

**The CAP and national priorities  
within the EU budget  
after 2020**





INSTITUTE OF AGRICULTURAL  
AND FOOD ECONOMICS  
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# The CAP and national priorities within the EU budget after 2020

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CHALLENGES, CHANCES, THREATS, PROPOSALS

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# Contents

The CAP and national priorities within the EU budget after 2020 .....	11
<i>Dr Marek Wigier</i>	
1. CAP between 2020 and 2027 – legislative proposals of the European Commission.....	19
<i>Prof. dr hab. Andrzej Kowalski</i>	
1.1. CAP financing .....	19
1.2. Market regulations .....	21
1.3. Direct payments .....	23
1.4. Rural monitoring.....	26
References: .....	26
2. Holistic risk management as a response to budgetary constraints .....	27
<i>Prof. dr hab. Jacek Kulawik, mgr Grzegorz Konat, dr Michał Soliwoda, dr Joanna Pawłowska-Tyszko</i>	
2.1. Introduction .....	27
2.2. The holistic risk management concept.....	28
2.3. Holistic risk management in agriculture – key issues of concern .....	31
2.4. Holistic risk management in agriculture on the example of the United States of America .....	35
2.5. Summary and conclusions .....	38
References.....	38
3. Economic and social features of contemporary development of the Czech agriculture and rural areas .....	40
<i>Prof. Věra Majerová, Ing. Jiří Sálus, Ing. Tereza Směkalová</i>	
3.1. Introduction .....	40
3.2. Globalisation and its effects (consequences) .....	41
3.3. Characteristic features of contemporary development .....	42
3.4. Change of food autarchy concept .....	43
3.5. Consumer behaviour of households .....	44
3.6. Dual quality of food.....	45
3.7. Social farming .....	46
3.8. Summary and conclusions .....	47
References.....	48
4. To whom belongs the future of rural prosperity 2020+? .....	50
<i>PhD Rita Vilké, PhD Živilě Gedminaitė-Raudonė</i>	
4.1. Introduction .....	50
4.2. Theoretical assumptions for rural prosperity .....	51

4.3.	Methodology .....	54
4.4.	Results and discussion.....	56
4.5.	Summary and conclusions .....	60
	References.....	60
5.	The specificity of economic integration processes in agriculture .....	63
	<i>Prof. Julian Krzyżanowski</i>	
5.1.	Introduction .....	63
5.2.	Objectives and methods .....	65
5.3.	Research results and discussion .....	65
5.4.	Summary and conclusions .....	69
	References.....	70
6.	The Common Agricultural Policy of the European Union – main challenges for a new budget .....	72
	<i>PhD Justyna Góral, Prof. Anatolii Pilyavskyy</i>	
6.1.	Introduction .....	72
6.2.	Agricultural policy post-2020 .....	76
6.3.	Summary and conclusions .....	81
	References.....	82
7.	Problems and risks linked with investment supports in agrarian sector – the Czech experience .....	85
	<i>PhD Marie Šimpachová Pechrová, Prof. Tomáš Doucha, MSc Ondřej Chaloupka</i>	
7.1.	Introduction .....	85
7.2.	Material and methods .....	87
7.3.	The assessment model for application of farms for investment supports .....	89
7.4.	Summary and conclusions .....	91
	References.....	91
8.	The adoption of agricultural insurance to manage farm risk: preliminary evidences from a field survey among Italian and Polish farmers.....	93
	<i>Prof. Samuele Trestini, PhD Elisa Giampietri, PhD Magdalena Śmiglak-Krajewska</i>	
8.1.	Introduction .....	94
8.2.	Data and methodology .....	95
8.3.	Results .....	97
8.4.	Summary and conclusions .....	99
	References.....	100
9.	The Common Agricultural Policy and the farm households’ off-farm labour supply .....	102
	<i>PhD Jason Loughrey, Prof. Thia Hennessy</i>	
9.1.	Introduction .....	103

9.2.	Theoretical framework.....	103
9.3.	Methodology .....	105
9.4.	Data.....	108
9.5.	Results – farm operator.....	110
9.6.	Results – farm operator and spouse.....	114
9.7.	Summary and conclusions .....	115
	References.....	116
10.	Comparison of potential effects on the profitability of the US MPP application on dairy farms in Veneto (Italy) and Wielkopolska (Poland) .....	117
	<i>MSc Federico Vaona, PhD Cristian Bolzonella, Prof. Martino Cassandro, Prof. Tomasz Szwaczkowski</i>	
10.1.	Introduction .....	118
10.2.	Materials and methods .....	119
10.3.	The situation in Veneto.....	120
10.4.	The situation in Wielkopolska .....	121
10.5.	Summary and conclusions .....	123
	References.....	124
11.	The risk management and the insurance of agricultural production .....	125
	<i>Prof. Drago Cvijanović, PhD Željko Vojinović, Prof. Otilija Sedlak, PhD Dejan Sekulić</i>	
11.1.	Introduction .....	125
11.2.	Theoretical basis .....	126
11.3.	Characteristics of the plant production insurance in Serbia.....	128
11.4.	The position of farmers in the system.....	132
11.5.	Research results.....	133
11.6.	Summary and conclusions .....	138
	References.....	142
12.	Distribution of interventions of the Rural Development Programme and Regional Operational Programmes in 2007-2013 in the context of territorial development .....	144
	<i>Dr Paweł Chmieliński, Dr hab. Marcin Gospodarowicz, prof. IERiGŻ-PIB</i>	
12.1.	Introduction .....	144
12.2.	Types of intervention of the RDP and 16 ROPs.....	145
12.3.	Support for local development in the rural and regional policy between 2007 and 2013 .....	151
12.4.	Discussion and summary .....	155
	References.....	156

13. The role of organic farming in the CAP, the rural development programme, with particular regard to subsidies.....	158
---	-----

*PhD Gábor Gyarmati*

13.1. Introduction .....	158
13.2. Organic farming's characteristics.....	159
References.....	171

14. Agricultural policy in the servitized economy .....	173
---	-----

*PhD Dalia Vidickiene, PhD Zivile Gedminaitė-Raudonė*

14.1. Introduction .....	173
14.2. Reasons to use servitized business model in agriculture .....	174
14.3. Summary and conclusions .....	178
References.....	179

### 15. The Model of Innovative Rural Entrepreneurship Development

Designing.....	181
----------------	-----

*Prof. Lesia Zaburanna, PhD, Associate Professor Tetiana Lutska*

15.1. Introduction .....	181
15.2. The aim and methodology of the research .....	184
15.3. The research results .....	186
15.4. Summary and conclusions .....	200
References.....	200

16. Smart Manufacturing – potential of new digital technologies and big data in the food industry .....	202
---	-----

*PhD Katarzyna Kosior*

16.1. Introduction .....	202
16.2. Smart manufacturing .....	203
16.3. Big data analyses – basis for the development of smart enterprises .....	204
16.4. Digital twin paradigm.....	206
16.5. Smart manufacturing in the food industry in Poland .....	207
16.6. Summary and conclusions .....	211
References.....	211

17. A paradigmatic view on the possibility of applying the provisions of the Common Agricultural and Fisheries Policy of the EU in the agrarian sector of the economy in Ukraine.....	214
---	-----

*DSc (Econ) Vasyl D. Zalizk, Prof. DSc (Econ) Nataliia M. Vdovenko, Sergiy S. Shepeliev*

17.1. Introduction .....	214
17.2. The development of the EU Common Agricultural Policy and Common Fisheries Policy and its impact on the competitiveness of the fisheries sector .....	215



17.3.	Components of the Common Fisheries Policy of the EU in the context of the conservation system and sustainable usage of fisheries resources.....	218
17.4.	Fundamental principles of CFP reforms.....	219
17.5.	Results of aquaculture producers activities on the possibilities of provisions' implementation of the Common Agricultural and Fisheries Policy of the EU in fisheries during AGRO-2018.....	223
17.6.	Summary and conclusions .....	229
	References.....	229
18.	Direct producer support measures and level of harmonization with Common Agricultural Policy in Bosnia and Herzegovina .....	232
	<i>MSc Alen Mujčinović, Merima Makaš, Prof. dr Sabahudin Bajramović</i>	
18.1.	Introduction .....	232
18.2.	Materials and methods .....	234
18.3.	Economic and agricultural development of the country.....	235
18.4.	Budgetary support to the agricultural sector .....	236
18.5.	Direct producer support measures .....	239
18.6.	Direct payments .....	241
18.7.	Summary and conclusions .....	242
	References.....	243
19.	The Hungarian and Polish agricultural trade in the light of CAP budgetary restrictions .....	245
	<i>PhD Tamás Mizik</i>	
19.1.	Introduction .....	245
19.2.	Methodology and data sources.....	247
19.3.	Importance of the agriculture .....	247
19.4.	Trade characteristics of the Hungarian agriculture .....	250
19.5.	Trade characteristics of the Polish agriculture.....	253
19.6.	Comparison of the Hungarian-Polish agricultural trade.....	255
19.7.	The future of the Hungarian-Polish agricultural trade in the light of the possible budgetary changes .....	256
19.8.	Summary and conclusions .....	258
	References.....	259
20.	Implementation of innovation projects in the context of agribusiness 4.0 in Ukraine .....	262
	<i>Prof. Lesia Kucher</i>	
20.1.	Introduction .....	262
20.2.	Methodology .....	264
20.3.	Implementation of the most important innovation projects in agribusiness in Ukrainian regions: current state and problems of their financing sources .....	265

20.4.	Cluster analysis of the implementation of investment and innovative projects in agribusiness in Ukrainian regions .....	269
20.5.	Summary and conclusions .....	275
	References.....	276
21.	The impact of globalization on farmers income. Evidence from Poland and Romanian agriculture .....	279
	<i>MSc Călin Henriette Cristiana, MSc Izvoranu Anca Marina, MSc Todirica Ioana Claudia</i>	
21.1.	Introduction .....	279
21.2.	Literature review .....	280
21.3.	Globalization impact on rural areas.....	282
21.4.	Globalization impact on small farmers – foreign investment in Romania and Poland.....	288
21.5.	Summary and conclusions .....	290
	References.....	291
22.	Land concentration and competitiveness of agricultural enterprises in Ukraine .....	292
	<i>PhD Anatolii Kucher</i>	
22.1.	Introduction .....	292
22.2.	Methodology .....	294
22.3.	Status and trends of land concentration in agricultural enterprises of Ukraine .....	294
22.4.	The level of concentration and the intensity of competition in the land rental market: the case of Ukrainian agroholdings .....	300
22.5.	Impact of the level of land concentration on the competitiveness of agricultural enterprises.....	303
22.6.	Summary and conclusions .....	309
	References.....	310
	Instead of a summary .....	312
	Annex I .....	314

## 20. Implementation of innovation projects in the context of agribusiness 4.0 in Ukraine

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### **Abstract**

In the European Union works have been launched about perspective directions of the Common Agricultural Policy (CAP) and national priorities within the EU budget after 2020. One of the expected problems is the reduction in the amount of funding, particularly in the form of subsidies. For Ukraine this issue has been relevant before. At the same time, the level of implementation of innovations in the agricultural sector remains low. The paper examines the current state of implementation of the most important innovation projects in agribusiness in Ukraine and their financing sources. Results of cluster analysis of the implementation of investment and innovative projects in Ukrainian regions allowed to identify four clusters, each of which is represented by relatively homogeneous parameters of the potential of innovative development of agribusiness 4.0. Given the fact that contemporary agribusiness both in Ukraine and in Europe remains weakly digitized, we propose one of the strategic priorities of agrarian policy to recognize the promotion of the implementation of digital agricultural projects (projects connected with agribusiness 4.0). The investments in digital agricultural projects are an important tool for improving competitiveness and economic efficiency of Ukrainian enterprises and development of agriculture 4.0 in Europe.

**Keywords:** innovation projects, implementation, agribusiness 4.0, agricultural enterprises, digital agriculture

**JEL codes:** Q12, Q13, Q14, Q18

### **20.1. Introduction**

In the modern world literature the problem of development of agriculture 4.0 and implementation of digital technologies in agribusiness is among the most topical academic and practical issues [Cofre-Bravo et al., 2018; De Clercq et al., 2018; Deichmann et al., 2016a, 2016b; Fatusin and Oladehinde, 2018; Gwaka, 2017; Krzyżanowska and Sikorska, 2016; Ozdogan et al., 2017; Wolfert

et al., 2017; Zhudro, 2017a, 2017b; and many others]. However, there are some problems with the implementation of these innovations in developing countries.

Digital technologies have significantly affected practically all sectors of the economy and agriculture is no exception [Deichmann et al., 2016a]. The new information and communication technologies promote the rise in efficiency by complementing other production factors, and innovation by reducing transaction costs. Digital technologies overcome information problems that hinder market access for many small-scale farmers, and they provide novel ways for improving agricultural supply chain management [Deichmann et al., 2016b].

The implementation of digital technologies in some European countries is at different stages. For example, in Turkey digital agriculture applications are in the early development stage [Ozdogan et al., 2017].

The paper by Wolfert et al. [2017] focuses on the Smart Farming is a development that emphasizes the use of information and communication technology in the cyber-physical farm management cycle. New technologies are expected to leverage this development and introduce more robots and artificial intelligence in farming. This is encompassed by the phenomenon of Big Data, massive volumes of data with a wide variety that can be captured, analysed and used for decision-making [Wolfert et al., 2017].

The study by Fatusin and Oladehinde [2018] established that enterprises that made use of smart technologies tend to be more efficient in terms of production and marketing especially in identification of new markets.

The literature identifies multiple factors that can affect the adoption of innovation in agriculture, such as farmers' socio-economic characteristics and the characteristics of the promoted innovation, among others. One of the relevant components of innovative behaviour is farmers' ability to generate and implement new ideas, to extend their networks and to involve the workforce in the adoption process [Cofre-Bravo et al., 2018].

The paper by Zhudro [2017b] investigates the new methodological research platform worker-ness agribusiness organizations in an economy 4.0, which is based on the dominance of hybridization "live" and "smart" management and generates the possibility of permanent and total system-situational managers correction specialists AIC organizations management. Another article by Zhudro [2017a] examines the practice of agrarian smart business, which involves the domination of "smart" agrotechnologies and creates the need for a permanent system-situational correction of managerial decisions carried out by managers and specialists of the agroindustrial complexes. The author describes the methodology and tools of "smart" and traditional management in the modern agrarian economy 4.0 [Zhudro, 2017a].

The problem of implementation of innovative projects and project management in agricultural enterprises is considered in publications of the following scientists: Babenko [2017]; Butenko [2017]; Chemerys et al. [2017]; Ilchuk and Shpomer [2017]; Lytvynchuk [2017]; Prysiazhniuk and Plotnikova [2017]; Roucan-Kane et al. [2013]; Turnera et al. [2017]; Volodin [2017].

Innovation projects are an important factor for the economic development. Ukraine has a strong position in the development of human capital (education, availability of skilled personnel, the labour market, patent activity of the population, educational and scientific infrastructure). But the organizational, institutional components and market and business environment hamper the development of innovation, the formation of economic growth [Butenko, 2017].

Implementation of innovative projects increases interest in the issue of the transfer of intellectual property rights. According to Lytvynchuk [2017] there are two opposite groups of IP assignment legal models in the agriculture being taking into account – classical models based on obtaining exclusive rights of ownership and alternative models within the framework of fair use, generis sui and public domain doctrines. Further progress of the intellectual property institutionalization processes requires flexible mechanisms of public management based on the economic efficiency of assignment legal models but without losing connection with the humanistic context [Lytvynchuk, 2017].

The paper by Volodin [2017] presents methodical approaches and organizational tools for the preparation of commercial proposals by scientific institutions, on the basis of which the fast plant-technology is created and projects of their use in the science-intensive niche business.

In the European Union works have been launched about perspective directions of the Common Agricultural Policy (CAP) and national priorities within the EU budget after 2020. One of the expected problems is the reduction in the amount of funding, particularly in the form of subsidies. For Ukraine this issue has been relevant before. At the same time, the level of implementation of innovations in the agricultural sector remains low. However, there are practically no studies on implementation of innovative projects in the context of development agribusiness 4.0 in Ukraine.

## **20.2. Methodology**

The purpose of the paper is to present results of one of the first studies of the current state of implementation of the most important innovation projects in the context of agribusiness 4.0 in Ukraine and their financing sources.

The methodological basis of the research is the fundamental postulates of economic science and system approach to studying the economic phenomena and processes. This study used the following methods: abstract-logical (definition of essence of the category „agribusiness 4.0”, theoretical generalization and formulation of conclusions); analysis and synthesis (assessment and analysis of the state of implementation of innovation projects); monographic (depth analysis of the issue under study and specific innovative enterprises); graphic and cartographic (visual representation of the results and the construction of cartograms); cluster analysis by the Ward’s method (Euclidean distances) and the k-means method (determination of the main clusters of innovative development of agribusiness).

To achieve the goal we utilize datasets at regions or at national levels collected from Ministry of Agrarian Policy and Food of Ukraine, data of the Association „Ukrainian Agribusiness Club” (UCAB) and the data of some innovative public enterprises.

### **20.3. Implementation of the most important innovation projects in agribusiness in Ukrainian regions: current state and problems of their financing sources**

Summarizing the results of theoretical analysis and synthesis of literature, it can be concluded that agribusiness 4.0 – provides for the massive implementation of cyberphysical systems in agriculture (industry 4.0) for its automation, computerization and robotization. The main directions of agribusiness 4.0: digitalization, big data, blockchain, vertical farms, unmanned technology, automation of production, smart machines, precision farming, etc.

According to the Ministry of Agrarian Policy and Food of Ukraine, as of January 1, 2018 in the agricultural sector of the economy of Ukraine enterprises generally implemented 474 investment projects, which is by 94 projects (24.7%) more than the corresponding date of 2017 (Table 1).

Among the regions, the largest numbers of investment projects are implemented in: Poltava – 69 units (+ 29 units or by 72.5% more compared with 2017); Lviv – 64 units (+ 16 units or 33.3% more); Vinnitsa – 48 units (+ 3 units or 6.7%); Chernivtsi – 43 units (+ 20 units or 2.2 times more); Cherkassy – 41 units (- 2 units or 4.7% less); and Kherson – 38 units (- 1 unit or 2.7% less) regions. The expected social effect from the implementation of these projects is the creation of more than 16 thousand jobs [Analytical note, 2018].

The total amount of the estimated cost of investment projects was almost 41.3 billion UAH, of which the main source of financing were own funds – 30.7 billion UAH (74.3%). The cost of investment projects realizing in the regions ranges from 0.1 million UAH to 9.6 billion UAH. Compared to the data as

of 01.01.2017, the total sum of the estimated cost of investment projects increased by 13.4 billion UAH, including own and raised funds increased by 11.5 billion UAH and 1.9 billion UAH, respectively.

Table 1. The state of preparation and implementation of the most important investment and innovative projects in Ukraine as of 01.01.2018\*

Names of regions	The total number of projects	Cost of projects, bln UAH	Completed projects	The amount of investments, bln UAH
Vinnitsya	48	19.9	16	0.4
Volyn	8	0.2	4	0.1
Dnipropetrovsk	10	0.4	1	0.001
Donetsk	0	0	0	0
Zhytomyr	16	1.1	5	0.7
Zakarpattya	5	0.02	0	0
Zaporizhya	6	0.2	3	0.2
Ivano-Frankivsk	6	0.1	2	0.01
Kyiv	23	3.3	3	0.5
Kirovohrad	25	1.0	9	0.03
Luhansk	4	0.03	0	0
Lviv	64	1.1	23	0.5
Mykolayiv	27	2.0	1	0.004
Odesa	8	2.8	0	0
Poltava	69	1.0	44	0.3
Rivne	9	0.3	2	0.009
Sumy	4	2.3	0	0
Ternopil	8	0.7	0	0
Kharkiv	4	0.2	0	0
Kherson	38	1.5	9	0.6
Khmelnyskiy	3	0.1	1	0
Cherkasy	41	2.1	11	0.03
Chernivtsi	43	0.4	25	0.2
Chernihiv	5	0.5	2	0.3
Total	474	41.3	161	3.8

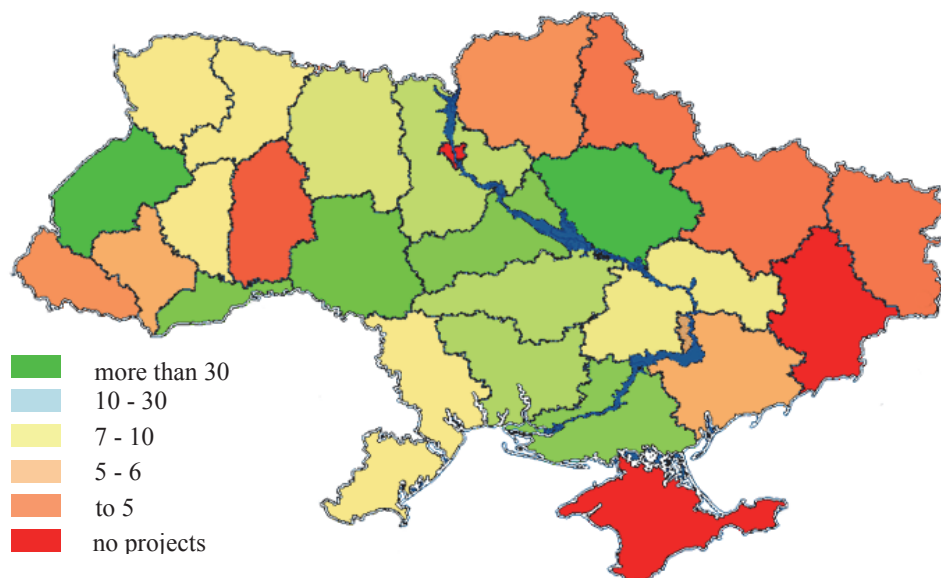
Notes. \* Here and below – excluding the temporarily occupied territories of the Autonomous Republic of Crimea, also excluding the part of the anti-terrorist operation zone.

Source: author's calculations and presentation based on the data of Ministry of Agrarian Policy and Food of Ukraine [Analytical note, 2018].

Figure 1 shows of the implementation of investment and innovative projects in agribusiness in the regions of Ukraine. Regarding the regional distribution of the number of investment and innovative projects in agribusiness in the regions of Ukraine, it should be noted that their high concentration is in the central and western regions, the lowest concentration – in the north-eastern regions.

The most common directions for the implementation of investment agricultural projects in Ukraine as of 01.01.2018 were the following (construction or reconstruction): development of cattle breeding (23.6%); development of pig farming (12.4%); development of poultry production (5.7%); perennial plantations (4.2%); processing, storage of cereals and technical crops (18.6%); vegetable and fruit storage (12.2%); irrigation (3.0%) (Table 2).

Figure 1. Cartogram of the implementation of investment and innovative projects in agribusiness in the regions of Ukraine, 2018



Source: author's presentation based on the data of Ministry of Agrarian Policy and Food of Ukraine [Analytical note, 2018].

Table 2. Directions of the implementation of the investment and innovative projects (construction, reconstruction), units

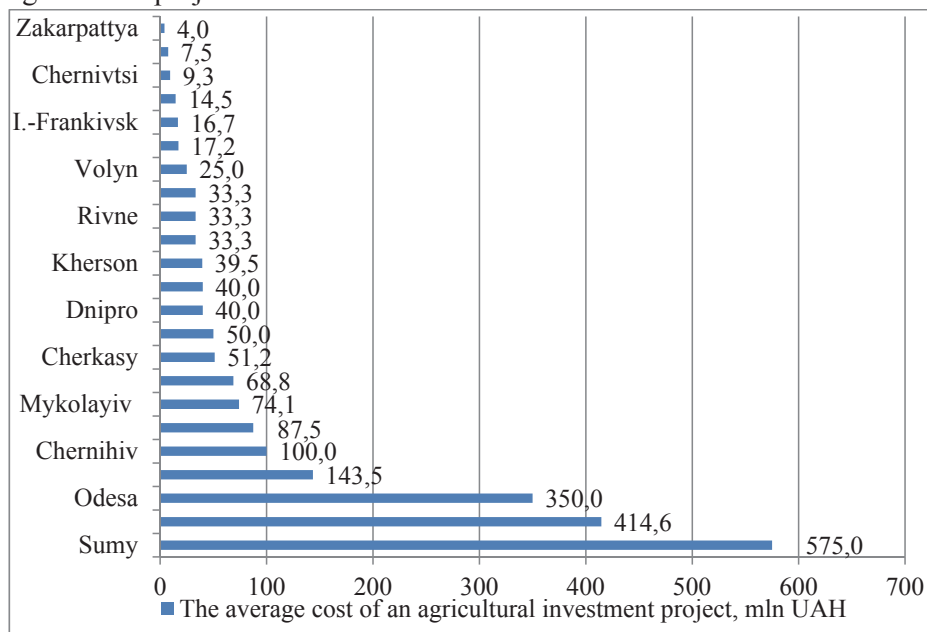
Directions of implementation of projects	01.01.2017		01.01.2018	
	units	%	units	%
Development of cattle breeding	89	23.4	112	23.6
Development of pig farming	62	16.3	59	12.4
Development of poultry production	23	6.1	27	5.7
Perennial plantations	13	3.4	20	4.2
Processing, storage of cereals and technical crops	73	19.2	88	18.6
Vegetable and fruit storage	35	9.2	58	12.2
Irrigation	13	3.4	14	3.0

Source: author's calculations and presentation based on the data of Ministry of Agrarian Policy and Food of Ukraine [Analytical note, 2018].



The average estimated cost of the investment agricultural project, realized as of 01.01.2018, in terms of the regions, ranged from 4.0 million UAH in the Zakarpattya region to 575.0 million UAH in the Sumy region, with an average value of this indicator in Ukraine at 87.1 million UAH (Figure 2).

Figure 2. Rating of regions of Ukraine by the average cost of an investment agricultural project as of 01.01.2018



Source: author's calculations and presentation based on the data of Ministry of Agrarian Policy and Food of Ukraine [Analytical note, 2018]

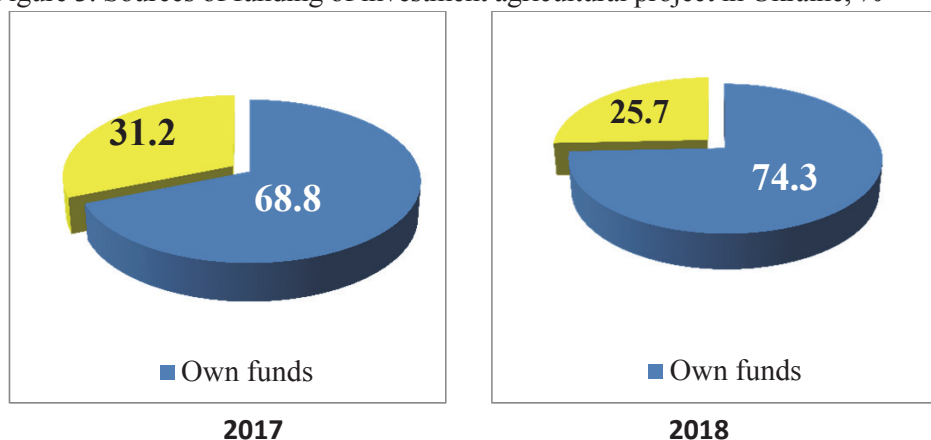
Considering at the regions level data, we can state a significant differentiation of the cost of projects. For example, the largest investment agricultural project can be found in the Sumy region, their average cost was 575.0 million UAH in 2018. The Sumy region is followed by the Vinnytsya region (414.6 million UAH) and Odesa region (350.0 million UAH). On the other side, in Zakarpattya, Lviv and Chernivtsi regions realize the lowest by average cost of investment projects; their average cost is 4.0, 7.5 and 9.3 million UAH, respectively.

In the Ukrainian agro-industrial complex, according to the regions, mainly investment projects were implemented, the estimated cost of which was up to 10.0 million UAH – 277 units (or 58.4% of the total), from 10.0 million UAH to 50.0 million UAH – 112 units (23.6%), the total value of almost 780 million UAH and more than 2.6 billion UAH, respectively. The number of projects costing from 50.0 million UAH to 100.0 million UAH is 32 units (6.8%) with a total

value of almost 2.2 billion UAH; from 100.0 million UAH to 500.0 million UAH – 28 units (5.9%) with a total value of more than 5.9 billion UAH; from 500.0 million UAH to 1.0 billion UAH – 1 unit (0.2%) worth more than 0.5 billion UAH; more than 1 billion UAH – 7 units (1.5%) with a total value of more than 27.3 billion UAH.

Characterizing the structure of sources of financing for investment agricultural projects (Figure 3), it should be noted that the majority of own sources – 74.3%.

Figure 3. Sources of funding of investment agricultural project in Ukraine, %



Source: author's calculations and presentation based on the data of Ministry of Agrarian Policy and Food of Ukraine.

The largest intensity of investment activity in 2017 was observed in the Vinnytsya region – the volume of capital investments was 6.3 billion UAH (or 31.7% of the total value of projects implemented in the region); in the Kyiv region – 1.1 billion UAH (or 32.8% of the total value of projects implemented in the region); in the Poltava region – 614.7 million UAH (or 63.0% of the total value of projects implemented in the region); in Cherkassy region – 444.6 million UAH (or 20.8% of the total value of projects implemented in the region); in the Sumy region – 431.0 million UAH (or 18.7% of the total value of projects implemented in the region).

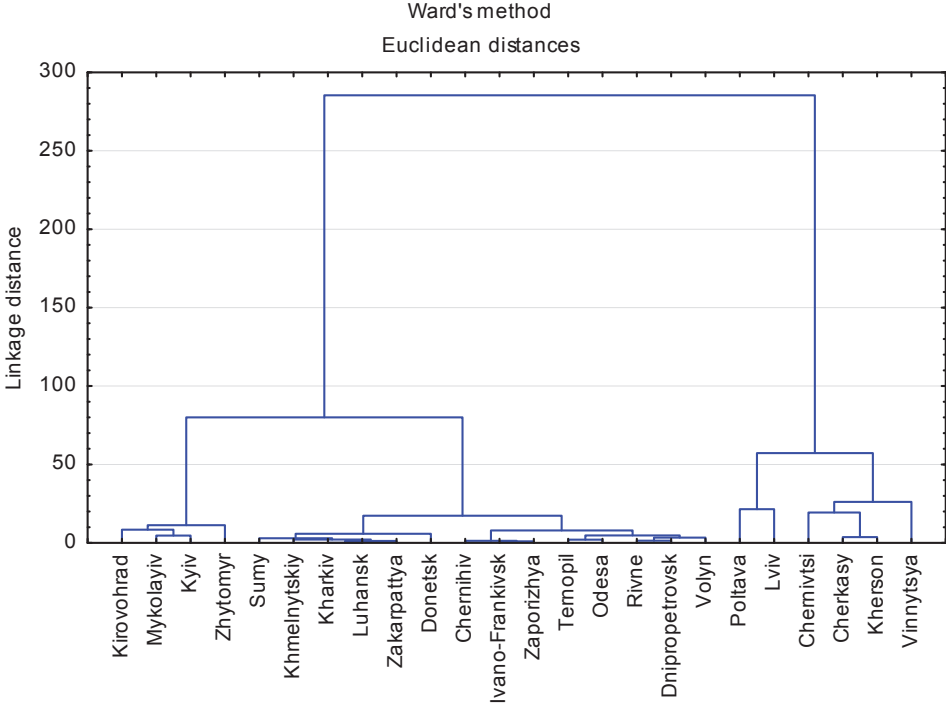
#### 20.4. Cluster analysis of the implementation of investment and innovative projects in agribusiness in Ukrainian regions

Creation and support of the functioning the clusters give possibility for the revival of various sectors of domestic production and for providing innovative, competitive regional and national development [Stoianets, 2017; Chemerys

et al., 2017]. Thus, the cluster structure in the relevant territory can contribute to its innovative development based on the initiation and implementation of innovative projects in the context of agribusiness 4.0.

The results of cluster analysis by the Ward’s method (Euclidean distances) made it possible for us to form four clusters (Figure 4).

Figure 4. Vertical dendrogram of cluster analysis results for implementation of investment and innovative projects in agribusiness in the regions of Ukraine, 2018



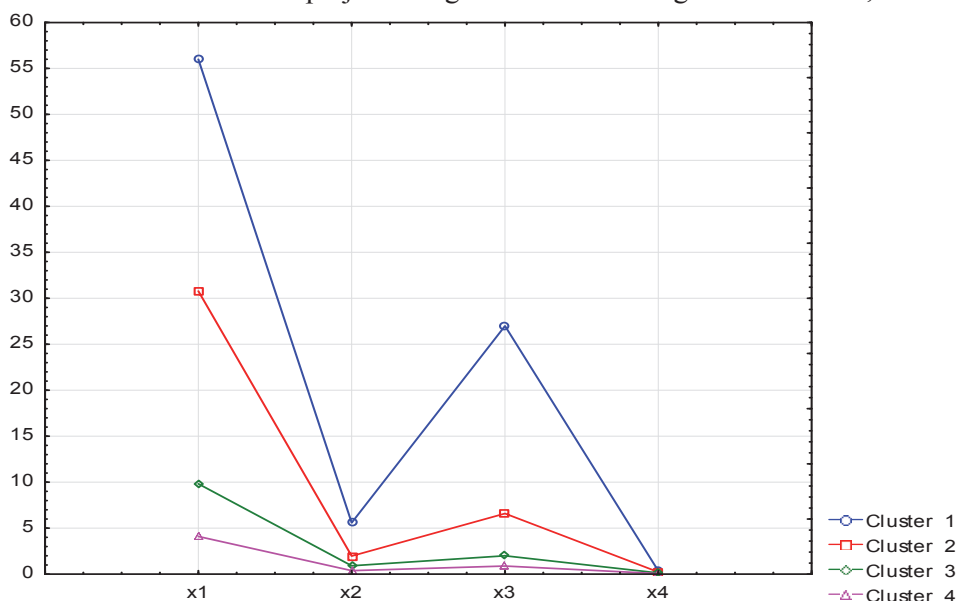
Source: author’s calculations and presentation based on the data of Ministry of Agrarian Policy and Food of Ukraine [Analytical note, 2018].

At the second stage, we performed a cluster analysis by the k-means method (Figure 5). Its results were very close to the previous ones. According to group-based clustering, Ukrainian regions can be divided into four clusters, each of which is represented by relatively homogeneous parameters of the potential of innovative development of agribusiness 4.0.

Cluster 1 – “Leading regions with high potential for innovation development”. The first cluster includes Vinnytsya, Lviv, Poltava and Chernivtsi regions. The regions participating in this cluster (16.7% of the total number of regions) are characterized by the greatest innovative activity: (i) the average total

number of projects per region is 56 units; (ii) the average cost of projects per region is 5.600 bln UAH; (iii) the average completed projects per region is 27 units; (iv) the average amount of investments per region is 0.350 bln UAH.

Figure 5. The results of cluster analysis (by k-means method) of implementation of investment and innovative projects in agribusiness in the regions of Ukraine, 2018



Note. x1 – the total number of projects; x2 – cost of projects, bln UAH; x3 – completed projects; x4 – the amount of investments, bln UAH.

Source: author's calculations and presentation based on the data of Ministry of Agrarian Policy and Food of Ukraine [Analytical note, 2018].

Cluster 2 – „Regions are followers of leaders with an average potential of innovation development”. The second cluster includes Kyiv, Kirovohrad, Mykolaiv, Kherson and Cherkasy regions. The regions participating in this cluster (20.8% of the total number of regions) are characterized by the average (middle) level of innovative activity: (i) the average total number of projects per region is 30.8 units; (ii) the average cost of projects per region is 1.980 bln UAH; (iii) the average completed projects per region is 6.6 units; (iv) the average amount of investments per region is 0.232 bln UAH.

Cluster 3 – „Medium-sized regions with low potential for innovation development”. The third cluster includes the following regions: Volyn, Dnipropetrovsk, Zhytomyr, Odesa, Rivne and Ternopil. The regions participating in this cluster (25.0% of the total number of regions) are characterized by the low level of innovative activity: (i) the average total number of projects per region is

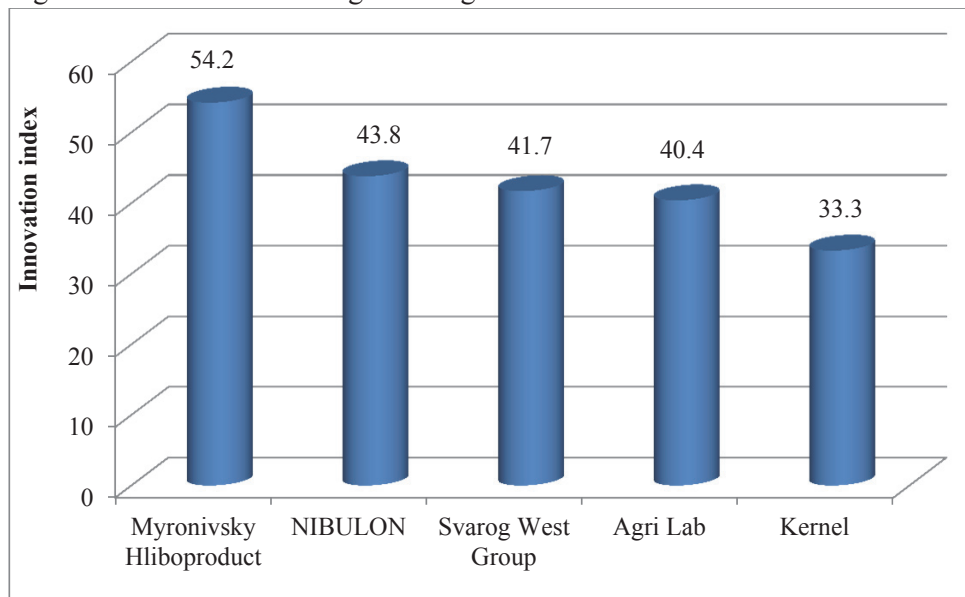
9.8 units; (ii) the average cost of projects per region is 0.917 bln UAH; (iii) the average completed projects per region is 2.0 units; (iv) the average amount of investments per region is 0.135 bln UAH.

Cluster 4 – „Regions-outsiders with very low potential for innovation development”. The fourth cluster includes the following regions: Donetsk, Zakarpattia, Zaporizhyya, Ivano-Frankivsk, Luhansk, Sumy, Kharkiv, Khmelnytskyi and Chernihiv. The regions participating in this cluster (37.5% of the total number of regions) are characterized by the very low level of innovative activity: (i) the average total number of projects per region is 4.1 units; (ii) the average cost of projects per region is 0.383 bln UAH; (iii) the average completed projects per region is 0.9 units; (iv) the average amount of investments per region is 0.057 bln UAH.

#### *Examples of implementation of digital technologies in agribusiness of Ukraine*

Analysing the practice of implementation of digital technologies in the agricultural sector of Ukraine, it should be noted that there are five agricultural holdings in the TOP-20 innovative companies of Ukraine (Figure 6).

Figure 6. TOP-5 innovative agroholdings of Ukraine

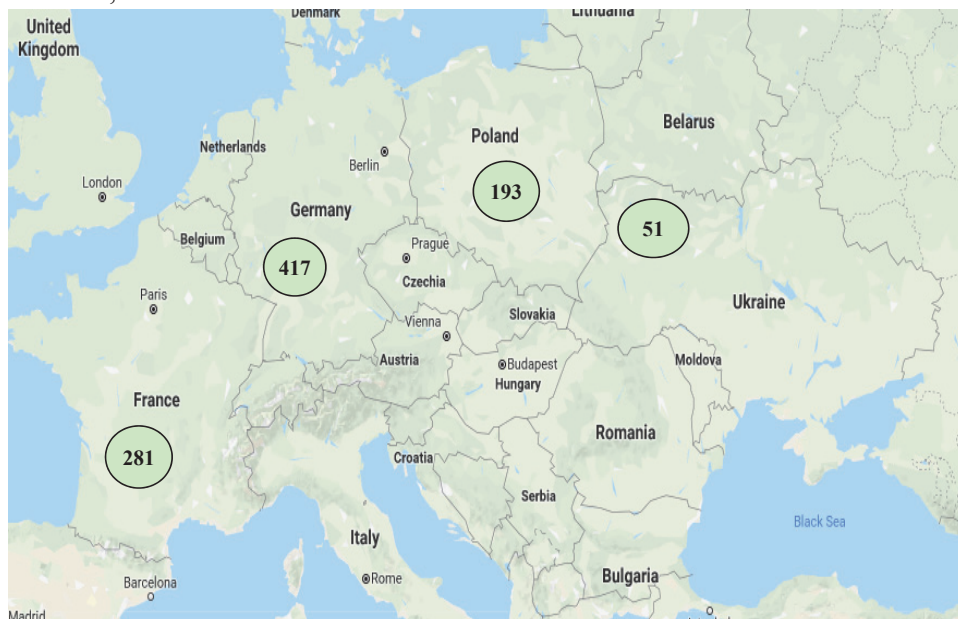


Source: author's presentation based on the data of <https://propozitsiya.com> [In the TOP-20, 2017].

Some Ukrainian agricultural enterprises are already working on automation of production processes, buying more technologically advanced equipment, more and more implementing precise farming systems and other innovative so-

lutions. This increases to equipment cost per unit of land area. In Ukraine, the average expenses of agricultural enterprises for the purchase of machinery and equipment in 2017 were about 51 USD/hectare, while in Germany this indicator was 417 USD/hectare, in France – 281, in Poland – 193 USD/hectare (Figure 7).

Figure 7. The costs for the purchase of agricultural machinery in some European countries, USD/ha



Source: author's presentation based on the data of UCAB [Lakhai, 2018].

Such a significant difference in the costs of agricultural machinery is due, first of all, to the use of more technologically advanced equipment by German, French and other European farmers. Such equipment, respectively, is much more expensive and is aimed at attracting as few employees as possible and more efficient use of land [Lakhai, 2018].

At the same time, the level of implementation of innovations in the agricultural sector remains low [The level, 2018]. According to expert estimates, no more than 10% of Ukrainian agrarian companies implement IT-technologies. According to IDC, by 2019 organizations that have made a digital transformation will receive at least 45% of their income from new business models [9 Steps, 2018]. Given the fact that contemporary agribusiness both in Ukraine and in Europe remains weakly digitized, we propose one of the strategic priorities of agrarian policy to recognize the promotion of the implementation of digital agricultural projects (projects connected with agribusiness 4.0).

The investments in digital agricultural projects are an important tool for improving competitiveness and economic efficiency of Ukrainian enterprises and development of agriculture 4.0 in Europe.

According to the International Society of Precision Agriculture (ISPA), today UAV technology and drone are used by about 39% of farmers; by 2020 their number will increase by 34%, that is, almost doubled. In Ukraine, according to expert estimates, UAV technology and drones use about 7% of agricultural enterprises. Considering this, we propose to provide the state financial support for the implementation of innovative solutions. For example, in Ukraine drones should be added the list of machinery and equipment for the agriculture, for the purchase of which the state provides subsidies.

Digital technologies in agriculture in Ukraine are implemented primarily by agricultural holdings. For example, agroholding “Myronivsky Hliboproduct” develops digital agriculture in the following main directions [Melnyk, 2017]:

- precision farming as an element of digital agriculture;
- observing the harvest using drones, mapping, satellite systems, radar surveillance;
- annual replenishment of the technical park, in particular, for digital farming. Each year, agroholding buys machinery for 25 mln USD or 68 USD/ha;
- management system of land bank based on agrarian GIS technologies.

Agroholding „Mriya” develops digital agriculture in the following main directions [Khmeliuk, 2018; Hryhorov, 2018]:

- creation of own IT-solution in which all data is combined – 1C, GPS and GIS;
- equipment of machinery by GPS trackers for control the consumption of fertilizers and fuel;
- development and use of its own „Planner of the agronomist”;
- monitoring of crops using drones and unmanned aerial vehicles.

According to expert estimates, there are about 15 robotic dairy farms in Ukraine. The most famous of them – Dairy Complex “Terezino” – a system of robotic milking of cows and management of Delavar Delpro™ Farm Management.

For effective implementation of digital technologies in agribusiness experts offer 9 steps to successful digital transformation [9 Steps, 2018]:

1. To develop a detailed digital strategy;
2. To convince the importance of the transformation of each manager;
3. To assign a person responsible for implementing the strategy;
4. To provide additional staff training at all levels;
5. To review organizational structure;

6. To get rid of old thinking patterns;
7. To hire consultants (if necessary);
8. To involve suppliers and customers as co-authors;
9. To evaluate the results.

## **20.5. Summary and conclusions**

This paper examines the current state of implementation of the most important innovation projects in agribusiness in Ukraine and their financing sources. Now in the agriculture of Ukraine enterprises generally implemented 474 investment projects. The total amount of the estimated cost of investment projects was almost 41.3 billion UAH, of which the main source of financing were own funds – 30.7 billion UAH (74.3%).

The cartogram showing the distribution of the number of investment and innovative projects in agribusiness in the regions of Ukraine is constructed. It is established that the majority of investment and innovative projects are located in Poltava (69 units), Lviv (64 units), Vinnitsa (48 units), Chernivtsi (43 units), Cherkassy (41 units) and Kherson (38 units) regions. We identified a significant variation of the cost of projects. The largest investment agricultural project can be found in the Sumy region, their average cost was 575.0 million UAH. The Sumy region is followed by the Vinnytsya (414.6 million UAH) and Odesa region (350.0 million UAH). On the other side, in Zakarpattya, Lviv and Chernivtsi regions realize the lowest by average cost of investment projects; their average cost is 4.0, 7.5 and 9.3 million UAH, respectively.

According to results of cluster analysis, Ukrainian regions can be divided into four clusters, each of which is represented by relatively homogeneous parameters of the potential of innovative development of agribusiness 4.0: (i) "Leading regions with high potential for innovation development"; (ii) "Regions are followers of leaders with an average potential of innovation development"; (iii) "Medium-sized regions with low potential for innovation development"; (iv) "Regions-outsiders with very low potential for innovation development". The results of clusterization can be taken into account when forming a regional and agrarian policy on innovative development.

According to expert estimates, no more than 10% of Ukrainian agrarian enterprises implement digital technologies. Given the fact that contemporary agribusiness both in Ukraine and in Europe remains weakly digitized, we propose one of the strategic priorities of agrarian policy to recognize the promotion of the implementation of digital agricultural projects (projects connected with agribusiness 4.0). The investments in digital agricultural projects are an im-



portant tool for improving competitiveness and economic efficiency of Ukrainian enterprises and development of agriculture 4.0 in Europe. Consequently, there are significant reserves of increase of efficiency of agrarian enterprises implement digital projects that require the appropriate management of them, it may be the prospect for further research.

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