). The base year is 2019–2021 (a three-year average for 2019–2021). Each country's market consists of production (yield and planted area), consumption, exports, imports, and ending stocks until 2040. The WECC model covers equations for projecting wheat yield and planted area affected by climate change and agricultural investments. Koizumi (2019) examined how agricultural investments, based on OECD data, will impact wheat price volatility under climate change. However, the model did not cover agricultural labor force, fertilizer use, pesticide use and energy prices. Therefore, WECC model was developed in addition to incorporating endogenous fertilizer use, exogenous fertilizer prices, labor force, and other agricultural input elements into the model. This study applies the developed WECC model for baseline and scenario projections. Equations for the developed WECC model are shown in the appendix. As for other detailed model structures, refer to Koizumi (2024).

Historical temperatures, precipitation, and solar radiation data are derived from CRU TS. 3.2. For larger countries, the values for the grids that correspond to major wheat-producing areas are averaged.³⁾ For the other countries, the values for all the grids that cover the entire territory are spatially averaged. Historical yield, planted area, harvested area, production, per capita consumption, imports, exports, and ending stock data for wheat are derived from PS&D

(Production, Supply, and Distribution) (USDA-FAS, 2023). Agricultural labor force, fertilizer use, and pesticide use data are derived from FAOSTAT (FAO, 2022a), and fertilizer prices are derived from the World Bank (2022).

This study applies the agricultural knowledge & innovation system, and the development & maintenance of infrastructure, for Australia, Canada, the USA, the EU, Argentina, China, India, Russia, and Ukraine. These time-series data are derived from OECD General Service Support Estimates (GSSE) (OECD, 2022).

2) Baseline assumptions and scenario setting

The baseline projection adopts a set of assumptions for the general economy, agricultural policies, and technological changes without any policy shocks during the projection period. The climate variables (temperatures, precipitation, and amount of solar radiation) for both the baseline projection and scenarios come from the climate change projections of MIROC (Model for Interdisciplinary Research on Climate), a global climate model under the RCP 4.5 scenario. Spatially averaged climate variables for each country are computed similarly to the historical climate data used for regression.⁴⁾ The exogenous variables for per capita GDP growth rate are derived from IMF (2023),⁵⁾ population data are derived from United Nations (2022), and international commodity prices are derived from OECD-FAO (2022).

This study assumes that the growth rate of agricultural knowledge & innovation systems, and development & maintenance of infrastructure from 2006 to 2021 will continue during the projection period. This study applies alternative scenarios to the baseline projection. For scenario 1, this study applies that the Ukrainian wheat production and exports in 2022/23 will decrease by 36.7% and 20.4%, respectively. For scenario 2, this study also applies that the Ukrainian wheat production and exports in 2023/24 will decrease by 21.1% and 33.3%, respectively. The scenario 2 covers the decreasing Ukrainian wheat production and exports in 2022/23. These data are derived from the estimated data⁶⁾ from USDA-FAS (2023).

For scenario 3, this study applies that the agricultural knowledge & innovation systems in Ukraine will decrease to the historical lowest level in 2000, recover to the level of 2019/21 by 2026, and be subjected to the same growth rate

2) It covers budgetary expenditure financing research & development activities, training and others (OECD, 2022).

3) For detailed producing areas, refer to Koizumi (2019).

4) For detailed climate variables, refer to Koizumi (2019).

5) For Ukraine, per capita GDP growth projection data are derived from IMF (2022), due to lack of long-term projection from IMF (2022).

6) There are based on PS&D data in May 2023 (USDA-FAS, 2023).

Table 1. Scenarios

Baseline/scenarios of agricultural knowledge & innovation systems in	Unit	2000	2019/21	2022	2027	2031	2040
Baseline	Million USD	39.6	71.4	73.7	85.8	96.9	127.6
Scenario 3	Million USD	39.6	71.4	39.6	73.2	82.7	108.9
Scenario 4	Million USD	39.6	71.4	39.6	57.3	71.4	94.0
Baseline/scenarios of agricultural labor force in Ukraine	Unit	2000	2017-19	2022	2027	2031	2040
Baseline	Thousands	5,395	2,686	2,613	2,278	2,041	1,594
Scenario 5	Thousands	5,395	2,686	1,343	2,278	2,041	1,594
Scenario 6	Thousands	5,395	2,686	1,343	1,731	2,041	1,594

from the baseline assumption from 2027 to 2040 (Table1). For scenario 4, this study applies that the agricultural knowledge & innovation systems in Ukraine will decrease to the historical lowest level in 2000, recover to the level of 2019/21 by 2031, and be subjected to the same growth rate from the baseline assumption from 2032 to 2040 (Table1).

Under scenario 5, this study applies that the number of the agricultural labor force in Ukraine will decrease by 50% in 2022, recover to the level of baseline projection by 2026, and be subject to the same level from the baseline assumption from 2027 to 2040 (Table1). Under scenario 6, this study applies that the number of the agricultural labor force in Ukraine will decrease by 50% in 2022, recover to the level of baseline projection by 2031, and be subject to the same level from the baseline assumption from 2032 to 2040 (Table1). The amount of development & maintenance of infrastructure in Ukraine has been decreasing since 2014, and is much lower than that of agricultural knowledge & innovation systems.⁷⁾ Therefore, this study does not apply to setting the scenario of development & maintenance of infrastructure.

3. Results

Under the baseline assumptions, global wheat production and consumption are predicted to increase at a rate of 1.3% and 1.1% per annum from 2019/2021 to 2040, respectively (Appendix Table). World wheat exports and imports are forecasted to increase at a rate of 1.2% and 1.5% per annum, respectively, during the same period (Appendix Table). The international wheat price is projected to increase from 249.5 USD/t during 2019/21 to 452.8 USD/t in 2040. The CV of international wheat price from 2019/21 to 2040 is 0.3975.

Under scenario 1, Ukrainian wheat production and exports are forecasted to decrease by 28.7% and 34.3%, respectively, compared to the baseline projection from 2022 to 2024.

Global wheat production and exports are predicted to decrease by 0.5% and 1.5%, respectively, compared to the baseline projection from 2022 to 2024. Moreover, global wheat production and exports are expected to decrease by 0.2% and 1.6%, respectively, compared to the baseline projection from 2022 to 2040. Consequently, the international wheat price is projected to increase by 8.1% compared to the baseline projection average from 2022 to 2024, and by 6.7% compared to the baseline projection average from 2022 to 2040 (Table 2).

Under scenario 2, Ukrainian wheat production and exports are predicted to decrease by 36.5% and 44.0%, respectively, compared to the baseline projection from 2022 to 2024. Global wheat production and exports are forecasted to decrease by 0.6% and 1.9%, respectively, compared to the baseline projection from 2022 to 2024. Moreover, global wheat production and exports are forecasted to decrease by 0.3% and 2.2%, respectively, compared to the baseline projection from 2022 to 2040. Accordingly, the international wheat price is projected to increase by 10.3% compared to the baseline projection average from 2022 to 2024, and by 9.4% compared to the baseline projection average from 2022 to 2040 (Table 2).

Under scenario 3, Ukrainian wheat production and exports are predicted to decrease by 29.8% and 39.0%, respectively, compared to the baseline projection from 2022 to 2024. Global wheat production and exports are forecasted to decrease by 0.2% and 1.7%, respectively, compared to the baseline projection from 2022 to 2024. Therefore, the international wheat price is predicted to increase by 8.2% compared to the baseline projection average from 2022 to 2024 (Table 2). As a long term impact, global wheat production and exports are forecasted to decrease by 0.2% and 1.1%, respectively, compared to the baseline projection from 2022 to 2040. Therefore, the international wheat price is predicted to increase by 4.7% compared to the baseline projection average from 2022 to 2040 (Table 2).

Under scenario 4, Ukrainian wheat production and exports are expected to decrease by 33.2% and 52.6%, respectively, compared to the baseline projection from 2022 to 2024. Global wheat production and exports are predicted to decrease by 0.3% and 1.9%, respectively, compared to the baseline projection from 2022 to 2024. Consequently, the international wheat price is projected to increase by 9.2%

7) The amount of development & maintenance of infrastructure in Ukraine was 4.2 million USD, while that of agricultural

knowledge & innovation systems were 71.4 million USD in 2019/21(OECD, 2022).

compared to the baseline projection average from 2022 to 2024 (Table 2). As a long term impact, global wheat production and exports are predicted to decrease by 0.3% and 1.8%, respectively, compared to the baseline projection from 2022 to 2040. Consequently, the international wheat price is projected to increase by 7.7% compared to the baseline projection average from 2022 to 2040 (Table 2).

Under scenario 5, Ukrainian wheat production and exports are predicted to decrease by 24.6% and 32.3%, respectively, compared to the baseline projection from 2022 to 2024. Global wheat production and exports are forecasted to decrease by 0.2% and 1.4%, respectively, compared to the baseline projection from 2022 to 2024. Accordingly, the international wheat price is projected to increase by 6.5% compared to the baseline projection average from 2022 to 2040 (Table 2). Global wheat production and exports are forecasted to decrease by 0.1% and 0.3%, respectively, compared to the baseline projection from 2022 to 2040. Accordingly, the international wheat price is projected to increase by 1.5% compared to the baseline projection average from 2022 to 2040 (Table 2).

Under scenario 6, Ukraine wheat production and exports are predicted to decrease by 26.8% and 35.0%, respectively, compared to the baseline projection from 2022 to 2024. Global wheat production and exports are predicted to decrease by 0.2% and 1.6%, respectively, compared to the baseline projection from 2022 to 2024. Consequently, the international wheat price is projected to increase by 7.5% compared to the baseline projection average from 2022 to 2024 (Table 2). As a long term impact, global wheat production and exports are predicted to decrease by 0.1% and 0.7%, respectively, compared to the baseline projection from 2022 to 2040. Consequently, the international wheat price is projected to increase by 3.0% compared to the baseline projection average from 2022 to 2040 (Table 2).

The CVs of the international wheat prices from 2019/21–2040 in all scenarios are higher than in the baseline projection (0.3975). As a result, the CV is calculated as 0.3973 during the simulation period (scenario 1), 0.4091 (scenario 2), 0.4236 (scenario 3), 0.4289 (scenario 4), 0.4090 (scenario 5) and 0.4168 (scenario 6). The CV of the scenario 4 is the highest of all scenarios (Table 3).

4. Conclusion

This study examines how decreasing wheat production and exports in 2022/23 and 2023/24, attributable to Russian

Table 2. Average changing rate between scenarios and baseline

	Scenario 1		Scenario 2		Scenario 3	
	From 2022 to 2024	From 2022 to 2040	From 2022 to 2024	From 2022 to 2040	From 2022 to 2024	From 2022 to 2040
Ukraine						
Production	-28.7%	-28.5%	-36.5%	-39.6%	-29.8%	-19.4%
Consumption	-0.6%	-0.4%	-0.5%	-0.4%	-0.6%	-0.4%
Exports	-34.3%	-39.3%	-44.0%	-54.7%	-39.0%	-26.7%
Imports	-16.4%	-15.2%	-5.0%	-1.7%	-6.5%	-4.2%
World						
Production	-0.5%	-0.2%	-0.6%	-0.3%	-0.2%	-0.2%
Consumption	-0.2%	-0.2%	-0.3%	-0.3%	-0.2%	-0.1%
Exports	-1.5%	-1.6%	-1.9%	-2.2%	-1.7%	-1.1%
Imports	-1.5%	-1.6%	-1.9%	-2.2%	-1.7%	-1.1%
International wheat price	8.1%	6.7%	10.3%	9.4%	8.2%	4.7%
	Scenario 4		Scenario 5		Scenario 6	
	From 2022 to 2024	From 2022 to 2040	From 2022 to 2024	From 2022 to 2040	From 2022 to 2024	From 2022 to 2040
Ukraine						
Production	-33.2%	-31.9%	-24.6%	-5.6%	-26.8%	-11.5%
Consumption	-0.7%	-0.6%	-0.5%	-0.1%	-0.6%	-0.2%
Exports	-52.6%	-44.4%	-32.3%	-7.4%	-35.0%	-15.7%
Imports	-7.5%	-7.0%	-5.2%	-1.2%	-6.3%	-2.6%
World						
Production	-0.3%	-0.3%	-0.2%	-0.1%	-0.2%	-0.1%
Consumption	-0.3%	-0.2%	-0.2%	-0.1%	-0.2%	-0.1%
Exports	-1.9%	-1.8%	-1.4%	-0.3%	-1.6%	-0.7%
Imports	-1.9%	-1.8%	-1.4%	-0.3%	-1.6%	-0.7%
International wheat price	9.2%	7.7%	6.5%	1.5%	7.5%	3.0%

Table 3. Scenario impacts on international wheat price (2019/21-2040)

Scenario/Baseline	Coefficient of variation (CV)	Standard Deviation	Average
Baseline	0.3975	153.1202	385.1603
Scenario 1	0.3973	159.9014	402.4948
Scenario 2	0.4091	169.2364	413.6404
Scenario 3	0.4236	171.7591	405.5080
Scenario 4	0.4289	179.0477	417.4351
Scenario 5	0.4090	160.2853	391.9007
Scenario 6	0.4168	163.2480	391.6370

aggression against Ukraine, will affect the global wheat market. This study conducted simulations of Ukrainian agricultural knowledge & innovation systems, and agricultural labor force recovery to impact on wheat production systems and markets using a partial equilibrium model. The study demonstrates that Ukrainian wheat production and exports will decrease in 2022/23 and 2023/24, due to Russian aggression against Ukraine, which will in turn lead to an 8.1% increase in international wheat price from 2022 to 2024 on average. The study also shows decreasing Ukrainian wheat production and exports in 2022/23 and 2023/24 will drive to increase international wheat prices by 10.3% from 2022 to 2024 on average. This study suggests that decreasing wheat production and exports in Ukraine will impact on global wheat market not only short term, but also long term.

The simulation results show that the decrease in Ukrainian

wheat production and exports, agricultural knowledge & innovation systems, and agricultural labor force will have an impact on the global wheat market in the long term. The impact from the delay of agricultural knowledge & innovation systems recovery is higher than that in other scenarios. This study suggests that the earlier recovery of both agricultural knowledge & innovation systems, and the agricultural labor force in Ukraine will contribute to the stabilization of international wheat prices in the long term. Therefore, international cooperation toward the earlier recovery of agricultural investments and labor force in Ukraine is a crucial factor in stabilizing international wheat prices and contributing to global food security. Ensuring agricultural labor force after the aggression in Ukraine will be a more complicated and difficult issue, compared to ensuring the amount of agricultural investments by collecting funds from international cooperation.

This study examines the long-term impact of Russian aggression on the global wheat market, which is based on currently available data. This study sets scenario 1 and 2 to examine short term impact from the aggression on global wheat market. These scenarios assume that the wheat production and exports in Ukraine will recover from 2024. However, there are uncertain that they will recover from 2024. Many uncertainties remain regarding when the aggression will peacefully end. Further economic recessions due to the prolonged aggression represent additional uncertainties in this study. Therefore, the future direction of this study is continuing to examine the impact of the aggression on global wheat market. Furthermore, this study requires to examine the aggression impact on food and other agricultural commodities. This is also future direction of this study.

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Appendix. Wheat Production and Exports Equations for the Developed WECC Model (Ukraine)

Wheat yield equation depends on annual flowering season averages of temperature, precipitation, amount of solar radiation, lagging agricultural investments, fertilizer uses, employment in agriculture, and pesticide use, as follows:

$$\ln(Y_{t,c}/Y_{t-1,c}) = 4.6710 - 0.2506(TEMFLAV_{t,c}/TEMFLAV_{t-1,c}) (2.8305) (-1.7114) - 0.2013(PREFLAV_{t,c}/PREFLAV_{t-1,c}) - 0.0891 \ln (-1.2449) (-2.7438) (SORFLAV_{t,c}/SORFLAV_{t-1,c}) + 0.1296 \ln (AGIS_{t-1,c}/ (1.1268) AGIS_{t-2,c}) + 0.0334 \ln (DMF_{t-1,c}/DMF_{t-2,c}) + 0.1884 \ln (1.5009) (1.3540) (NITUW_{t,c}/NITUW_{t-2,c}) + 0.1985 \ln (PHOUW_{t,c}/ (1.5613) PHOUW_{t-1,c}) + 0.1508 \ln (POTUW_{t,c}/POTUW_{t-1,c}) + 0.8558 (1.7270) (1.6474) \ln (AGL_{t,c}/AGL_{t-1,c})$$

(Sample: 2001-2017, R-square: 0.9173, Adjusted R-square: 0.7354, Durbin-Watson stat: 2.3118)

where *Y* is wheat yield, *TEMFLAV* is average temperature of flowering season, *PREFLAV* is average precipitation of flowering season, *SORFLAV* is average of the amount of solar radiation of flowering season, *AGIS* is investment amount of agricultural knowledge and innovation systems, *DMF* is the development and maintenance of infrastructure, *NITUW* denotes the use of nitrogen for wheat, *PHOUW* denotes the use of phosphate for wheat, *POTUW* denotes the use of potash for wheat, and *AGL* denotes employment in agriculture.

The wheat planted area equation depends on the domestic producer prices of wheat; competitive commodity prices; precipitation, lagging investments, domestic fertilizer prices, employment in agriculture, and domestic diesel prices as follows:

$$\ln(APW_{t,c}/APW_{t-1,c}) = 0.3227 \ln(DWP_{t,c}/DWP_{t-1,c}) - 0.1846 \ln (11.3577) (-11.6979) (PRCAV_{t,c}/PRCAV_{t-1,c}) - 0.9451 \ln(DMP_{t,c}/DMP_{t-1,c}) - 0.1399 (-2.3515) (-2.2216) \ln(DCGP_{t,c}/DCGP_{t-1,c}) + 0.6516 \ln(AGIS_{t-1,c}/AGIS_{t-2,c}) (7.1290) + 0.4711 \ln(DMF_{t-1,c}/DMF_{t-2,c}) + 0.0067 \ln(AME_{t-1,c}/ (18.9089) (1.1433) AME_{t-2,c}) - 0.1390 \ln(UREP_{t,c}/UREP_{t-1,c}) - 0.3769 \ln (-1.5230) (-1.2710)$$

$$(DAPP_{t,c}/DAPP_{t-1,c}) - 0.4372 \ln(POTP_{t,c}/POTP_{t-1,c}) (-6.7484) - 0.9311 \ln(DIEDP_{t,c}/DIEDP_{t-1,c}) + 0.9400 \ln (-5.3727) (11.5171) (AGL_{t,c}/AGL_{t,c})$$

(Sample: 2001-2019, R-square: 0.9994, Adjusted R-square: 0.9905, Durbin-Watson stat: 2.2186)

where *APW* is the planted area of wheat, *DWP* is the domestic wheat producer price, *PRCAV* is the average precipitation, *DMP* is domestic corn price, *DCGP* is domestic coarse grain price, *AME* denotes agricultural machinery/equipment, *UREP* denotes domestic urea price, *DAPP* denotes domestic diammonium phosphate price, *POTP* denotes domestic potassium chloride price, and *DIEDP* denotes domestic diesel price. The wheat harvested area is derived from the difference between the planted and abandoned areas. Furthermore, wheat production is calculated by multiplying harvested area and wheat yield as follows:

$$AHW_{t,c} = APW_{t,c} - ABD_{t,c} QPW_{t,c} = AHW_{t,c} * Y_{t,c}$$

where *AHW* is harvested area and *ABD* is abandoned area. Abandoned area is an exogenous variable and will be utilized for simulation for future studies. *QPW* denotes wheat production. Wheat exports in Ukraine are calculated by the exportable domestic market balance deficit remaining after the domestic market has been satisfied.

$$EXW_{t,c} = QPW_{t,c} - QCW_{t,c} + IMW_{t,c} - (ESW_{t,c} - ESW_{t-1,c})$$

where *EXE* is wheat exports, *QCW* is wheat consumption, *IMW* is wheat import, *ESW* is the ending stock of wheat.

Appendix Table. World wheat market (Baseline projection)

	Yield (MT/ha)			Harvested area (1,000 ha)			Production (1,000 MT)		
	2019/21	2040 (projection)	Growth rate (2019/21-2040)	2019/21	2040 (projection)	Growth rate (2019/21-2040)	2019/21	2040 (projection)	Growth rate (2019/21-2040)
World							772,117	958,515	1.3%
Argentina	3.0	3.3	0.6%	6,558	7,377	0.7%	19,847	24,517	1.3%
Australia	2.3	2.2	-0.2%	11,921	15,130	1.4%	28,027	33,503	1.1%
Canada	3.1	3.9	1.4%	9,640	10,332	0.4%	29,835	40,392	1.8%
China	5.7	5.8	0.1%	23,559	25,999	0.6%	134,932	151,841	0.7%
Egypt	6.4	6.6	0.2%	1,387	1,934	2.0%	8,890	12,762	2.1%
EU							134,637	132,222	-0.1%
France	7.2	7.5	0.3%	4,667	4,073	-0.8%	33,376	30,624	-0.5%
Germany	7.4	7.4	0.0%	2,930	2,383	-1.2%	21,816	17,651	-1.2%
Other EU	4.9	5.3	0.5%	16,260	15,820	-0.2%	79,446	83,947	0.3%
India	3.5	3.7	0.3%	30,600	35,398	0.9%	107,015	130,796	1.2%
Russia	2.8	3.1	0.6%	27,875	32,259	0.9%	78,040	99,855	1.5%
Ukraine	4.1	4.1	0.0%	7,092	7,827	0.6%	29,199	32,092	0.6%
USA	3.3	3.7	0.8%	15,020	16,178	0.4%	49,041	60,440	1.2%
Consumption (1,000 MT)							(1,000 MT)		(1,000 MT)
	2019/21	2040 (projection)	Growth rate (2019/21-2040)	2019/21	2040 (projection)	Growth rate (2019/21-2040)	2019/21	2040 (projection)	Growth rate (2019/21-2040)
World	767,218	926,557	1.1%	199,126	243,554	1.2%	193,412	247,962	1.5%
Argentina	6,350	7,757	1.2%	13,605	16,684	1.2%	5	17	7.6%
Australia	8,167	9,269	0.9%	20,161	22,959	0.8%	431	441	0.1%
Canada	9,461	10,559	0.6%	21,857	29,191	1.7%	609	578	-0.3%
China	141,333	154,841	0.5%	887	888	0.0%	8,566	10,923	1.4%
Egypt	20,467	25,887	1.4%	661	1,221	3.7%	12,153	13,968	0.8%
EU	107,250	100,788	-0.4%	33,009	35,091	0.4%	5,143	4,734	-0.5%
India	101,844	117,056	0.8%	3,701	13,505	7.9%	21	19	-0.5%
Indonesia	10,400	12,884	1.3%	345	427	1.3%	10,745	13,136	1.2%
Russia	41,417	44,849	0.5%	35,528	52,532	2.3%	342	168	-1.4%
Ukraine	9,000	8,492	-0.3%	18,889	23,408	1.3%	119	64	-3.5%
USA	30,482	32,343	0.3%	25,080	23,080	-0.5%	2,713	2,519	-0.4%