
**ЕКОНОМІКА ТА ЕФЕКТИВНІСТЬ
 ВИРОБНИЧО-ГОСПОДАРСЬКОЇ ДІЯЛЬНОСТІ**

УДК 338.43:330.3

**UKRAINE GRAIN AND OILSEED
 PRODUCTION: ASSESSING RECENT
 SUCCESS TO ATTAIN SUSTAINABLE
 SUCCESS ©**

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World prosperity in grain and oilseed production that began in 2006 opened the door for Ukraine to become a key international exporter of grains and oilseeds. Rapid yield increases and increased acreage played a key role, particularly for corn and soybeans. Nevertheless, Ukraine corn and soybean yields lag export competitors. Limited growth in domestic consumption also played a role, especially for wheat. High yield variability characterizes Ukraine grain and oilseed production. Compared with the US, standard deviation of percent deviation of yield from its linear trend-line value is 72% higher for Ukraine soybeans and even higher for corn, sunflowers, and especially wheat. Now that the period of prosperity has ended, Ukraine needs to internalize its recent momentum by using basic and adaptive research to drive yields higher and, more importantly, reduce yield variability. If Ukraine can make this strategic jump, its grain and oilseed sector has a bright future.

Key words: Ukraine, grains, oilseeds, yield variability, world export share

Fig. 7. Tabl. 1. Lit. 3.

Introduction: Prior to World War I Ukraine was one of the world's breadbaskets, a role it reclaimed during the recent period of world crop prosperity. This reemergence is discussed with the objective of identifying issues that need to be addressed for Ukraine to sustain this role. The discussion builds upon previous articles by Zulauf [2,3].

Production and consumption variables examined, source of data, and analytical procedures are described in the next section. Performance of Ukraine is then discussed, including comparisons with the world and other countries, in particular the US. Issues that need to be addressed to turn the recent success into sustainable success are then discussed, with the focus on improving yields relative to export competitors and, more importantly, reducing yield variability.

Data and Procedures: Data on production, harvested land, yield, domestic consumption, and exports are examined. Source of the data is the "Production, Supply, and Distribution Online" website maintained by the US Department of Agriculture (USDA), Foreign Agriculture Service. Data for Ukraine begin with the 1987 crop. Prior to 1987, data are reported only for the USSR. The analysis starts with the 1992 crop year because it allows the data to be divided into equal length periods: 1992-96 to 2002-06 and 2002-06 to 2012-

16. The first subperiod was one of adjustment to the breakup of the USSR amid low grain and oilseed prices and returns. The second subperiod generally coincides with a period of high prices and returns. Five year averages are used to reduce the impact of outlier years.

Data are available for Ukraine for these grains: barley, corn, millet, oats, milled rice, rye, sorghum, and wheat; and for these oilseeds: rapeseed, soybeans, and sunflowers. The discussion focuses on corn, soybeans, sunflowers, and wheat. These four crops account for 80% of grain and oilseed hectares harvested in Ukraine and all the increase in harvested grain and oilseed hectares since 1992.

To assess yield variability, a common metric is computed: standard deviation of the percent deviation of annual yield from its linear trend-line value. The specific calculations are:

(1) Trend-Line Regression: $\text{Yield}_t = \alpha + \beta \text{Year}_t + \varepsilon$, and

(2) Percent Deviation: $(\text{Yield}_t / \text{Trend-Line Yield}_t) - 1$,

where Yield_t is the yield for year t , Year_t equals 1 for 1992, 2 for 1993, ... 25 for 2016, $\text{Trend-Line Yield}_t$ is the yield estimated from the trend-line regression for year t , α and β are estimated parameters of the trend-line regression, and ε is a random error term of the trend-line regression.

Production: From 1992-96 to 2012-16, Ukraine's average annual production of grains and oilseeds more than doubled from 35,2 to 76,0 million metric tons (see Figure 1). However, the two subperiods differ dramatically. Almost all of the growth in output occurred from 2002-06 to 2012-16, after essentially remaining stagnant during the first subperiod. These contrasting subperiods suggest that world grain and oilseed prosperity was a key factor in the recent growth of Ukraine's grain and oilseed output.

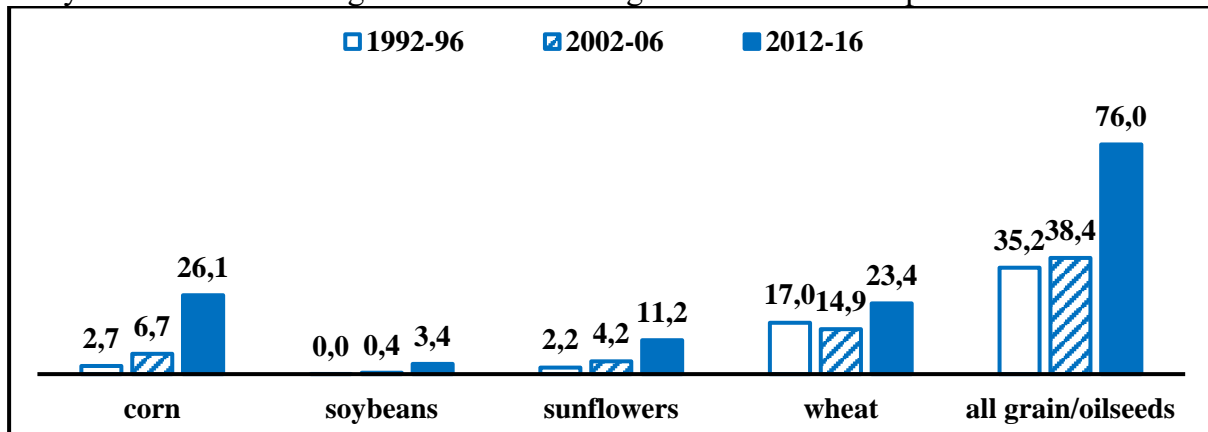


Figure 1. Average Annual Production of Corn, Soybeans, Sunflowers, Wheat, and All Grains and Oilseeds, Million Metric Tons, Ukraine, 1992-2016*

*Source: original calculations using data from the US Department of Agriculture [1]

Corn's share of Ukraine's grain and oilseed output doubled during both subperiods, surging from 8% in 1992-96 to 34% in 2012-16 (see Figure 1). In contrast, wheat's share declined from 48% to 31%. Combined share of corn, soybeans, sunflowers, and wheat grew from 62% to 84%.

Harvested Area: Average annual hectares of land harvested for grains and oilseeds increased by 60% between 1992-96 and 2012-16 (see Figure 2). The same contrasting subperiods emerge as the rate of increase was more than twice as fast during the later subperiod (17% to 37%). Corn now accounts for one-fifth of all harvested grain and oilseed

hectares due to a quadrupling of harvested hectares. Sunflowers accounts for more hectares than soybeans but soybean hectares are increasing at a faster rate. Wheat hectares increased over the entire observation period after falling from 1992-96 to 2002-06; however, its share of hectares declined from 40% in 1992-96 to 28% in 2012-16.

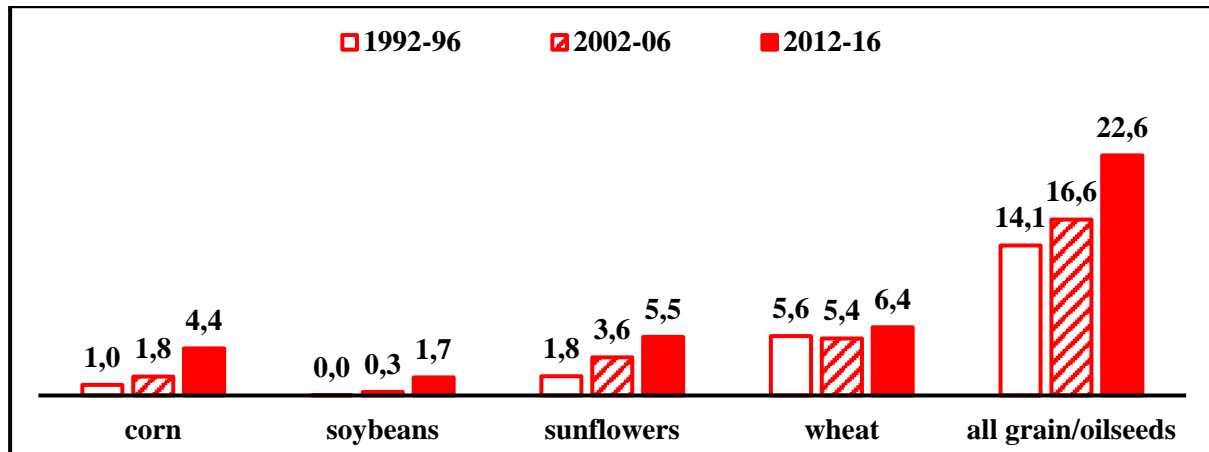


Figure 2. Average Annual Land Harvested for Corn, Soybeans, Sunflowers, Wheat, and All Grains and Oilseeds, Million Hectares, Ukraine, 1992-2016*

*Source: original calculations using data from the US Department of Agriculture [1]

Yield: Ukraine corn and soybean yields more than doubled from 1992-96 to 2012-16 as yield increased approximately 5% per year during both subperiods (see Figure 3). Ukraine sunflower yield increased 74% during the later subperiod after remaining flat during the earlier subperiod. On the other hand, Ukraine wheat yield increased only 19% over the entire period. As a result, wheat yield declined relative to the yield of the other three crops, which likely contributed to wheat's declining share of land.

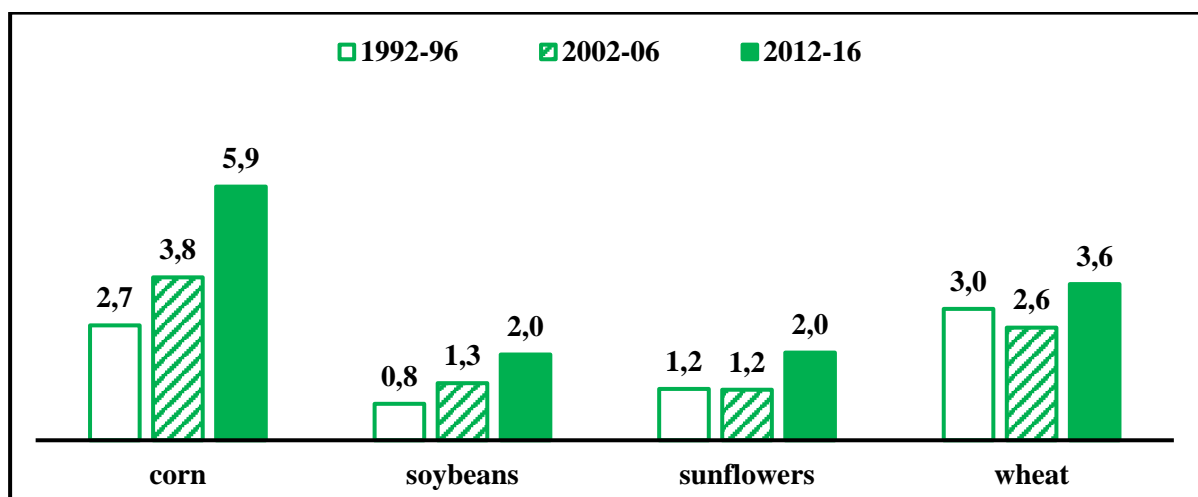


Figure 3. Corn, Soybean, Sunflower, and Wheat Yield, Metric Tons per Harvested Hectare, Ukraine, 1992-2016*

*Source: original calculations using data from the US Department of Agriculture [1]

Ukraine corn and soybean yield improved substantially relative to world average yield (see Figure 4). Ukraine corn yield was 32% below the world average during 1992-96 but 8% higher during 2012-16. Ukraine soybean yield remains below the world average,

but the gap narrowed from 59% below to 24% below. Despite the improvement, Ukraine corn and soybean yields notably lag yields in major export competitors. During 2012-16, the country-to-world yield ratio was 143% for Argentina corn, 183% for US corn, 110% for Argentina soybeans, 114% for Brazil soybeans, and 120% for US soybeans.

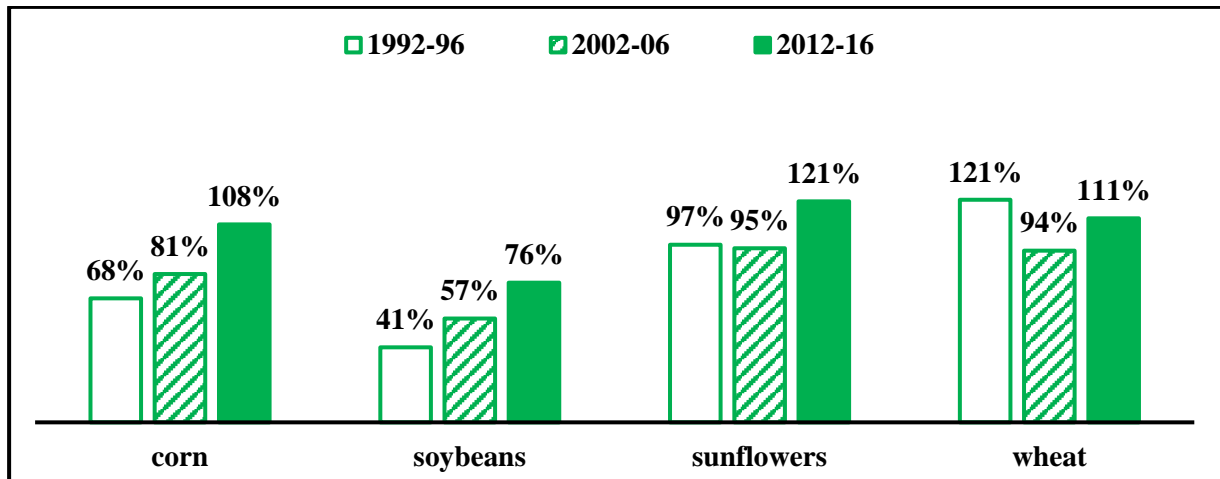


Figure 4. Ratio of Ukraine-to-World Harvested Yield, Corn, Soybeans, Sunflowers, and Wheat, 1992-2016*

*Source: original calculations using data from the US Department of Agriculture [1]

Recent Ukraine sunflower yield is 21% above the world average after being 3% to 5% below during 1992-96 and 2002-06. In contrast, Ukraine wheat yield may have declined slightly relative to the world average but the evidence is not definitive. It is however reasonable to hypothesize that more productive land is shifting to corn, thus dampening Ukraine-wheat yields.

Share of World Production and Trade: Figure 5 contains world production and trade shares only for 1992-96 and 2012-16 so that both shares can be put in the same figure. Consistent with the increases in harvested hectares and world yield ratio, Ukraine's share of world corn and soybean production increased. Ukraine's share of world trade increased even more because production grew faster than domestic consumption, especially for corn and especially between 2002-06 and 2012-16 (compare Figures 1 and 6). During 2012-16, Ukraine accounted for 14% of world corn exports and 2% of world soybean exports.

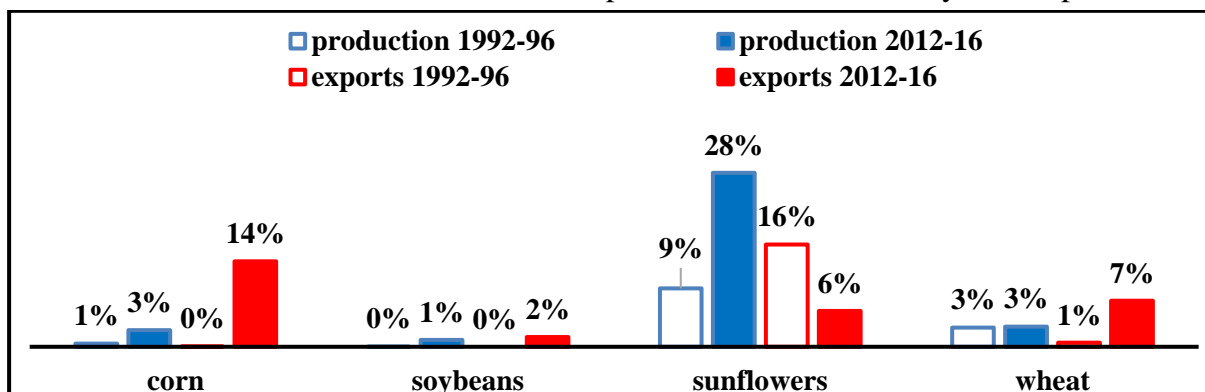


Figure 5. Ukraine's Share of World Corn, Soybean, Sunflower, and Wheat Production and Exports, 1992-2016*

*Source: original calculations using data from the US Department of Agriculture [1]

Ukraine's share of world sunflower production increased from 9% in 1992-96 to 28% in 2012-16; however, its share of world exports declined from 16% to 6% (see Figure 5). World export share declined because domestic consumption of sunflowers increased by more than production of sunflowers (compare Figures 1 and 6). On the other hand, Ukraine's share of world wheat exports increased from 1% in 1992-96 to 7% in 2012-16 even though its share of world wheat production was 3% in both periods. The reason world share of wheat exports increased was the decline in Ukraine domestic consumption of wheat from 1992-96 to 2002-06 followed by no change in domestic consumption of wheat through 2012-16 (see Figure 6).

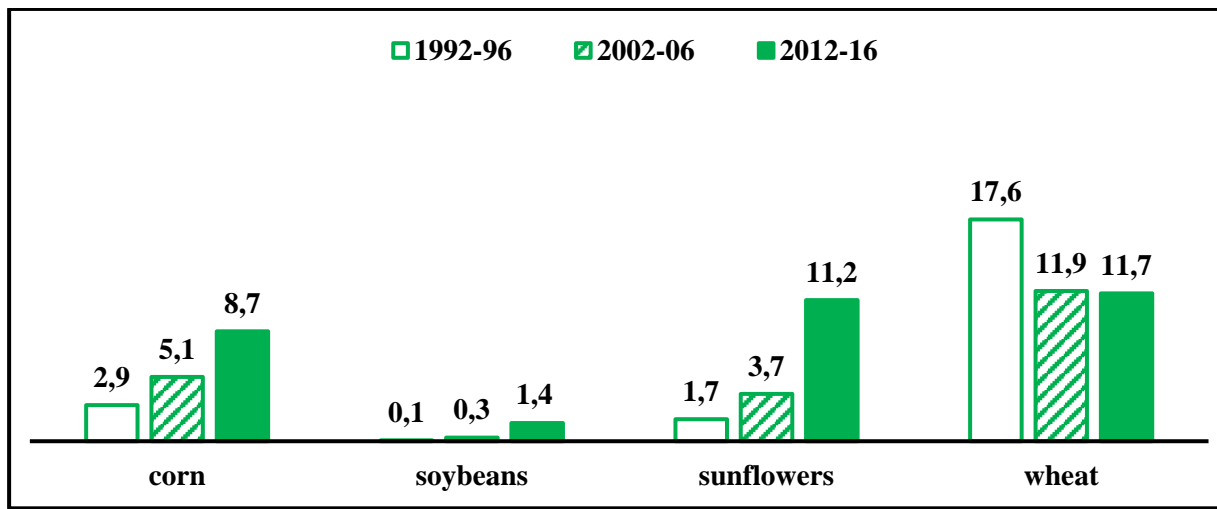


Figure 6. Average Annual Domestic Consumption of Corn, Soybeans, Sunflowers, and Wheat, Ukraine, Million Metric Tons, 1992-2016

*Source: original calculations using data from the US Department of Agriculture [1]

Yield Variability: An important feature of crop production in Ukraine is variable yields from year to year. A common measure of annual yield variability, standard deviation of the percent deviation of annual yield from its linear trend-line value, is compared for Ukraine and US in Figure 7.

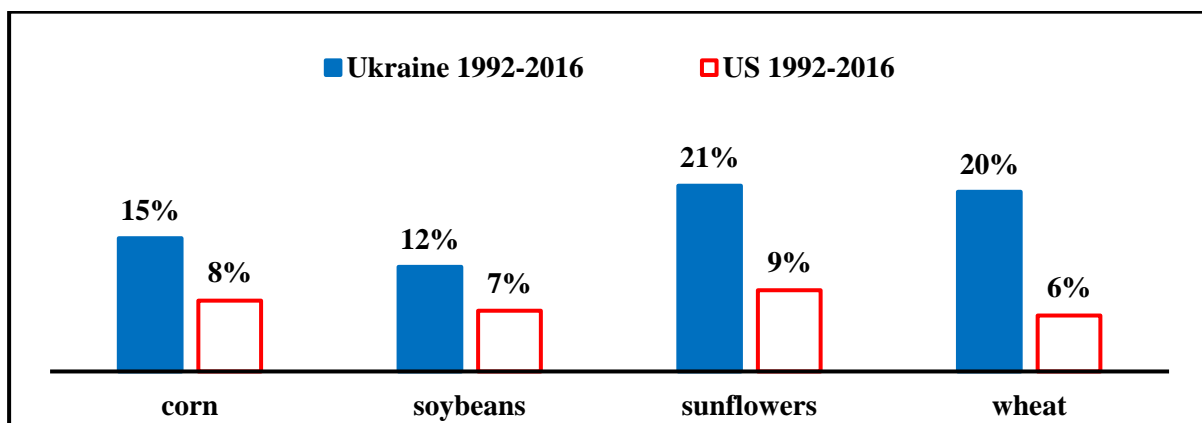


Figure 7. Variability (Standard Deviation) of Annual Percent Deviation of Yield from Trend-line Yield, Corn, Soybeans, Sunflowers, and Wheat, Ukraine vs. US, 1992-2016*

*Source: original calculations using data from the US Department of Agriculture [1]

Table 1 contains the estimated linear trend-line regression equations. Each equation and all coefficients are statistically significant with 99% statistical confidence except for Ukraine wheat slope coefficient and equation, which are significant with 90% statistical confidence. Consistent with the prior discussion of yields, initial yield (i.e., intercept coefficient) is higher for US corn, soybeans, and sunflowers but similar for wheat. The linear trend in yield (i.e., slope coefficient) is higher for Ukraine corn, soybeans, and sunflowers; but again similar for wheat.

Table 1

Linear Trend-Line Regression Equations for Corn, Soybeans, Sunflowers, and Wheat, Ukraine and US, 1992-2016*

Crop by Country	----- Intercept -----		----- Slope -----		R ²
	Coefficient	Standard Error	Coefficient	Standard Error	
Corn					
Ukraine	1,901***	0,230	0,166***	0,015	0,83***
US	7,394***	0,298	0,121***	0,020	0,61***
Soybeans					
Ukraine	0,658***	0,066	0,055***	0,004	0,87***
US	2,322***	0,079	0,032***	0,005	0,60***
Sunflowers					
Ukraine	0,831***	0,107	0,043***	0,007	0,61***
US	1,353***	0,057	0,014***	0,004	0,36***
Wheat					
Ukraine	2,552***	0,248	0,033*	0,017	0,14*
US	2,466***	0,075	0,028***	0,005	0,56***

Note: * and *** in the Table denote statistical significance at the 90% and 99% level of statistical confidence

*Source: original calculations using data from the US Department of Agriculture [1]

Compared with the US, standard deviation of the percent deviation of yield from its linear trend-line value is 88% higher for Ukraine corn, 72% higher for Ukraine soybeans, 129% higher for Ukraine sunflowers, and 221% higher for Ukraine wheat. An F-test finds that, for all crops, Ukraine and US variances and thus standard deviations differ with 99% statistical confidence.

Summary and Implications: Ukraine became a key player in international grain and oilseed markets during the recent period of world prosperity in grains and oilseeds. Ukraine currently accounts for 14% of world corn exports, 2% of world soybean exports, 6% of world sunflower exports, and 7% of world wheat exports. One driver of this success was the doubling of corn and soybean yields since 1992. Nevertheless, Ukraine's corn and soybean yields still lag Argentina and US corn and soybean yields and Brazil soybean yields. Moreover, yield variability is an important feature of crop production in Ukraine. Compared with the US, standard deviation of the percent deviation of yield from its linear trend-line value ranges from 72% higher for Ukraine soybeans to 221% higher for Ukraine wheat. Ukraine and US standard deviations differ significantly with 99% statistical confidence.

Another key driver of Ukraine's emergence as a grain and oilseed exporter was changes in domestic consumption. How fast domestic consumption grows in the future will

be important to whether Ukraine can maintain its world export status. To restate this observation somewhat differently, will the future path of domestic consumption mirror that of sunflowers or wheat?

Given the preceding observations, if Ukraine is to sustain its current role in world grain and oilseed markets, it must address its twin yield issues. Higher yields, especially relative to its export competitors, are needed to solidify Ukraine's position as a cost competitive international supplier. However, Ukraine must also be seen as a reliable supplier. In fact, yield variability is likely the more important long-term yield issue.

While yield variability is critically affected by climate, it is also critically affected by genetics and production techniques. Ukraine needs to aggressively pursue a national strategy of reducing yield variability in order to improve its reliability as an international supplier. Genetics often receives the most attention, but matching and adapting production techniques to land type can be just as important. Improving genetics and production techniques require investments in basic scientific research as well as adaptive research to customize basic research to local conditions.

In closing, the world-wide crop prosperity that began in 2006 opened the door for Ukraine to return to its historical role as one of the world's breadbaskets. However, periods of prosperity always end. Ukraine now needs to use science and research to internalize its recent momentum in the grains and oilseed sector. It needs to drive yields even higher and, more importantly, reduce the variability of its yields. A bright future lies ahead if Ukraine can make this strategic adjustment.

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АНОТАЦІЯ

ВИРОБНИЦТВО ЗЕРНОВИХ І ОЛІЙНИХ КУЛЬТУР В УКРАЇНІ: ОЦІНКА НЕДАВНЬОГО УСПІХУ ДЛЯ ДОСЯГНЕННЯ СТАЛОГО УСПІХУ

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Світове процвітання у виробництві зернових та олійних культур, що розпочалось у 2006 році відкрило двері для України, щоб стати ключовим міжнародним експортером зернових і олійних культур. Швидке підвищення врожайності і збільшення посівних площ зіграло ключову роль, особливо для кукурудзи і сої. Проте, рівень урожайності кукурудзи і сої в Україні відстає від показників її основних конкурентів по експорту. Обмежене зростання внутрішнього споживання також відіграє певну роль, особливо для пшениці. Висока нестабільність урожайності характеризує виробництво зернових і олійних культур в Україні. У порівнянні з США, стандартне відхилення відсоткового відхилення урожайності від її лінійного значення лінії тренда в Україні на 72% більше для соєвих

бобів і навіть вище для кукурудзи, соняшнику, і особливо пшениці. Тепер, коли період процвітання закінчився, Україна повинна інтерналізувати свій недавній імпульс за допомогою базових та адаптивних досліджень з метою збільшення урожайності і, що більш важливо, зменшити коливання врожайності. Якщо Україна може зробити цей стратегічний крок, її сектор зернових та олійних культур матиме світле майбутнє.

Ключові слова: Україна, зернові, насіння олійних культур, коливання врожайності, світова частка експорту.

Рис. 7. Табл. 1. Лит. 3.

АННОТАЦІЯ

ПРОИЗВОДСТВО ЗЕРНОВЫХ И МАСЛИЧНЫХ КУЛЬТУР В УКРАИНЕ: ОЦЕНКА НЕДАВНЕГО УСПЕХА ДЛЯ ДОСТИЖЕНИЯ УСТОЙЧИВОГО УСПЕХА

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Мировое процветания в производстве зерновых и масличных культур, которое началось в 2006 году открыло двери для Украины, чтобы стать ключевым международным экспортером зерновых и масличных культур. Быстрое повышение урожайности и увеличения посевных площадей сыграло ключевую роль, особенно для кукурузы и сои. Однако, уровень урожайности кукурузы и сои в Украине отстает от показателей ее основных конкурентов по экспорту. Ограниченный рост внутреннего потребления также играет определенную роль, особенно для пшеницы. Высокая нестабильность урожайности характеризует производство зерновых и масличных культур в Украине. По сравнению с США, стандартное отклонение процентного отклонения урожайности от ее линейного значение линии тренда в Украине на 72% больше для соевых бобов и даже выше для кукурузы, подсолнечника, и особенно пшеницы. Теперь, когда период процветания закончился, Украина должна интернализировать свой недавний импульс с помощью базовых и адаптивных исследований с целью увеличения урожайности и, что более важно, уменьшить колебания урожайности. Если Украина может сделать этот стратегический шаг, ее сектор зерновых и масличных культур будет иметь светлое будущее.

Ключевые слова: Украина, зерновые, семена масличных культур, колебания урожайности, мировая доля экспорта.

Рис. 7. Табл. 1. Лит. 3.

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The author thanks Natalia Pryshliak and Allan Lines for their useful comments, insights, and suggestions; and Natalia for her assistance with formatting the article.

