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Oleksandr Kuzmenko

D. Sc. (Economics), Professor,
Head, Economics and Business Department,
Petro Mohyla Black Sea National University
10, 68 Desantnykiv Str., Mykolaiv, 54003, Ukraine
oleksandr.kuzmenko@chmnu.edu.ua
ORCID ID:
<https://orcid.org/0000-0002-6192-5483>



Iryna Semenchuk

PhD (Economics), Associate Professor of
the Department of Economics and Business,
Petro Mohyla Black Sea National University
10, 68 Desantnykiv Str., Mykolaiv, 54003, Ukraine
irina.semenchuk@chmnu.edu.ua
ORCID ID:
<https://orcid.org/0000-0003-0425-887X>



Viktor Pohromskyi

PhD (History),
Acting Associate Professor,
Petro Mohyla Black Sea National University
10, 68 Desantnykiv Str., Mykolaiv, 54003, Ukraine
pogromski_y@ukr.net
ORCID ID:
<https://orcid.org/0000-0002-6387-240X>

Regional leadership of agrarian production in Ukraine: assessment, problems and directions of development

Abstract. The leading regions of Ukraine's agricultural production are the most eye-catching for attracting foreign investments, introducing innovative technologies and entering international markets. Research of the main factors, characteristics and experience which determine the agricultural guidance of the regions provide information to the potential investors for the accomplishment of investment and innovation programs, identify problems and ways to solve them for further expansion of the agricultural sector.

The study applied the method of estimating the level of agricultural production in terms of gross agricultural output per one person of the rural population (GAO per one person of the rural population). The evaluation of the leadership of agricultural production in the regional aspect was carried out on the basis of the Ukraine's regional allotment into three groups, formed by the ranges of the ratio of GAO per one person of the rural population to its average value in Ukraine. A group of regional leaders from 15 oblasts (regions) that form the leading agricultural district (Vinnytsia, Dnipropetrovsk, Donetsk, Zhytomyr, Zaporizhzhia, Kyiv, Kirovohrad, Mykolaiv, Poltava, Sumy, Kharkiv, Kherson, Khmelnytsky, Cherkasy, Chernihiv) has been established. In these oblasts, agricultural products worth UAH 525298.1 million are produced. (77.1% of the volume in Ukraine), is sold for export for USD 8181.0 million (40.3% of Ukraine's agricultural exports). It is determined that in the leading district the area of agricultural lands is 27.2 million hectares, 82.7% of which are arable lands of fertile chernozem. The structure of production has changed towards crop production, the most profitable and export-oriented one. The rural population has shrunk to 7.1 million, reducing its labor potential. More than 77% of agricultural machinery is concentrated in the district, but this is on the background of its overall reduction by 3.5 times or even more (in 2019 compared with 1990).

The main problems in land use are: high degree of plowing of agricultural lands (the highest in five oblasts reaches 81.5-88.1%), violation of the system of scientifically justified crop rotations, insignificant application of organic fertilizers (0.1-1.3 t/ha), which intensifies soil degradation processes. Investments in the leading agricultural district of 15 oblasts amount to UAH 45.3 billion, or 77.3% of the total volume in Ukraine, but their main part (65.4%) is own funds of enterprises and organizations and only 0.7% are the funds of foreign investors. The influence of farms' categorical factors and the scale of commodity production on certain types of products is analyzed and a significant influence on the leadership of large agricultural associations (agricultural holdings) is revealed.

The system of internal and external factors influencing the leadership of the regions is generalized in our study. The measures of the state agrarian policy should be intended to transition to production of products

with high added value, optimization of land use system, improvement of investment climate, rendering of the state help to agrarian producers, development of infrastructure and system of logistics, information and legal support of agrarian export, introduction of innovative technologies in the field of decision making in farming.

Keywords: Agrarian Production; Region; Leader; Group; Agricultural Land; Agricultural Holding; Crop; Export; Investment

JEL Classification: O52; Q1; R11; R12

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Кузьменко О. Б.

доктор економічних наук, професор, завідувач, кафедра економіки та підприємництва, Чорноморський національний університет імені Петра Могили, Миколаїв, Україна

Семенчук І. М.

кандидат економічних наук, доцент кафедри економіки та підприємництва, Чорноморський національний університет імені Петра Могили, Миколаїв, Україна

Погромський В. О.

кандидат історичних наук, доцент б.в.з. кафедри економіки та підприємництва, Чорноморський національний університет імені Петра Могили, Миколаїв, Україна

Регіональне лідерство аграрного виробництва України:

оцінка, проблеми та напрямки розвитку

Анотація. З метою інформаційного забезпечення потенційних інвесторів у дослідженні зроблено оцінку регіонального лідерства аграрного виробництва України. Використано метод оцінки рівня аграрного виробництва за таким показником, як валова продукція сільського господарства на одну особу сільського населення (ВП с.г. на одну особу сільського населення). Оцінку лідерства аграрного виробництва в регіональному аспекті проведено на підставі розподілу регіонів України на три групи, сформовані за діапазонами співвідношення ВП с.г. на одну особу сільського населення до його середнього значення по Україні. Встановлено групу регіонів лідерів з 15 областей які утворюють лідерський аграрний район (Вінницька, Дніпропетровська, Донецька, Житомирська, Запорізька, Київська, Кіровоградська, Миколаївська, Полтавська, Сумська, Харківська, Херсонська, Хмельницька, Черкаська, Чернігівська). У цих областях виробляють аграрної продукції на 525298,1 млн. грн. (77,1% від обсягу по Україні), реалізують її на експорт на суму 8181,0 млн. дол. США (40,3% від аграрного експорту України). Визначено, що в лідерському районі площа сільськогосподарських угідь складає 27,2 млн. га, 82,7% з яких – орні землі родючого чорнозему. Структура виробництва змінилася в бік продукції рослинництва, найбільш рентабельної й орієнтованої на експорт. Кількість сільського населення скоротилася до 7,1 млн. осіб, що зменшує трудовий потенціал. У районі зосереджено більше 77% сільськогосподарської техніки, проте її загальне скорочення досягло 3,5 разів і більше (у 2019 р. порівняно з 1990 р.).

У статті визначено переваги та проблеми лідерського району й аграрного виробництва України в цілому. Так, у землекористуванні основними проблемами є: високий ступінь розораності сільськогосподарських угідь (найвищий він у п'яти областях, де досягає 81,5–88,1%), порушення системи науково обґрунтованих сівозмін, незначне внесення органічних добрив (0,1–1,3 т/га), що посилює деградаційні процеси ґрунтів. Інвестиції в лідерський район складають 45,3 млрд грн., або 77,3% від загального обсягу по Україні, проте їх основна частина (65,4%) – це власні кошти підприємств й організацій, і лише 0,7% – кошти іноземних інвесторів.

Нами також проаналізовано вплив факторів категорій господарств та масштабу товарного виробництва за окремими видами продукції і виявлено суттєвий вплив на лідерство великих аграрних об'єднань (агрохолдінгів). Узагальнено систему внутрішніх і зовнішніх факторів, що впливають на лідерство регіонів. Запропоновано пріоритетні напрямки економічного зростання як регіонів-лідерів, так і галузі в цілому.

Ключові слова: аграрне виробництво; область; лідер; група; сільськогосподарська земля; агрохолдинг; урожай; експорт; інвестиції.

Кузьменко А. Б.

доктор экономических наук, профессор, заведующий, кафедра экономики и предпринимательства, Черноморский национальный университет имени Петра Могили, Николаев, Украина

Семенчук И. Н.

кандидат экономических наук, доцент кафедры экономики и предпринимательства, Черноморский национальный университет имени Петра Могили, Николаев, Украина

Погромский В. А.

кандидат исторических наук, доцент б.у.з. кафедры экономики и предпринимательства, Черноморский национальный университет имени Петра Могили, Николаев, Украина

Региональное лидерство аграрного производства Украины: оценка, проблемы и направления развития

Аннотация. С целью информационного обеспечения потенциальных инвесторов в исследовании сделана оценка регионального лидерства аграрного производства Украины. Использован метод оценки уровня аграрного производства по показателю валовой продукции сельского хозяйства на душу сельского населения (ВП с.г. на душу сельского населения). Оценку лидерства аграрного производства в региональном аспекте проведено на основании распределения регионов Украины на три группы, сформированные по диапазонам соотношения ВП с.г. на душу сельского населения к его среднему значению по Украине. Установлена группа регионов-лидеров из 15 областей, которые образуют лидерский аграрный район (Винницкая, Днепропетровская, Донецкая, Житомирская, Запорожская, Киевская, Кировоградская, Николаевская, Полтавская, Сумская, Харьковская, Херсонская, Хмельницкая, Черкасская, Черниговская). В этих областях производят аграрной продукции на 525298,1 млн. грн. (77,1% от объема по Украине), реализуют ее на экспорт на сумму 8181,0 млн. долл. США (40,3% от аграрного экспорта Украины). Определено, что в лидерском районе площадь сельскохозяйственных угодий составляет 27,2 млн. га, 82,7% из которых – пахотные земли плодородного чернозема. Структура производства изменилась в сторону продукции растениеводства, наиболее рентабельной и ориентированной на экспорт. Количество сельского населения сократилось до 7,1 млн. человек, что уменьшает трудовой потенциал. В районе сосредоточено более 77% сельскохозяйственной техники, однако ее общее сокращение достигло 3,5 раз и более (в 2019 г. по сравнению с 1990 г.).

В статье определены преимущества и проблемы лидерского района и аграрного производства Украины в целом. Так, в землепользовании основными проблемами являются: высокая степень распаханности сельскохозяйственных угодий (самая высокая она в пяти областях, где достигает 81,5–88,1%), нарушение системы научно обоснованных севооборотов, незначительное внесение органических удобрений (0,1–1,3 т/га), что усиливает деградационные процессы почв. Инвестиции в лидерский район составляют 45,3 млрд. грн., или 77,3% от общего объема по Украине, однако их основная часть (65,4%) – это собственные средства предприятий и организаций, и только 0,7% – средства иностранных инвесторов.

Нами также проанализировано влияние факторов категорий хозяйств и масштаба товарного производства по отдельным видам продукции и выявлено существенное влияние на лидерство крупных аграрных объединений (агрохолдингов). Обобщена система внутренних и внешних факторов, влияющих на лидерство регионов. Предложено приоритетные направления экономического роста как регионов-лидеров, так и отрасли в целом.

Ключевые слова: аграрное производство; область; лидер; группа; сельскохозяйственная земля; агрохолдинг; урожай; экспорт; инвестиции.

1. Introduction

Under the condition of the constant growth of demand for food in the world, Ukraine, which owns 10% of the world's black soil reserves, with skilled labor resources has to provide its own food security and the leading position of the country in the world market of agrarian products. Market transformation of Ukrainian agrarian production, integration into the world and European economic systems, globalization processes has led to changes in the differentiation of agrarian production on the regional level in the direction of greater polarization (Kuzmenko, 2016) [14]. The number of agrarian developed regions has increased (to 14 units), the number of poorly developed regions has increased (to 5 units) and the composition of mid-level developed regions has significantly reduced (from 8 to 3 units). Regional processes are caused by problems: unbalance of agricultural production in the regional space by categories of farms, scale of producers by particular agricultural products; lack of financial resources; low income of rural population. Territorial imbalances in agricultural production necessitate regional differentiation of measures for ensuring economic integrity, social and political unity of the country. The definition of the regional leaders is of interest to foreign investors in terms of maximizing the inflow of invested capital. It is important to study the factors influencing the regional leadership's position in agrarian production and on this basis the development of the of economic growth directions both of the regional leaders and the industry in general. Moreover, given the nature of the structural changes in the Ukrainian economy towards agrarian-industrial orientation, strategic orientation towards agrarian leadership in the world, the agricultural sector can become the engine of the national economic development and its effective integration into the world economic space, according to the Concept of the State target program for the agricultural sector of the economic development for the period up to 2022 (Cabinet of Ministers of Ukraine, 2015) [5].

In the European Union, where integration is constitutionally enshrined in Ukraine, agriculture is an important factor in economic growth on the regional level. The reform of the EU's common

agricultural policy contributes to the growth of gross domestic product through investment and is not limited to the main sector, but also affects other sectors (Loizou et al., 2019) [15].

2. The purpose of the paper is to assess the regional leadership of agrarian production in Ukraine and to substantiate the practical recommendations for economic growth of leaders and agrarian production. Achievement of the set goal has determined the necessity of solving the following tasks:

- to establish the leaders of agrarian production in the regional distribution as the most attractive investment objects;
- to identify problems of agrarian production, land use of leading regions in Ukraine in general;
- to analyze the export activity of the leading regions, organizational forms of enterprises, scale of commodity production by individual types of products, factors influencing the leadership positions;
- on the basis of the advantages, disadvantages and problems of farms that provide the leadership of the regions, propose the priority directions of leaders' development and the industry in general.

3. Brief Literature Review

Leadership in the development of industries in certain areas stems from the disproportions of regional development that are inherent in all countries, regardless of their place in the socio-economic typology. These disproportions are determined by the level of development of all territorial socioeconomic systems, including the agrarian sector. Reducing the lagging behind of the regional leaders of other regions is made by achieving a higher level of general development (ESDP, 1999; TA, 2020) [8; 27]. The differentiation of agrarian sector development at the national and regional levels significantly depends on natural resources and weather or climate conditions.

Methods of differentiation and grouping of regions depend on the purpose of the study of the agricultural sector. Zasada I. et al. developed a typology of regions (RT) using factor and cluster analysis to study the effectiveness of financial assistance under EU rural development policy (RDP), (Zasada et al., 2015) [35]. Within this typology, the six types of regions with the largest share of natural capital funding were selected to improve the prioritization of natural capital support over other RDP objectives. The assessment of the agricultural, environmental and socio-economic situation in the region is based on 21 indicators, (Zasada et al., 2018) [36].

The issue of leadership in agricultural production is studied not only at the regional level, but also in the networks of organizations that implement agricultural development policy. In East and West Africa and South Asia, the leaders in this policy are local and regional organizations are rather international ones (Rudnick et al., 2019) [20].

Scientists are actively investigating the problems of regional development disproportions and regional leadership. They are considered from the point of view of the entire complex of country's territorial socio-economic systems to (Živanović & Gatarić, 2017; Noor, 1992; Adamczyk-Lojewska, 2004) [37; 17; 1], ensure the competitiveness of the regions (Volkov, 2015) [32]. There is a generalization of the theoretical substantiation of various rates in the regional development (Szajnowska-Wysocka, 2009) [26].

Agriculture in the world faces challenges related to climate change (Ochuodho et al., 2016) [18], environment, demography (Shen et al., 2018) [23], policy, technology (Wolfert et al., 2017) [34], consumer preferences and trade. To address them comprehensively, researchers propose a protocol for the development of common socio-economic pathways for European agriculture, (Mitter et al., 2019) [16] as well as new data processing systems and models for decision-making in agricultural production (Jones et al., 2017; Capalbo et al., 2017; Wolfert et al., 2017) [11; 7; 34].

However, separate issues connected with the peculiarities and nature of regional leadership of agrarian production in Ukraine require a more in-depth study and justification of the territorial systems most attractive for investments, the introduction of innovations for the development of both individual regions and the industry in general.

4. Research Methods

GDP per capita is a common indicator of economic potential and level of development, which reflects the ratio of market value of all goods produced and services provided within the country to

the country's population. In the science of regions, this macroeconomic indicator has been modified as a gross regional product per capita (Shynkaruk et. al., 2015) [24]. The information base of statistical data of agricultural research in a regional context allows more accurately determine its level of development based on the ratio of gross regional agricultural output to the number of rural population. Methodology of the distribution of Ukraine's territorial economic space into three regional groups - economically developed, relatively well-off and impoverished regions, aggregated according to the established ranges of the ratio of the gross regional product per capita to its average Ukrainian value (100% and higher, from 75 to 100%, 75% and lower) is used both in domestic studies of the regional economy (Shynkaruk et. al., 2015) [24], as well as in European and world scientific and legislative normative practice. In particular, in the European Union, the largest financial support identified as the priority No.1 of the regional policy is the regions where the GDP per capita is less than 75% of the average indicator in the EU, corresponding to the low level of economic development (Vdovichen & Kruhlyanko, 2015) [30]. In the presented study, this methodical approach, which relates to calculation methods, was used for the first time in terms of the ratio of gross regional agricultural production to the number of rural population with similar ranges of distribution in the territorial space of agrarian production in Ukraine to determine the leading regions.

The development of the research of the regional leaders with the help of the mapping method allows us to obtain a visual territorial model of the leading agrarian region, to analyze the common and distinctive features of the regions in terms of location in natural zones, landscape, weather and climatic conditions and types of soils. The map defines the regions that border on the leading area, have similar natural resource characteristics, and is a reserve for its replenishment. The cartographic method has the advantages of visibility, the territorial modeling is widely used in regional studies (Veznik & Bartosova, 2004; Živanović & Gatarić, 2017; Schulte et al, 2019; Wietschel et al, 2019) [31; 37; 21; 33] and is used by us.

The method of direct analysis is used to determine the organizational forms of households, commodity products, and factors determining leadership positions. The priority directions of the leaders' regional development and the agrarian sector as a whole are formulated using the method of generalization.

5. Results and Discussion

Agrarian production of Ukraine in the conditions of the world financial and economic crisis and socio-political shocks in recent years shows stable growth. Gross agricultural output per one person of the rural population (GAO per one person of the rural population) in Ukraine since 2009 (32.57 thousand UAH / person) reached 2019, 53.08 thousand UAH / person (at constant prices in 2016). Agriculture is one of the few industries that has achieved such growth rates compared to others. However, in the regional dimension, the economic efficiency of agrarian production has a clear differentiation. Identification of leading regions, analysis of factors that determine their leadership will establish investment and innovative attractive territorial systems for the economic development of both regions and the agrarian sector in general.

Differentiation of regional economic development due to natural resources, historically formed specialization and territorial structure of the economy in agrarian production is enhanced by the location in physical and geographical zones, weather and climatic conditions, type of soils, landscape, etc. However, it is not considered as a static object that is not capable of change, its evolution is a continuous process under the influence of internal and external social, political and economic factors, which requires new approaches to the development of regional economic systems and agriculture in general.

The dynamics of the movement in the regional components of the agrarian sector was conditioned by the realization of comparative (competitive) preferences prevailing in previous periods: the area of agricultural land and the share of arable land in their composition, the specialization and structure of agricultural production, transport infrastructure, the provision of relatively cheap labor resources, socio-cultural characteristics of the population (traditions and norms).

To determine the regional differentiation of agricultural production, the distribution of Ukrainian regions into three groups, based on the ranges of the ratio in gross agricultural output per one person of the rural population to its average in Ukraine, is used: the leading group is regional leaders, agrarian developed - 100%, and above; the second group is average level of agrarian production development - from 75% to 100%; the third group of agrarians is poorly developed, the outsiders are 75% and below (Table 1).

In 2019, a group of regional leaders included 15 regions: Vinnytsia, Dnipropetrovsk, Donetsk, Zhytomyr, Zaporizhzhia, Kyiv, Kirovohrad, Mykolaiv, Poltava, Sumy, Kharkiv, Kherson, Khmelnytskyi, Cherkasy, Chernihiv. The middle level group is represented by the Luhansk and Ternopil regions. The outsiders are Volyn, Zakarpattia, Ivano-Frankivsk, Lviv, Odesa, Rivne and Chernivtsi regions.

It should be noted that such a division has developed during the administrative-command economy and during the period of market transformations since 1990 remained practically stable (Table 1).

Established 15 regions of agricultural production leaders in Ukraine produce agricultural products for 525298.1 million UAH (at constant prices in 2016) or 77.1% of the volume of this production in Ukraine, 2019, sell agricultural and food products (commodity groups 1-24 according to UKTZED) by 8181.0 million US dollars (40.3% of Ukraine's agrarian export, 2018, Table 3), which contributes to the trade balance and the stability of the national currency. Leading regions have the greatest investment attractiveness, competitive advantages, formed over a long period, large areas of agricultural and arable land in their composition for the use of intensive technologies, modern means of mechanization of agriculture, new varieties and rocks, specialization that meets the needs of the world market.

Portrait of Leading Regions. These are compactly located areas of Central, Northeastern and Southern Ukraine that form the Leading Agrarian Area. They are located in the Forest-Steppe and Steppe areas. A small part of Kiev, Chernihiv and Sumy regions - in the Forest zone. The landscape is plain. Weather-climatic conditions range from a damp, moderately warm zone to the north, to a very arid south. The ground cover is mainly of different types of black soil. An insignificant part of turf-podzolic soils in the north and chestnut in the south.

Based on the geographical location, the reserves of replenishment of a group of leading regions, in our opinion, should be sought in areas adjacent to the leading agrarian regions and have similar indicators of natural potential. Thus, in 2019, the Donetsk region became one of the leaders, and Luhansk came very close to it (lagging GAO per one person of the rural population

Table 1:
Distribution of Ukrainian regions by the level of development of agrarian production

Regions	Group of regions by year									2019	
	1990	1995	2000	2005	2010	2014	2016	2018	2019	GAO per one person of the rural population, thousand UAH / person (at constant prices in 2016)	% of the average in Ukraine
Autonomous Republic of Crimea	2	3	3	3	3	-	-	-	-	-	-
Vinnytsia	1	1	1	2	1	1	1	1	1	75.99	143.2
Volyn	2	2	2	2	2	3	3	3	3	33.52	63.1
Dnipropetrovsk	1	1	1	1	1	1	1	1	1	82.96	156.3
Donetsk	1	1	1	1	1	1	2	2	1	53.32	100.5
Zhytomyr	2	1	2	2	2	2	2	1	1	55.25	104.1
Zakarpattia	3	3	3	3	3	3	3	3	3	11.22	21.1
Zaporizhzhia	1	1	1	1	1	1	1	1	1	70.69	133.2
Ivano-Frankivsk	3	3	3	3	3	3	3	3	3	17.41	32.8
Kyiv	2	1	1	1	1	1	1	1	1	60.61	114.2
Kirovohrad	1	1	1	1	1	1	1	1	1	104.52	196.9
Luhansk	1	1	1	1	1	2	2	2	2	51.96	97.9
Lviv	3	3	3	3	3	3	3	3	3	23.45	44.7
Mykolaiv	1	1	1	1	1	1	1	1	1	73.29	138.1
Odesa	2	2	2	2	2	3	2	3	3	36.14	68.1
Poltava	1	1	1	1	1	1	1	1	1	83.12	156.6
Rivne	3	2	2	3	3	3	3	3	3	32.0	60.3
Sumy	1	1	1	1	1	1	1	1	1	91.39	172.2
Ternopil	2	2	2	3	3	2	3	2	2	42.65	80.4
Kharkiv	1	1	1	1	1	1	1	1	1	76.35	143.8
Kherson	1	1	1	1	1	1	1	1	1	71.59	134.9
Khmelnytskyi	2	1	1	2	1	1	1	1	1	66.74	125.7
Cherkasy	2	2	1	1	1	1	1	1	1	77.77	146.5
Chernivtsi	3	3	3	3	3	3	3	3	3	20.0	37.7
Chernihiv	1	1	1	1	1	1	1	1	1	90.17	169.9
Ukraine										53.08	100.0

Source: Calculated and compiled by the authors according to the data of State Statistics Service of Ukraine (2020)

from the average value in Ukraine 2.1% (Table 1)) despite the military-political reasons of recent years and after their elimination will be fixed in the group of leaders. Zhytomyr region has been among the leaders since 2018 due to the implementation of agricultural investment policy. Ternopil region is constantly moving from the third to the second group. And despite 19.6% lagging GAO per one person of the rural population from the average value in Ukraine is not significant; it is very difficult to predict the result. The reasons for this instability, according to the authors, are related to migration processes and need further study.

Separately it is necessary to highlight the Odesa region that borders on a leading agrarian region in the south of the country, has a similar natural and climatic potential with the Mykolaiv and Kherson regions, but in recent years there is stable balance between the second and third groups with a wide range of fluctuations of the percentage from the average value in Ukraine of the GAO per one person of the rural population from 68.1% to 98.4%, with constant decrease of the indicator observed since 2000 (98.4%) by 2019 (68.1%). This condition is explained by the inconsistency of the agricultural production output of the rural population in comparison with this indicator in Ukraine in general.

There were no more reserves for replenishment of the group of leaders for the conducted research, and the regions of Western Ukraine included in the third group have a percentage from the average in Ukraine of the GAO per one person of the rural population at the level of 21.1, or 68.1%.

The analysis of the characteristics of a leading agrarian region allows us to identify the advantages and existing problems and the investment direction for further development of both the district and the industry in general. The area of agricultural land is only in the possession and use of agricultural enterprises and the volume of agricultural area is 27.2 million hectares and inferior to the area of all agricultural lands of such EU countries as France (29.3 million hectares) and Spain (27.7 million hectares) and exceeds this indicator in all other countries (28 countries). Much of these lands (22.5 million hectares, 82.7%) are arable land of unique black soil, which provides favorable natural conditions for the development of crop production.

Trends in changing the sown areas of agricultural crops in the leading agrarian region over the last decades coincide with these changes in general in Ukraine. The largest reduction occurred in relation to fodder crops, the area of which decreased by almost five times in comparison with 1990, the crop area of sugar beet decreased by three times over the same period. Practically no changes have taken place in relation to other crops, except for sunflower whose cultivated area has grown almost by three times. This indicates a structural shift towards crop production and the potential for livestock development.

The labor potential of the leading agrarian region has negative demographic trends as well as the whole rural territory of Ukraine, which manifests itself in the overall reduction of the population. Accordingly, the number of rural population in this area has decreased from 9.9 million in 1990 to 7.1 million in 2019, i.e. by 28.3%. At the same time, the total population decline in the regions of the leading area was 17.4%, rural areas lose people more rapidly than in the whole region. These processes are caused not only by the decrease in fertility and increase in mortality, but also from the active processes of labor migration of the rural population both in the city and beyond Ukraine. Moreover, the length of stay abroad can vary between several months or years, and maybe irreversible. The reasons for these trends are the reduction of jobs due to the raw material orientation of agriculture, the reduction of the processing base of agrarian raw materials and livestock industries, the lack of alternative agriculture as the basis of jobs in rural areas, and so on. If such trends are preserved, there is a threat of depopulation of rural areas and the reduction of their potential for labor resources.

The technical support of the leading agrarian region shows the concentration of basic types of agricultural machinery in it, including the availability of 102236 units of tractors in agricultural enterprises (78.3% of their total number in Ukraine, 2019), combine harvesters - 20636 units (77.8%), cargo and cargo-passenger cars - 61998 units (78.8%). At the same time, such a correlation developed on the background of reducing the amount of agricultural machinery in both the leading region and Ukraine in general (in 2019 compared with 1990): tractors 3.8 times, combine harvesters 3.9 times, cargo and cargo-passenger cars 3.5 times. This is caused by lack of investment, gradual aging and deterioration of assets. Accordingly, the provision of modern agricultural machinery will increase the efficiency of agrarian production of the leading region.

The leading agrarian region focuses on the production of the most productive and export-oriented crop production (grain and leguminous crops, sugar beet, sunflower, vegetables). Potatoes,

fruits and berries have a share of 62.2 and 65.0%, respectively in the leading area, and this is due to a significant production of households that are common in all areas. A similar picture is found in production and animal husbandry: meat and eggs are almost 75%, milk is 67.3% (large farms and exports), but wool is not a specialized production of the area (Table 2).

Table 2:

Volumes of production of the main types of agricultural products in the leading agrarian region, their share in Ukrainian production and productivity among the oblasts of the leading agrarian region in 2019

Product type	Unit of measurement (kt, or thousand tons)	Production amount	The share of production in Ukraine,%	Crop yield among areas of the leading agrarian region, c/ha	
				Highest	Lowest
Cereals and legumes	kt	61042.3	81.2	67.9	33.9
Sugar beet	kt	7275.2	71.3	629.9	419.7
Sunflower seeds	kt	13136.1	86.1	36.6	18.2
Potato	kt	12605.3	62.2	183.6	84.3
Vegetables	kt	6977.6	72.0	321.8	145.9
Fruits and berries	kt	104.4	65.0	177.6	18.5
Meat in slaughter mass	kt	2628.7	75.3	–	–
Milk	kt	6525.4	67.3	–	–
Eggs	million pcs	13138.2	78.8	–	–
Wool	tons	531	30.6	–	–

Source: Calculated and compiled by the authors according to the data of State Statistics Service of Ukraine (2020)

Despite the reduction in technical support at the highest yield crop areas of leading agricultural area (Table 2) these indexes are close to the corresponding indexes of leading agricultural countries of the EU (except potatoes). At the same time, the lowest yield points to a significant level of divergence of this indicator in the oblasts of the region. This is due to the significant dependence of crop production in Ukraine on natural and climatic conditions and the associated risk and specialization of regions in certain types of products.

Structural changes in agriculture in the direction of crop development and its orientation towards export grains and oilseeds have aggravated the problem of land use in the leading agrarian region and Ukraine in general. This leads to an increase in anthropogenic pressure on the environment, posing a threat to the efficiency of economic activity and the sustainable development of agrarian production.

First of all, this is an overly high level of agricultural land cultivation. According to the Strategy for Improving the Management Mechanism in the Sphere of Use and Protection of State-Owned Agricultural Lands and Their Disposal (Cabinet of Ministers of Ukraine, 2017) [6] the highest level of agricultural land cultivation in the leading agrarian region is observed in five southern and central regions of the steppe and forest-steppe zones (Dnipropetrovsk, Zaporizhzhia, Kirovohrad, Mykolaiv and Kherson regions), from 81.5% in Kherson region to 88.1% in Zaporizhzhia region. In the Vinnytsia, Poltava, Sumy, Kharkiv, Khmelnytskyi and Cherkasy regions, it is in the range of 72.2, or 79.4%. The lowest level is Chernihiv region (66.2%) and Kyiv region (63.1%). The cultivation of the territory of Ukraine is 53.9%, which is much higher than in European countries, which ore lands reach 30-32% (Bavrovska & Boryshkevych, 2016) [3].

The high degree of cultivation of agricultural land has led to an increase in the processes of water and wind erosion. In Ukraine, 13.3 million hectares (including 10.6 million hectares of arable land) were exposed to water erosion, and over 6 million hectares of wind farms. In the context of extensive land use, degradation processes of soils are intensified in a rush of scientifically grounded system of crop rotation. For example, crops of sunflower in the leader agrarian area occupy 5033.8 thousand hectares of the area from which the crop was harvested, or 84.5% of the area of this crop in the area. Considering that sunflower takes 22.2% of the area from which all crops are harvested in Ukraine, then this culture returns to the same field at best, four years later, and very often in three. According to scientific recommendations sunflower must be present in a cycle of crop rotation in seven years. This increases the negative balance of nutrients and humus in the soil and intensifies the processes of loss of natural fertility. In particular, the decline in humus content, which is a battery plant nutrients, soil bioregulation processes and the basis of its energy potential.

For example, the dynamics of the average weights of humus content in the soils of the Mykolaiv region (Figure 1), which is a typical representative of the leading agrarian region, shows its constant decrease in the long period (1880-2015). Moreover, if during the period of

1880-1980 the average annual reduction of humus content was 0.0063% per year, then now (1980-2015) it has increased by 2.5 times and reached 0.016% per year. It should be noted that the negative balance of humus in the soils of the Mykolaiv region in 1990 was offset to a greater extent by the introduction of organic fertilizers per hectare of arable land (5.8 t/ha), then in 2019 they were 0.2 t/ha. While maintaining the general trend of decreasing humus content, according to the latest data of agrochemical surveys, there is a slowdown in this process and even an increase in its concentration. This is due to the improvement of technology, the growth of mineral fertilizers, the prioritization of the remains of non-commodity crop production in the fields. But as a whole it doesn't remove a problem of deterioration of a qualitative condition of soils in the Mykolaiv region, in the leading area and in Ukraine.

The application of organic fertilizers in the leading agricultural district in 2019 is in the range from 0.1 t/ha (Kirovohrad region) to 1.3 t/ha (Donetsk and Cherkasy regions), and on the whole in Ukraine 0.6 t/ha. This is explained by the decline in livestock due to structural changes in agricultural reform (changes in the form of ownership of agricultural enterprises, the general economic crisis, reduction of the forage base, etc.), but does not solve and eliminate the problem of negative balance of humus.

Reproduction of natural soil fertility is constrained by the insufficiently involved synergistic interaction of economic incentives and legal responsibility in the field of rational land use, as well as the legally prescribed environmental restrictions based on effective land management.

For many countries around the world (including China), the basic concept of solving environmental and related socio-economic problems is the sustainable development of agriculture (Shen et al, 2018) [23]. In the movement of this concept is the management of sustainable land use (Schulte et al, 2019) [21]. A methodology for assessing the sustainability of land use at the regional level has been developed (Kotykova et al, 2019) [12], which provides information on regional issues for the development of strategic plans for the management of sustainable land use. Such plans are taken into account in the development of the common agricultural policy of the European Union for the period 2021-2027 (Schulte et al, 2019) [21] which focuses on public expectations regarding the functions to be performed by agricultural lands. These functions are: basic production; drainage regulation and water purification; limiting the entry of carbon dioxide into the atmosphere; biodiversity conservation; the use of organic matter from the remnants of the non-commodity part of crop production and agricultural waste for the nutrient cycle. The development of strategic plans for the management of sustainable land use is an urgent task of land use at the regional level and in Ukraine.

The use of organic matter from non-marketable crop products (wheat straw, barley, rapeseed, stalk and corn leaves) is possible not only for biofuel production (Wietschel et al., 2019) [33] but also for the recovery of nutrients in the soil that supports the cycle of these substances and partially compensates for the shortage of organic fertilizers in Ukraine (Kuzmenko, 2011) [13].

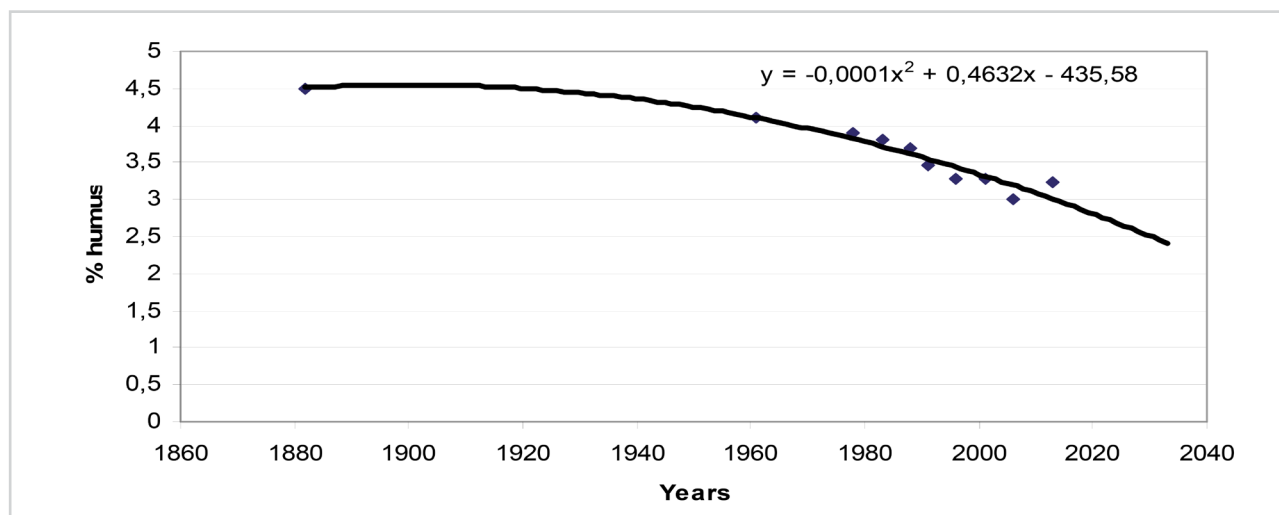


Figure 1:
**Graphical model of the change in the average weights
of humus content in the soils of Mykolaiv region**

Source: Developed by the authors

The land reform launched in 1991 led to the fragmentation of land, which resulted in 6.9 million citizens of Ukraine being entitled to a land share and most of them becoming shareholders. The average size of the land share in the leading agricultural district ranges from 2.5 ha in Vinnytsia region to 7.2 ha in Zaporizhzhia region. Not being able to cultivate the units on their own due to lack of resources from their owners has led to the fact that the main form of land use is rent. The lack of an effective mechanism to control the deterioration of the soil quality and the lack of interest of tenants in preserving natural fertility will lead to further soil depletion.

Rents for agricultural land use depend on their regulatory monetary valuation. Regulatory monetary valuation of one hectare of arable land as of January 1, 2020 in the regions of the leading agrarian region is in the range from 21411.0 UAH/ha (Zhytomyr region) to 33646.0 UAH/ha (Cherkasy region). The average rent for one hectare of land parcels (shares) per year is the smallest in the Zaporizhzhia region 878 UAH/ha, the highest in Poltava region 3524.7 UAH/ha (the average in Ukraine is 1613.4 UAH / ha, 2018).

The group of leaders of agricultural production through the prism of their activity in export of agricultural and food products is analyzed (Table 3).

The share of total agricultural output of the leading regions ranges from 3.05% to 8.38%. However, in the export activity, the leadership group is not homogeneous. The most export-oriented agricultural products are Vinnytsia, Kyiv, Kirovohrad, Mykolaiv, Kherson, Khmelnytskyi and Cherkasy regions. The share of exports of agricultural and food products in these regions is 64.19, or 83.22% and in monetary terms from USD 170.1 to USD 1452.2 million.

The leadership regional group that are both industrially developed (Dnipropetrovsk, Zaporizhzhya, Poltava, Kharkiv regions) with a high overall export have a small share of agricultural exports 6.67, or 25.74%, but its monetary equivalent is comparable to the regions mentioned above.

Exports in monetary terms lead Kyiv and Mykolaiv regions. Zhytomyr, Kirovohrad, Kharkiv, Kherson and Khmelnytskyi regions, which have a significant share in the agricultural production of Ukraine (Table 3), are highlighted in the leading group, but the volume of export in monetary terms indicates not fully utilized export potential.

Table 3:

Rural population share, agricultural production and exports of agricultural and food products by regions of Ukraine in 2018

Regions	Rural population share, %	Production of agricultural and food products		Exports of agricultural and food products	
		at constant 2010 prices, UAH million	share of products	USD thousand	share of total exports of the region, %
Ukraine	30.6	269408.1	100.0	18221655.8	38.50
Autonomous Republic of Crimea	-	-	-	-	-
Vinnytsia	48.6	22589.5	8.38	1139864.9	80.26
Volyn	47.8	7089.2	2.63	113262.1	15.73
Dnipropetrovsk	16.1	15667.4	5.82	514901.3	6.67
Donetsk	9.2	6956.1	2.58	79339.7	1.64
Zhytomyr	40.9	11128.7	4.13	143297.8	21.65
Zakarpattia	62.9	4301.2	1.60	109888.2	6.62
Zaporizhzhia	22.7	8220.2	3.05	475271.2	14.07
Ivano-Frankivsk	55.8	6108.2	2.27	82754.2	9.50
Kyiv	37.9	18427.4	6.84	1195248.3	64.39
Kirovohrad	36.8	12503.0	4.64	389228.6	74.60
Luhansk	13.0	4946.0	1.84	41281.2	20.34
Lviv	39.0	10189.9	3.78	527353.6	27.82
Mykolaiv	31.6	9362.7	3.48	1452220.0	68.74
Odesa	33.0	11943.2	4.43	1198016.1	71.81
Poltava	37.6	17747.4	6.59	430306.4	22.58
Rivne	52.5	7237.4	2.69	96267.3	23.43
Sumy	30.8	11362.2	4.22	442168.1	55.12
Ternopil	54.7	9836.6	3.65	177286.7	39.18
Kharkiv	19.0	14949.1	5.55	329162.3	25.74
Kherson	38.7	11243.9	4.17	174087.7	64.49
Khmelnytskyi	42.9	14426.4	5.35	409654.6	64.19
Cherkasy	43.3	16284.2	6.04	653847.9	83.22
Chernivtsi	56.9	4750.1	1.76	62532.8	31.25
Chernihiv Oblast	34.8	12138.1	4.51	431703.2	57.18
Kyiv	x	x	x	7552711.6	73.70
Sevastopol (City Council)	-	-	-	-	-

Source: Calculated and compiled by the authors according to the data of State Statistics Service of Ukraine (2020)

It should be noted that the registration of many agricultural enterprises and export companies in Kyiv gives the capital the leading positions in export activity, both in monetary and relative terms, but, in fact, production is concentrated in agricultural regions, outside the capital. Accordingly, tax resources are settled in Kyiv, not used to support or secure the leadership positions of the regions.

Odesa region has high rates both in monetary terms as well as relative (Table 3). But all these indicators do not correspond to the potential of labor resources in agricultural production, in the presence of favorable natural potential.

The commodity basis of Ukraine's agricultural exports is sunflower oil - USD 4.1 billion sales, corn - 3.5, wheat - 3.0, which provided 58.2% of cash receipts. However, the raw material orientation of exports, according to studies in other industries leads to volatility in regional economic growth and deindustrialization (Orihuela & Echenique, 2019) [19].

In addition to natural and climatic factors, an explanation of the leadership positions of the regions is provided by the analysis of organizational forms of farms, the scale of commodity production by particular types of products. In the leading regions, agro holdings that use intensive technologies for growing export-oriented, highly profitable crops have become widespread. In the regions of Western Ukraine of the third group of regions the major share of agricultural production falls on households (from 55.3% to 91.3%), and in animal husbandry it is even greater. Population households specialize in the labor-intensive production of livestock (milk - 72.6%, wool - 82.6%, honey - 98.8%) and plant growing (fruit and berry crops - 78.4%, vegetables - 85.6%, potatoes - 98.1%) and it is difficult for them to provide the market with quality, standard product in large commodity volumes.

Agroholdings concentrated in management of large land banks concentrate significant financial resources and invest them in production, development of storage and distribution infrastructure, access to export markets, opportunities to implement advanced technologies and machines and political influence at local and national levels. Large agricultural associations can form large batches of commodity products whose quality meets the requirements of the world market for contractual obligations.

The generalization of the results of the analysis of regional leadership of agrarian production of Ukraine determined the system of factors that influence it (Figure 2).

The determining factors are the natural resource (soil fertility, landscape) and weather and climate (average temperature of the growing season, rainfall), which are determined by the geological development of the territory and geographical location. On this basis, the organizational factor and development of large agrarian associations, which realize the best scientific, technical, financial-investment and infrastructural factors, come into effect. This conclusion is confirmed by the formation of the leading agricultural district and reserves of its expansion (areas on the border of the district).

At the same time, it should be noted that agroholdings providing leadership in agricultural production of the territories have also negative consequences. This is a monocultural specialization of crop production, reduction of animal husbandry, commodity orientation of export, concentration

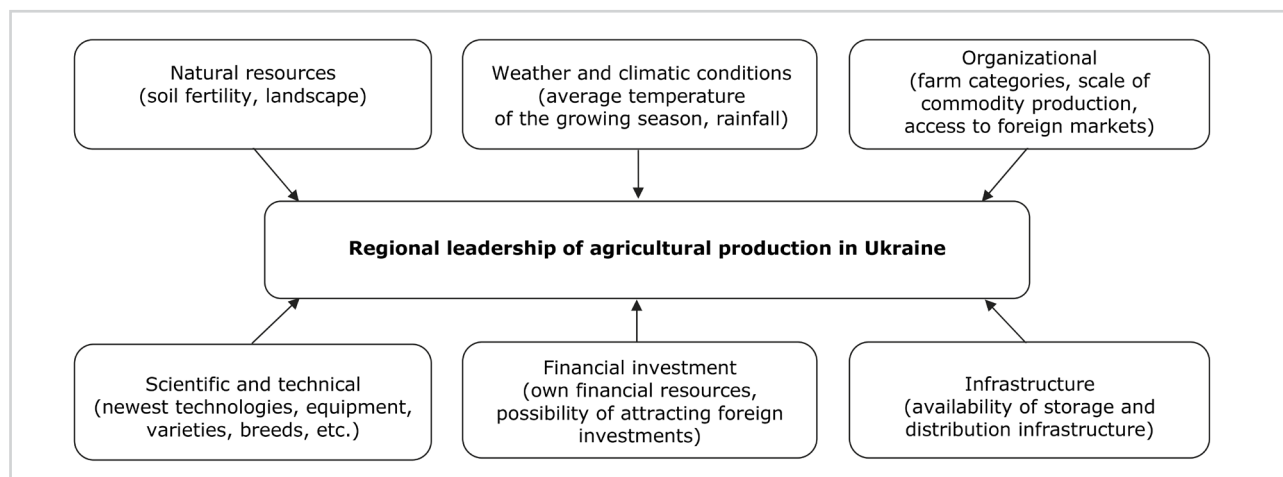


Figure 2:
Factors of influence on regional leadership of agrarian production of Ukraine

Source: Developed by the authors

of tax revenues in the centers of registration of large agricultural associations, which reduces the financial base of local budgets of territories.

Regional leadership of agricultural production is realized against the background of the general intensification of investment activity. Capital investment in agriculture, hunting and related services and their share in the total volume in Ukraine have grown significantly in recent years: UAH 18.4 billion (8.4%) - 2014; UAH 29.3 billion (10.7%) - 2015; UAH 49.7 billion (13.9%) - 2016; UAH 63.4 billion (14.1%) - 2017; UAH 65.1 billion (11.2%) - 2018; UAH 58.6 billion (9.4%) - in 2019, although from 2018 there is a decrease in their share, and in 2019 in absolute terms, which highlights the need to improve the investment climate in agriculture. The corresponding growth and recession of capital investments for this type of economic activity is also observed in the leading regions, with total investments in the leading agrarian area for 2019 amounting to 45.3 billion UAH or 77.3% of the total volume in Ukraine. It should be noted that the main source of capital investment in the economy of Ukraine is the own funds of enterprises and organizations 65.4% and only 0.7% are funds of foreign investors, 4.9% of the state budget. Separately, it should be noted decrease in direct investment (equity) in agriculture, forestry and fisheries by 27.8% from USD 776.9 million in 2014 to USD 560.9 million in 2018. Accordingly, the preconditions for further growth of domestic investment, especially state support (Bezpyata, 2015; Vakulenko, 2016) [4; 29] have been created in the leading agrarian region and there is a need to solve problems of attracting foreign investments. In particular, this is the incompleteness of land reform (moratorium on agricultural land sales), low efficient and environmentally dangerous use of land resource potential of agricultural production, poor storage and distribution infrastructure of crop production, non-compliance of agricultural production with European and world standards.

Investment in a leading agricultural area should be based on innovative development. Achievements of agricultural science solve the problems of limited resources, reducing the natural fertility of soils, increasing productivity. To make optimal decisions, both at the level of farms and large agricultural associations use complex system models (Jones et al., 2017) [11] which take into account the biophysical, socio-economic, environmental situations in all industries (in crop production individual crops and factors; in animal husbandry in the processes of fattening and animal productivity), in the economy, the region and the country as a whole. A study of the development of such models in historical retrospect (Jones et al., 2017) [10] showed a trend of globalization of agricultural problems (increasing demand for food due to population growth, ensuring sustainable development in environmental and economic terms) and, accordingly, the need to combine different models and databases to create a compatible set of models, data and platforms to deliver global public goods. Models for analyzing the introduction of new technologies and evaluating management decisions for farms (Capalbo et al., 2017) [7] require different types of data (publicly available biophysical, economic and confidential data of specific farms). These data and models must be integrated with modern information technology and should be easy to use, functionally compatible with various devices for use by farmers. Ukraine, as the world's leading agricultural country, should be more actively involved in the exchange of information on the creation of databases and the use of information technology.

Innovative technologies and equipment for agricultural production: precision farming, global navigation satellite systems, unmanned aerial vehicles, data generation and storage in cloud systems, digital communication of all types of objects and devices provide large amounts of data. Their analysts using information platforms and systems (Wolfert et al., 2017) [34] provide decision support for business process optimization in smart agriculture (Smart Farming). The introduction of innovations in the complex of smart farming will increase the efficiency and competitiveness of farms and large agricultural associations in all regions of Ukraine.

Modern innovations in agricultural production face complex problems that require a comprehensive analysis of components (biophysical, technological, socio-cultural, economic, institutional and political). As a diagnostic tool for problems, a rapid appraisal of agricultural innovation systems (Schut et al., 2015) has been proposed [22], which combines several methods of data collection, seminars, and interviews. The introduction of innovations faces institutional problems and the lack of effective tools to stimulate and support innovation, even in agriculturally developed countries (Turner et al., 2016) [28]. The experience of overcoming them is useful for the agricultural policy of Ukraine. Timely communication strategies are necessary for institutions that implement agricultural policy to avoid conflicts between the state and businesses (Alpmann & Bitsch, 2017) [2].

Thus, the state in the process of implementation of agrarian policy should create conditions for economic growth of the leading regions and the agrarian sector as a whole. The implementation of agricultural policy objectives requires a comprehensive and systematic approach in the priority areas:

1. The transition from commodity orientation of agricultural sector to production of products with high added value. This will reduce the dependence on fluctuations in demand and prices for commodities in foreign markets, lead to the development of processing enterprises, increase employment and income of the rural population, reduce migration processes. For this purpose it is necessary to improve the quality of foodstuffs, their compliance with the European and world standards.
2. Ensuring effective control of land use, aimed at preserving the natural fertility of soils. Optimization of structure, land areas and land use systems to prevent degradation of soil cover. Strengthening accountability for non-compliance with rational land use and soil protection measures.
3. Improvement of investment climate and investment attractiveness of agricultural production on the basis of clear and transparent regulatory principles of the regulatory framework adapted to the EU requirements in the field of phytosanitary control, certification, and conformity assessment.
4. Increasing and providing state aid to agricultural production targeted not only at large, but also small and medium-sized agricultural enterprises. Introduction of a mechanism of insurance of agricultural producers with the support of the state.
5. Development of infrastructure and logistics systems for agricultural production with the aim of reducing losses of agricultural products during transportation, storage and primary processing. Infrastructural and logistical capacities are concentrated mainly in agroholdings and their increase will facilitate access to them by small and medium-sized agribusinesses.
6. State support for agricultural exports in the form of information on the state of export markets, state programs and agencies for the development of agricultural exports, assistance in contracting directly to farmers.
7. Creating favorable conditions for investment in agriculture, especially for foreigners. Ensuring investment based on innovative development. To do this, implement in agricultural production systems for making optimal decisions based on modeling, innovative technologies and equipment (precision farming, global navigation satellite systems, unmanned aerial vehicles, generation and storage of data in cloud systems, digital communication of all types of objects and devices) in the complex of smart farming. Conducting periodic analysis of the effectiveness of innovation to eliminate problems and avoid conflicts.

6. Conclusions

The optimum development of agricultural production is possible only if the combination of stimulating the economic growth of the leading regions and solving the problems of the regions lagging behind the average level of development of the agrarian industry in Ukraine. This process is ensured by market mechanism and state regulation at national and regional levels. In the first place it attracts investment and innovation. Therefore, the conducted research represents information support for potential investors of agrarian production of Ukraine, including foreign ones.

Regions of Central, North-Eastern and Southern Ukraine have for a long period formed a leading agrarian district of 15 regions that have GAO per one person of the rural population 100% and above the average value in Ukraine (Vinnytsia, Dnipropetrovsk, Donetsk, Zhytomyr, Zaporizhzhia, Kyiv, Kirovohrad, Mykolaiv, Poltava, Sumy, Kharkiv, Kherson, Khmelnytskyi, Cherkasy, Chernivtsi regions). They are the most attractive objects for attracting investments, introduction of innovative technologies. The reserve group of leaders is the two regions (Luhansk and Ternopil), which are located in the metropolitan area, which have a significant lag behind the average value in Ukraine and the resource potential of joining the group of leaders.

The analysis of the leading agricultural area characteristics revealed the advantages and problems of agricultural production. The area of agricultural land owned and used by agricultural enterprises and households in the area is less than the area of agricultural land of only European Union countries such as France and Spain and more than all others. A considerable part of these lands is arable land of unique black earth, which provides high natural-land potential. The labor potential of the district tends to decrease as a result of the decline in rural

population, even at a higher rate than the decrease in the population of Ukraine as a whole. Against the background of basic types of agricultural machinery concentration in the agricultural leadership area of (more than 77%), its overall decrease compared to 1990 (more than 3.5 times) occurred, which further actualizes the need for investment. The agrarian production of the district, both in plant and animal production, focuses on the most profitable and export oriented products (cereals and legumes, sugar beet, sunflower, meat, eggs, milk). Structural changes in agrarian production in recent decades, in the direction of increasing the share of crop production and the decrease in animal husbandry, have aggravated problems in land use. In particular, it is a high degree of plowing of agricultural land. It is the largest in the five southern and central regions of the district, the steppe and forest-steppe zones (Dnipropetrovsk, Zaporizhzhia, Kirovohrad, Mykolaiv and Kherson regions) more than 80%. The high degree of plowing of the lands combined with the violation of the system of scientifically grounded crop rotations led to an increase in the processes of soil degradation (water and wind erosion, a negative balance of humus and nutrients, etc.) and as a consequence of intensification of loss of natural resources. For example, the average annual decrease of the average weighted humus content in soils of the Mykolaiv region in recent years has reached 0.016% per year. The incompleteness of land reform in terms of creating a free market for agricultural land impedes investment in the agricultural sector of both the leading agricultural district and Ukraine as a whole.

In the export of agricultural and food products, the group of leaders is not homogeneous. The most export oriented ones are Vinnytsia, Kyiv, Kirovohrad, Mykolaiv, Kherson, Khmelnytskyi and Cherkasy regions. Zhytomyr, Kirovohrad, Kharkiv, Kherson and Khmelnytskyi regions have a significant share in agricultural production in Ukraine, but the volume of export in monetary terms indicates that the export potential is not fully utilized. The main organizational form of farms that provides leadership positions are large agricultural associations (agro holdings) that effectively realize the scientific, technical, financial and investment and infrastructure levers of economic growth. Factors affecting regional leadership: natural resources, weather, climate, organizational, scientific, technical, financial and investment, infrastructure. Among them are crucial natural-resource and weather-climatic conditions, on the basis of which large agrarian associations develop, realizing in the best way scientific, technical, financial-investment and infrastructure factors. Against the background of the general growth of investments in agriculture of Ukraine, 77.3% of their total volume by industry is invested in the leading agricultural region. In order to ensure the economic growth of the leading regions and the agrarian sector as a whole, it is necessary to direct the measures of the state agrarian policy in the part of transition to production of high value-added products, optimization of the land use system, improvement of the investment climate, provision of state aid to agrarian producers, infrastructure development and logistics systems, information and legal support of agricultural exports, introduction of innovations. Innovative data processing technologies for making optimal decisions, smart farming complex will increase the competitiveness of agricultural production. Implementation of the measures presented and, first and foremost, attracting investments in the agricultural sector, according to expert estimates, can provide wheat and fodder grain production up to 130-150 million tons per year, and grain exports up to 110-120 million tons (Halushchak, 2018) [9]. And that ensures the stability of the national currency, the creation of new jobs, the introduction of innovative technologies. Further research will focus on identifying the prerequisites and developing practical recommendations for increasing foreign investment in agriculture, justifying sources for increasing investment in the agricultural sector of Ukraine from the state budget with a focus on small and medium-sized businesses, development of innovation development strategy.

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