ATLAS OF NEW PROFESSIONS AND COMPETENCIES OF KAZAKHSTAN АТЛАС НОВЫХ ПРОФЕССИЙ И КОМПЕТЕНЦИЙ КАЗАХСТАНА

ATLAS
OF NEW
PROFESSIONS
AND COMPETENCIES
OF KAZAKHSTAN

2020

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№
03

AGRICULTURE

МИНИСТЕРСТВО ТРУДА И
СОЦИАЛЬНОЙ ЗАЩИТЫ НАСЕЛЕНИЯ
РЕСПУБЛИКИ КАЗАХСТАН

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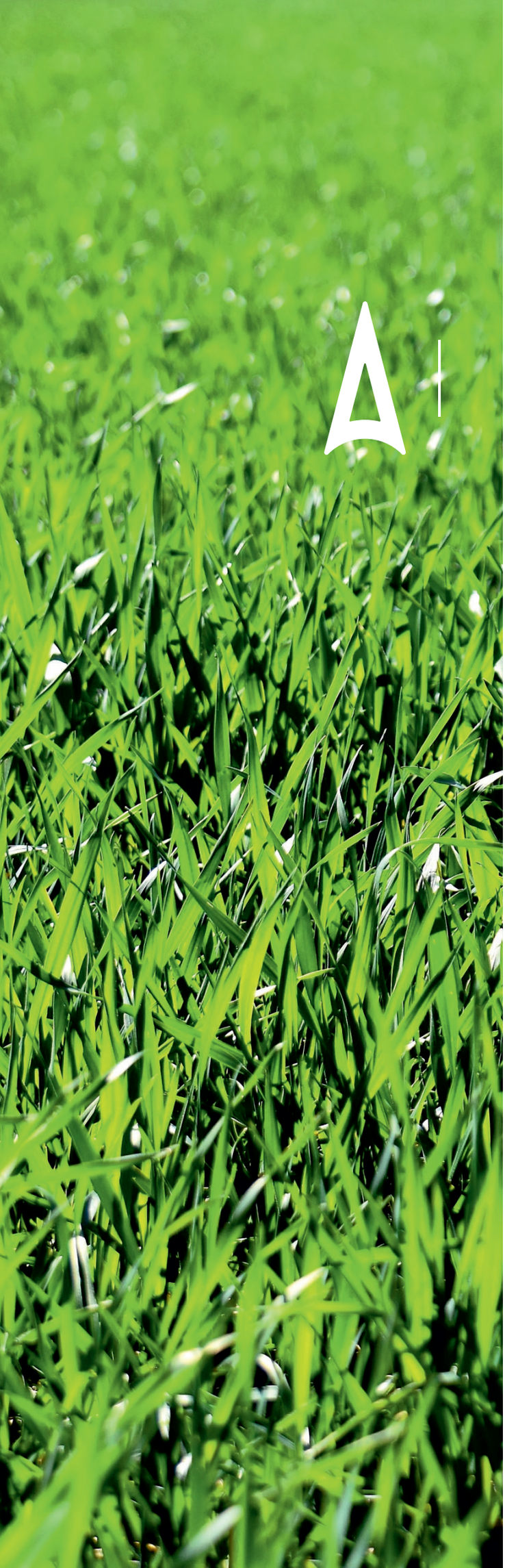
РАЗВИТИЕ ТРУДОВЫХ НАВЫКОВ
И СТИМУЛИРОВАНИЕ
РАБОЧИХ МЕСТ

ATLAS OF NEW PROFESSIONS AND COMPETENCIES OF KAZAKHSTAN


New Holland



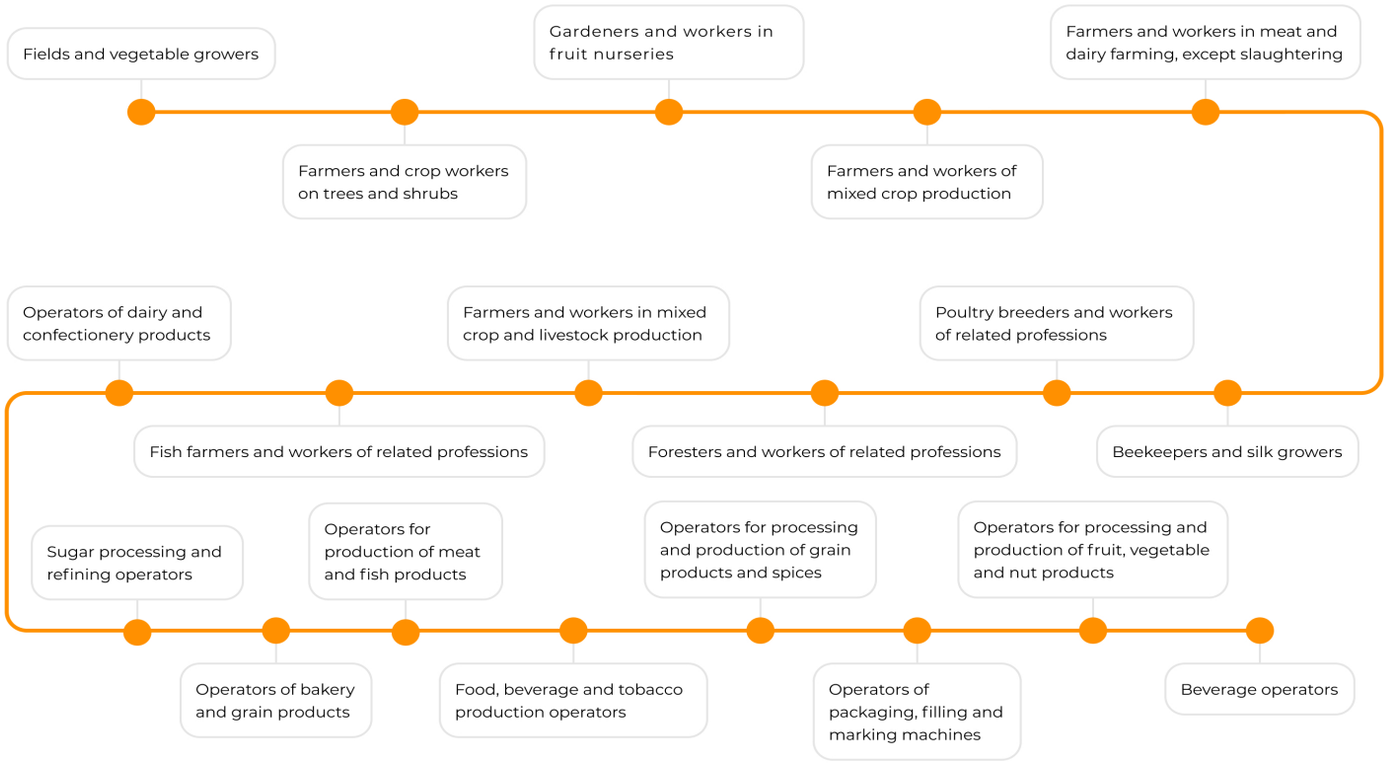
CONTENT

LIST OF ABBREVIATIONS

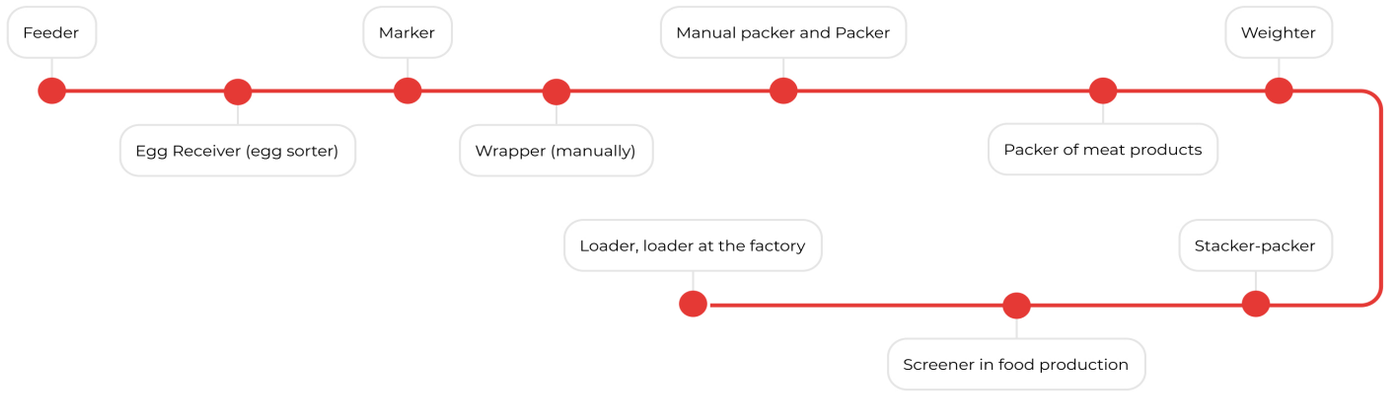
- **3D** - 3-dimensional.
- **5G** - the fifth generation mobile network.
- **AEL** - the Association of Legal Entities.
- **AI** - Artificial Intelligence.
- **ALEIE** - the Association of Legal Entities and Individual Entrepreneurs.
- **AR** - Augmented Reality.
- **Big Data** – Big Data.
- **CIS** – Commonwealth of Independent States.
- **CRISPR** - Clustered Regularly Interspaced Short Palindromic Repeats.
- **CVI** - Chlorophyll Vegetation Index.
- **DNA** - deoxyribonucleic acid.
- **EU** – European Union.
- **EVI** - Enhanced Vegetation Index.
- **GDP** – Gross Domestic Product.
- **GIS** - Geographical Information Systems.
- **GMO** – genetically modified organism.
- **GNDVI** - Green Normalized Difference Vegetation Index) - green normalized relative vegetation index.
- **GPS** - Global Positioning System.
- **GVA** – Gross Value Added.
- **HR** – Human Resources.
- **IoT** - Internet of Things.
- **IPCC** - the Intergovernmental Panel on Climate Change.
- **IT** - Information Technology.

- **JSC** – Joint-Stock Company.
- **LLP** – limited liability partnership.
- **MIID RK** – the Ministry of Industry and Infrastructure Development of the Republic of Kazakhstan.
- **MNE RK** – the Ministry of National Economy of the Republic Kazakhstan.
- **NDVI** - Normalized Difference Vegetation Index.
- **OECD** - the Organization for Economic Co-operation and Development.
- **R & D** – Research and Development.
- **TPF** – Total Productivity Factor.
- **TVE** - Technical and Vocational Education.
- **USA** – United States of America.
- **VR** - Virtual Reality.
- **WEF** - World Economic Forum.

Transforming Professions in Agriculture

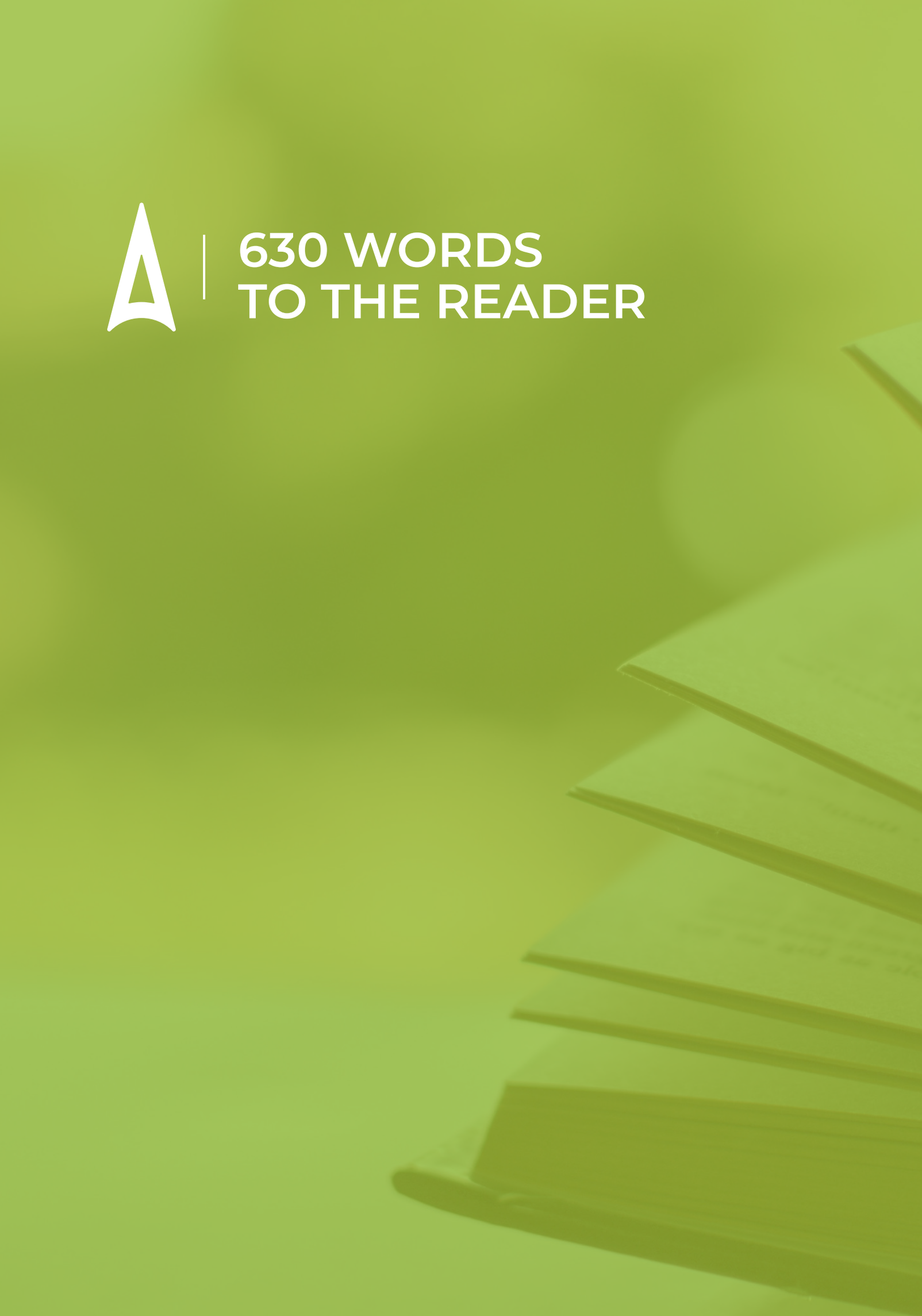


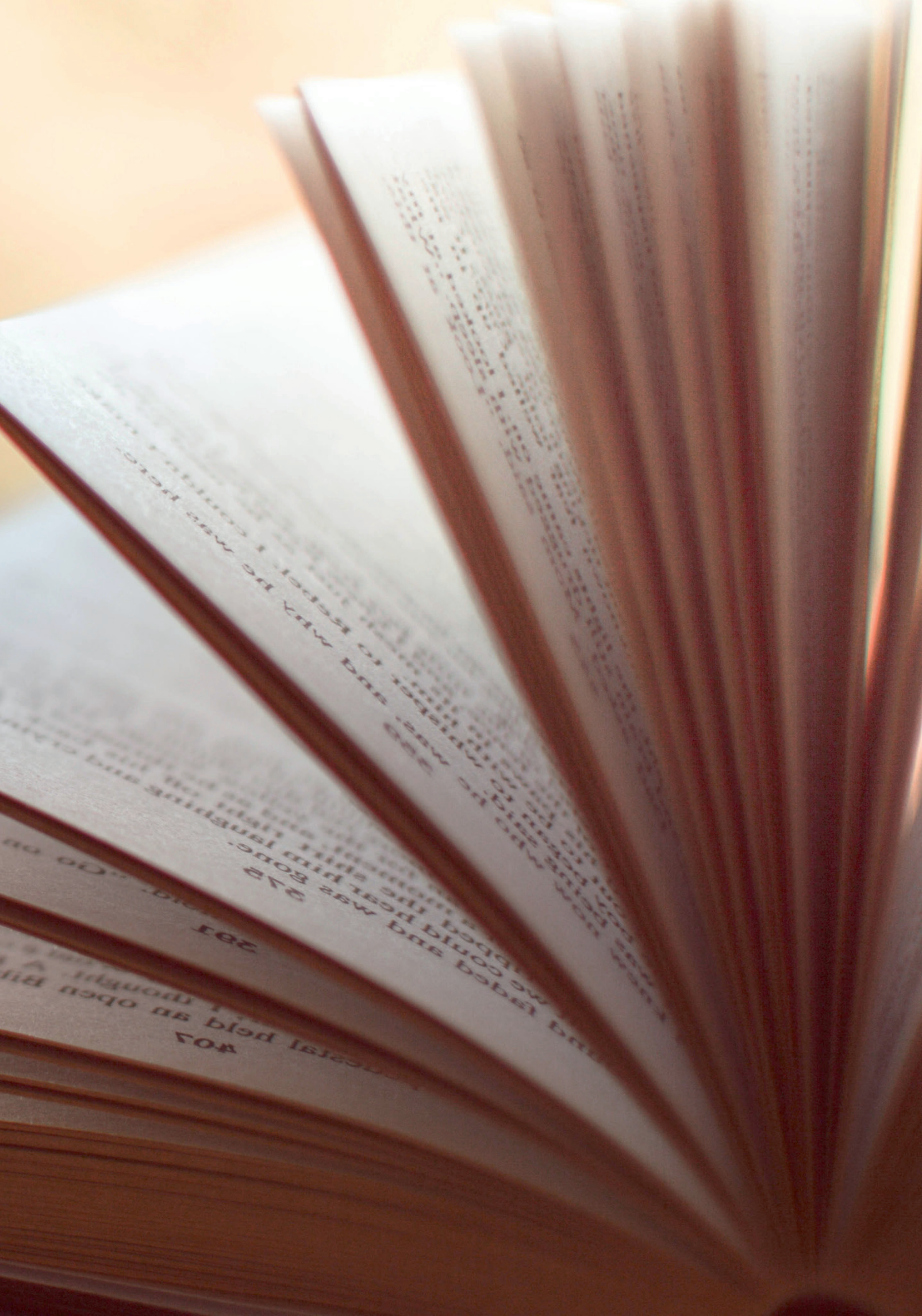
Disappearing Professions in Agriculture



New Professions in Agriculture

630 WORDS TO THE READER





630 WORDS TO THE READER

Dear reader!

We are all witnessing and participating in the Fourth industrial revolution, which has virtually engulfed the entire world and all countries.

Over the past twenty or thirty years, we have first entered the digital era step by step, adapted to it, and got used to living in a new reality.

However, scientific progress never stands still, and all of humanity has already crossed the threshold of the Fourth Industrial Revolution.

WHAT CAN WE EXPECT FROM THE RAPIDLY CHANGING REALITY?

Let us remember the Hollywood movie of the eighties, The Terminator. The modern world as we know it sometimes in some ways surpasses the fantastic ideas, events, things described in this picture, published thirty years ago. Nevertheless, the most important is a warning of The Terminator authors that technologies can be developed to a level when human labor or human participation in the process might disappear or be reduced to a minimum. Moreover, this minimal human participation will require the highest qualification and ability to work in a completely new reality to manage the process and not be a new technology puppet.

THE FOURTH INDUSTRIAL REVOLUTION. Like any technological revolution, the Fourth Industrial Revolution is aimed at improving production efficiency, making people's work more comfortable, bringing good, not harm. However, in the human world, this mechanical approach does not work.

As new technologies take over the world, there are those who "need to run as fast as they can just to stay in place" and those who “need to run at least twice as

fast to get somewhere." There are suggestions from Alice, a heroine of a fairy tale by Lewis Carroll. What does all this mean to the changing labor markets and economic sectors?

In 2016, the World Economic Forum (WEF) conducted a study and published the report "The Future of Professions".

During the study, WEF experts interviewed more than a hundred top managers responsible for strategic human resources in several major multinational companies with a total number of employees exceeding 15 million people. Multinational companies as global market leaders agreed that the world's labor market is changing dramatically.

Under the pressure of the Fourth Industrial Revolution, some knowledge and skills, and specific professions, will inevitably become outdated shortly. Some professions will remain, but they will require completely different knowledge and skills.

The most important is the coming of new jobs! For people working now or just learning and preparing to become professionals, all these large-scale, global changes mean only one thing. They have to learn and relearn new things throughout their life... But, dear reader, you feel deep inside that things are not so simple. Moreover, this is true.

THE DEVELOPMENT OF A NEGATIVE SCENARIO IS THEORETICALLY POSSIBLE.

What do we mean? All these technological changes of the Fourth Industrial Revolution may be accompanied by an acute shortage of professionals in changing and new professions. Unemployment

among specialists in outgoing professions will only increase, which will significantly increase social inequality.

The chances of this negative scenario development will be minimal if governments, businesses, and ordinary people proactively together prepare for the new technologies that are increasingly changing people, companies, and entire industries.

Our dear reader may object and say that people were engaged in agriculture and will continue to do so in one form or another. That is right! Indeed, until recently, the agricultural industry was considered very conservative and slowly changing. However, new technologies of the 21st century will "shake" this industry to its very foundation. There is no doubt about that.
We can say that the agricultural sector is no longer a harbor for traditional methods and accumulated knowledge.

Therefore, the professionals in this industry and those still planning to work in the agricultural sector should take heed of all risks and opportunities coming.

The Atlas of New Professions is the step that Kazakhstan is taking today to adapt people, businesses, and the Republic's economy to new realities.

We hope the Atlas will help. Dear reader, you need to look to the future with more confidence and consciously choose the direction of actions for the younger generation, students, and employees!

ABOUT THE ATLAS OF NEW PROFESSIONS

ATLAS OF NEW PROFESSIONS AND COMPETENCIES OF KAZAKHSTAN

MCC

A set of related industries and production process stages, from raw material extraction to production of finished products - ferrous and non-ferrous metals and their alloys.

Energetics

The sector of economy engaged in generation, transformation, distribution and use of energy resources of all types.

Oil & Gas

The sector of economy engaged in extraction, processing, storage and sale of natural minerals - oil and related petroleum products.

Mechanical Engineering

An industry that designs, manufactures, maintains and disposes of all kinds of machines, process equipment and their parts.

Agricultural industry

Economic sector, aimed at the production, storage and processing of food (food products) and raw materials for a number of industries.

IT

A sector of the economy aimed at finding, collecting, storing, processing, transferring and providing useful information through technical means.

Transport and logistics

The economy sector carrying passengers, as well as transport management system (logistics) to optimize cargo and passenger flows.

Tourism

An industry that organizes the departure (travel) of a person / group of people to another country or area other than the place of residence of the travelers, to get acquainted with the lifestyle, architecture, gastronomy, nature, etc.

Construction

The industry that designs, constructs (erects) buildings, structures, as well as performs their capital and current repairs.

ABOUT THE ATLAS OF NEW PROFESSIONS

The content of the Atlas of New Professions for the agricultural sector is structured as follows.

First, dear reader, you will be acquainted with the current situation in agriculture of Kazakhstan to better understand the subject of our conversation.

Next, you will take the first step into the future, you will learn the most plausible scenario of technological development of agriculture in Kazakhstan. It will be assembled as a LEGO set from several parts.

Firstly, industry experts will give their assessments (see the ***«EXPERT OPINION»*** section).

Then you will hear the voice of the entire industry, including hundreds of professionals who are working in agriculture, in specialized education, and trade unions (section ***«LOOKING INTO THE FUTURE»***).

The opinion of professionals is good and significant. However, people make a decision about their career future independently. To help you, dear reader, understand what is happening, we will explain you the situation.
You will learn about ***«GLOBAL AND INDUSTRY TRENDS AFFECTING AGRICULTURE»***. You will see from the inside the driving forces of change to try to determine your place in the evolving world.

Now we come to the most important moment when hundreds of personal opinions of professionals and objective facts of reality grow into «THE IMAGE OF THE FUTURE».

How does it happen? Do you remember the Cheshire Cat from Alice in Wonderland and his brilliant response to Alice, "if you don't know where you want to go, then you don't care which way to go"?

Therefore, the preferred future comes only if WE clearly know where we want to go and actively move in this direction. In our case, during foresight sessions discussions, industry experts crystallized the theoretical image of the future, which has every chance to come true, and we are already approaching that future.

The final sections of the Atlas will tell you, dear reader, what will happen to the professions in agriculture:

- which professions will disappear,
- which ones will change,
- which ones will appear and determine the knowledge and skills to learn for the future; they will tell you where to go and what to study; you will find this information in the sections;

You will find this information in the sections

- ***«The List of Future Professions»,***
- ***«Competencies of Future Professions»,***
- ***«The Location of New Professions».***

AGRICULTURAL SECTOR OF KAZAKHSTAN

1.

AGRICULTURAL SECTOR OF KAZAKHSTAN

«The agro-industrial complex is one of the most important sectors of the economy, which forms the food and economic security of the country, as well as the labor and settlement potential of rural territories»[1].

According to statistics of the Ministry of National Economy of the Republic of Kazakhstan for January-December In 2019, the share of agriculture in the gross domestic product[2] of Kazakhstan was 4.5%, or 3,092,417. 6 mn. tenge.

In the fourth quarter of 2019, the industry employed 13.4%, or 1,173.9 thsd. people of the working-age population of the Republic. At the same time, labor productivity in the industry is significantly lower than the national average: in 2018, GVA per employee in the industry was 2076.6 thsd. tenge against 6173.2 thsd. tenge per employee in the whole economy (ed. – GVA[3] per employee in the industry is only 33.6% of the national average).

The average monthly salary in the industry was 127283 tenge[4] in the fourth quarter of 2019 this figure is lower than the national average of 203,883 KzT and is only 62.4% of the national average.

The industry has 13,390 active legal entities, or 4.3% of the total number of active legal entities in the country's market[5] this is the ninth industry in the Republic by the number of operating organizations[6].
In 2018, the volume of investments in agriculture amounted

to 365,001 mn. tenge, or 3.27% of 11 179,036 mn. tenge of the total investment in fixed assets.

The growing demand for imported food products has led to the fact that since 2004 Kazakhstan has become a net importer of agricultural products.

Thus, according to The 2018 Committee on Statistics of MNE of the RK Report, imports of animal and plant products, including processed food, exceed exports (638 3 489,2 thsd. dollars. USA import vs 3 102,121. 1 thsd. US dollars export; exports account for 85.3% of imports, see Table 1.1).

Table 1.1.

Structure of exports and imports by main commodity groups in 2018, thousand US dollars.

Product group name	Import, thousand USD, including			Export, thousand USD, including		
	Total	CIS	Rest of the world	Total	CIS	Rest of the world
Total including:	33 658 519,4	16 033 877,4	17 624 642,0	61 111 221,4	9 568 349,4	51 542 872,0
Products of animal and vegetable origin, ready-made food products	3 638 489,2	2 374 204,5	1 264 284,7	3 102 121,1	1 614 266,9	1 487 854,2

SOURCE: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan. "Structure of exports and imports by main product groups»

[1] *Source: https://kapital.kz/economic/77001/sel-skoye-khozyaystvo-osnova-sil-noy-ekonomiki.html*
[2] *Source: Express – information. № 36-2/75 from 14 february 2020 Gross domestic product by production method for January-December 2019. https://stat.gov.kz/official/industry/11/statistic/6*
[3] *GVA-gross value added*
[4] *Source: Average monthly salary for the main types of economic activity for the year 2010-2019 https://stat.gov.kz/official/industry/25/statistic/7*
[5] *The total number of active legal entities in the Republic of Kazakhstan according to the data for 2019 was 308 011. Source: https://stat.gov.kz/official/industry/13/statistic/6*
[6] *The market leader according to 2019 data is the wholesale and retail trade industry (83,158 active legal entities or 27% of the total number of active legal entities in the Republic).Источник: https://stat.gov.kz/official/industry/13/statistic/6*
[7] *Source: http://www.oecd.org/eurasia/competitiveness-programme/central-asia/Kazakhstan-Monitoring-Agricultural-Co-operatives-2019-RUS.pdf*

Table 1.2.

Gross output of agricultural products (services) by category of farms and types of products, million tenge (and %)

2018 year	Gross output of agricultural products (services) (all categories of farms)			
	Gross output of crop production, KZT mln/ %	Gross livestock production, KZT mln/%	Services in the field of agriculture, KZT mln/%	Total per line, KZT mln./%
Gross output of agricultural products (services) in agricultural enterprises.	746 792,2 / **31%**	308 745,2 / **15%**	12 145,6 / **100%**	1 067 683,0 / **23,9%**
Gross output of agricultural products (services) in peasant or farm households.	951 327,1 / **39,4%**	366 025,9 / **17,9%**	-*	1 317 352,9 / **29,4%**
Gross output of agricultural products (services)in households.	713 367,5 / **29,6%**	1 375 684,7 / **67,1%**	-	2 089 052,2 / **46,7%**
Total for each column, KZT mln.	**2 411 486,7**	**2 050 455,8**	**12 145,6**	**4 474 088,1**
Total for each column,%.	100%	100%	100%	100%

SOURCE: Committee on statistics of the Ministry of national ECONOMY of the Republic of Kazakhstan. Dynamic tables for regions and the Republic of Kazakhstan as a whole.

Crops dominate agricultural production; a slightly smaller amount comes from animal husbandry. However, in 2018, both sub-sectors accounted for 99.7% of the total gross production in the Republic's agricultural sector.

In 2018, the gross output of agricultural products (services) was 4,474,088.1 mn. KzT.

The structure of agricultural output looks like this (see table 2):

- 53.9%, or 2,411,486. 7 mn. KzT, is the gross crop production;
- 45.8%, or 2,050,455. 8 mn. KzT,– gross production of animal husbandry;
- 0.3%, or 12,145. 6 mn. KzT, – services in the field of agriculture.

It is interesting to note that in the total volume of production of agricultural products (services), almost half (46.7%, or 2,089,052.2 mn. KzT) falls on the personal farms of Kazakhstanis. About a third (29.4%, or 1,317,352.9 mn. KzT) of production is produced by farmers or farms.

In crop production, more than a third (39.4%, or 951,327.1 mn. KzT) of products are produced by farmers or farms.

In animal husbandry, almost two-thirds (67.1%, or 1,375,684. 7 mn. KzT) of products are produced in private households of Kazakhstan.

Services are fully (100%, or 12,145. 6 mn. KzT) produced by agricultural enterprises.

There are significant regional differences in the structure of agricultural production. Analysis of the data on the gross output of agricultural products (services) for 2018 in the regional context clearly indicates the dominance and universality of the Almaty region (the shares are calculated based on the data presented in monetary terms) (see Table 1.3.):

- ▸ 16.4% of gross output of all products;
- ▸ 15.5% of crop production;
- ▸ 17.4% of livestock production;
- ▸ 19.6% of services.

IN ADDITION TO ALMATY REGION, MOST AGRICULTURAL PRODUCTS ARE PRODUCED IN TURKESTAN, NORTH KAZAKHSTAN, AND EAST KAZAKHSTAN REGIONS.

ALMATY, NORTH KAZAKHSTAN, AND KOSTANAY REGIONS ARE THE LEADERS IN CROP PRODUCTION.

THE LEADERS OF LIVESTOCK PRODUCTION ARE ALMATY, EAST KAZAKHSTAN, AND TURKESTAN REGIONS.

AGRICULTURAL SERVICES ARE MOSTLY PROVIDED IN ALMATY AND KYZYLORDA REGIONS.

[8] *Source: Committee on statistics of the Ministry of national ECONOMY of the Republic of Kazakhstan. The dynamic table. Gross output of agricultural products (services). https://stat.gov.kz/official/industry/14/*

Table 1.3.

Gross output of agricultural products (services) by regions and types of products, %.

	2018			
	Gross output, %	Crop production, %	Livestock, %	Agricul. service, %
1. Akmola region	9,1%	11,1%	6,7%	8,5%
2. Aktobe region	5,2%	3,5%	7,3%	1,7%
3. Almaty region	16,4%	15,5%	17,4%	19,6%
4. Atyrau region	1,5%	1,1%	1,9%	3,6%
5. West Kazakhstan region	3,1%	2,0%	4,5%	3,0%
6. Zhambyl region	6,0%	6,1%	5,9%	5,8%
7. Karaganda region	6,2%	5,1%	7,6%	5,5%
8. Kostanay region	8,6%	11,1%	5,8%	10,1%
9. Kyzylorda region	2,3%	2,6%	1,9%	16,2%
10. Mangystau region	0,3%	0,1%	0,6%	0,6%
11. South Kazakhstan region	-*	-*	-*	-*
12. Pavlodar region	5,1%	4,7%	5,7%	0,9%
13. North Kazakhstan region	11,5%	15,2%	7,2%	6,6%
14. Turkestan region	12,3%	12,1%	12,5%	6,0%
15. East Kazakhstan region	11,5%	9,2%	14,3%	3,2%
16. Astana	0,0%	0,0%	0,0%	3,3%
17. Almaty	0,1%	0,2%	0,1%	-*
18. Shymkent	0,6%	0,4%	0,8%	5,1%

** No data*

SOURCE: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan. Dynamic tables by region and the Republic of Kazakhstan as a whole. "Gross output of agricultural

DYNAMICS OF THE MAIN INDICATORS OF THE AGRICULTURAL SECTOR IN KAZAKHSTAN. THE GROSS OUTPUT OF AGRICULTURAL PRODUCTS (SERVICES) AND INVESTMENT

As for the dynamics of agricultural development in the Republic, since 2004, Kazakhstan has been a net importer of agricultural products. According to The Global Food Security Index in 2019, Kazakhstan took the 48th position out of 113 countries with a total score of 67.3. This result is evaluated as a "good indicator of food security." Singapore takes the top line with a total score of 87.4, and while Venezuela closes the list with a score of 31.29.

Despite good indicators of food security ("level of food availability and consumption" 10-77.5 points; "availability and sufficiency of food" 11-57.7 points; "level of food quality and safety" 12-68.3 points), ensuring food independence remains one of the strategic tasks of the state.

The above-expanded indicators of The Global Food Security Index fully coincide with domestic requirements for ensuring food security. In particular, according to the law of the Republic of Kazakhstan dated on July 8, 2005, "On the State Regulation of the Development of the Agro-Industrial Complex and Rural Territories," the requirements for ensuring food security are the following:

1. ***Economic accessibility*** of food products.
2. ***Physical availability*** of food products.
3. ***Food safety guarantee***[13].

However, how can we measure the sufficiency of a country's food independence? Kazakhstan does not have a law on food security, but in 1999 at the meeting of the inter-parliamentary Assembly of the CIS states, the Republic adopted the model law "On Food Security of the CIS" (resolution no. 14-10 of October 16, 1999). According to this law, food independence is considered secured if the country's annual

[9] *Source: https://foodsecurityindex.eiu.com/Index.*
[10] *Food availability and consumption-an assessment Of consumers ' ability to buy food, their vulnerability to price shocks, and the availability of consumer support programs and policies in the event of shocks. Source: https://foodsecurityindex.eiu.com/Index.*
[11] *Food availability and sufficiency - Measures to ensure the sufficiency of national food supplies, the risk of supply disruptions, national capacity for food distribution, and research efforts to expand agricultural production. Source: https://foodsecurityindex.eiu.com/Index.*
[12] *Food quality and safety level-Measures the diversity and nutritional value of the average diet, as well as food safety. Source: https://foodsecurityindex.eiu.com/Index.*
[13] *Source: https://moa.gov.kz/documents/1538732758.pdf.*

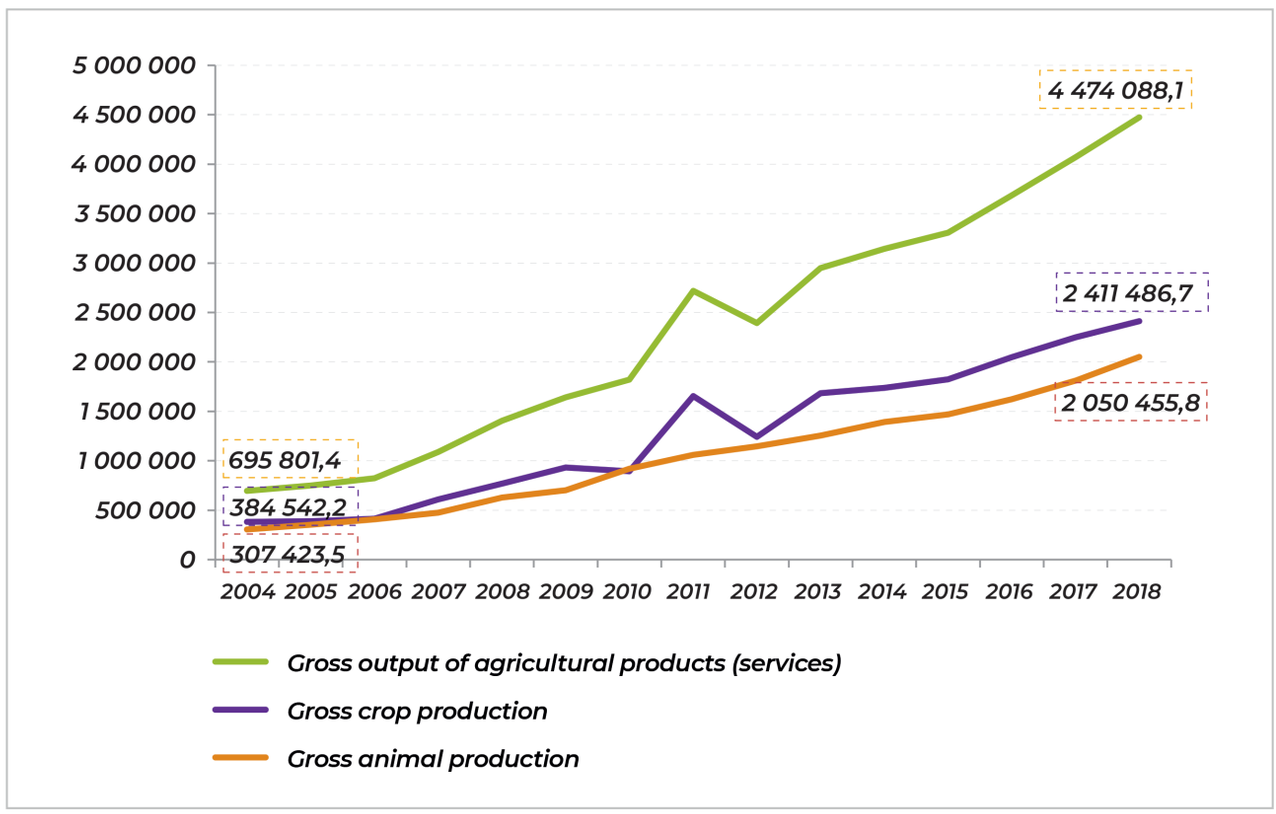
production of vital food products is at least 80% of the population annual needs for such food following physiological norms.

According to the statement of Vice-Minister of agriculture of the Republic of Kazakhstan Gulmira Isayeva (dated 2016), "domestic producers cover the needs of the population in basic food products by 95%, and import dependence exists only for some types of products (for example, fish or apples)".
The gross output of agricultural products (services) from 2004 to 2018 increased by 6.4 times, including the gross output of crop production increased by 6.3 times, livestock production-by 6.7 times, and services in agriculture- 3.2 times (see Diagram 1.1.).

However, it should be noted that, despite the considerable increase in gross output of agricultural products both in General and by industry (crop production, animal husbandry, services), Kazakhstan continues to be an importer of agricultural products.

Chart 1.1.

Gross output of agricultural products (services), in dynamics, 2004-2018, in current prices, million tenge.



SOURCE: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan. Dynamic tables. "Gross output of agricultural products (services)"

Table 1.4.

Gross output of agricultural products (services) by regions and types of products, %.

Year	Gross output of agricultural products (services)	Gross crop production	Gross livestock production	Agricultural services
2004	695 801	384 542	307 424	3 836

SOURCE: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan. Dynamic tables. "Gross output of agricultural products (services)"

As already mentioned, there are significant regional differences in the structure of agricultural production in the Republic.

The Northern regions specialize in grain production, which is produced by large capital-intensive grain farms. In contrast, the southern regions are home to most small and medium-sized enterprises that specialize in producing fruits, vegetables, rice, and cotton.

In this regard, it is interesting to trace the dynamics of sown areas for the main crops in the Republic since 2004 (see table 1.5).

[14] *Source: https://articlekz.com/article/5263*
[15] *Source: http://today.kz/news/kazahstan/2016-04-25/715630-proizvoditeli-kazahstana-pokryivayut-95-protsentov-potrebnostej-naseleniya-msh/*

Other crops (oilseeds, potatoes, vegetables, melons, sugar beets, fodder) occupy significantly smaller areas in the total volume.

Data analysis shows that the lion's share of acreage is devoted to cereals, including rice and legumes.

However, even though the share of area under grain crops remains the most significant, during the time under review (2004-2019), this share has almost steadily decreased (Diagram 1.3), while the total sown area steadily increased (Diagram 1.2).

Table 1.5.

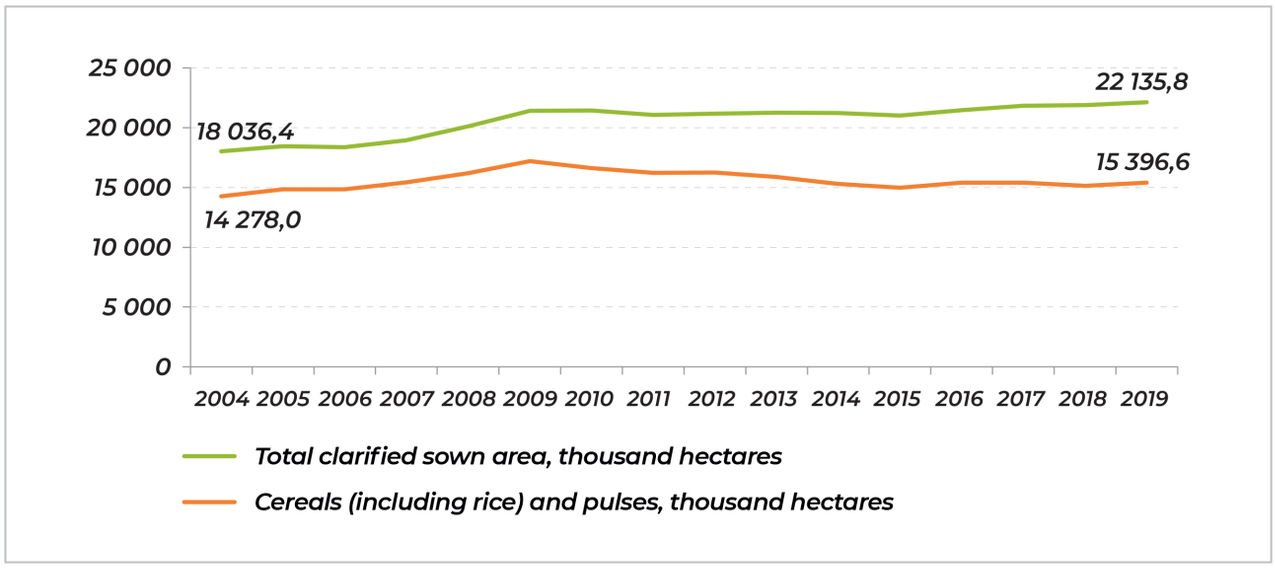
Adjusted sown area of the main agricultural crops, in dynamics, 2004-2019, thousand hectares.

Year	Total adjusted cultivated area	Cereals (including rice) and legumes	Oilseeds	Potatoes	Open field vegetab.	Melons and gourds	Sugar beet	Fodder crops
2004	18 036,4	14 278,0	665,0	168,2	111,3	43,6	22,3	2 515,8
2005	18 445,2	14 841,9	669,7	168,2	110,8	43,4	17,5	2 380,6
2006	18 369,1	14 839,8	751,4	153,9	103,0	42,0	14,4	2 255,6
2007	18 954,5	15 427,9	672,8	155,5	104,2	38,8	13,7	2 329,0
2008	20 119,2	16 190,1	913,7	163,7	112,9	55,9	13,1	2 486,2
2009	21 424,9	17 206,9	1 186,1	170,3	110,6	52,4	10,6	2 535,8
2010	21 438,7	16 619,1	1 748,1	179,5	120,3	63,3	11,2	2 555,6
2011	21 083,0	16 219,4	1 816,2	184,4	128,7	67,7	18,2	2 484,3
2012	21 190,7	16 256,7	1 853,9	190,2	128,7	81,8	11,8	2 517,4
2013	21 271,0	15 877,6	1 980,9	184,8	133,1	82,3	2,7	2 866,8
2014	21 244,6	15 291,5	2 299,5	186,8	137,7	89,8	1,2	3 109,9
2015	21 022,9	14 982,2	2 009,7	190,6	139,5	94,7	9,2	3 497,1
2016	21 473,6	15 403,5	2 035,7	186,7	145,9	93,9	12,6	3 485,2
2017	21 839,9	15 405,4	2 478,9	183,4	142,9	93,8	17,4	3 382,3
2018	21 899,4	15 150,0	2 834,2	193,0	152,3	96,1	17,4	3 323,2
2019	22 135,8	15 396,6	2 861,1	193,0	159,1	102,1	15,2	3 277,2

SOURCE: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan. Dynamic tables. "Adjusted sown area of major agricultural crops"

Chart 1.2.

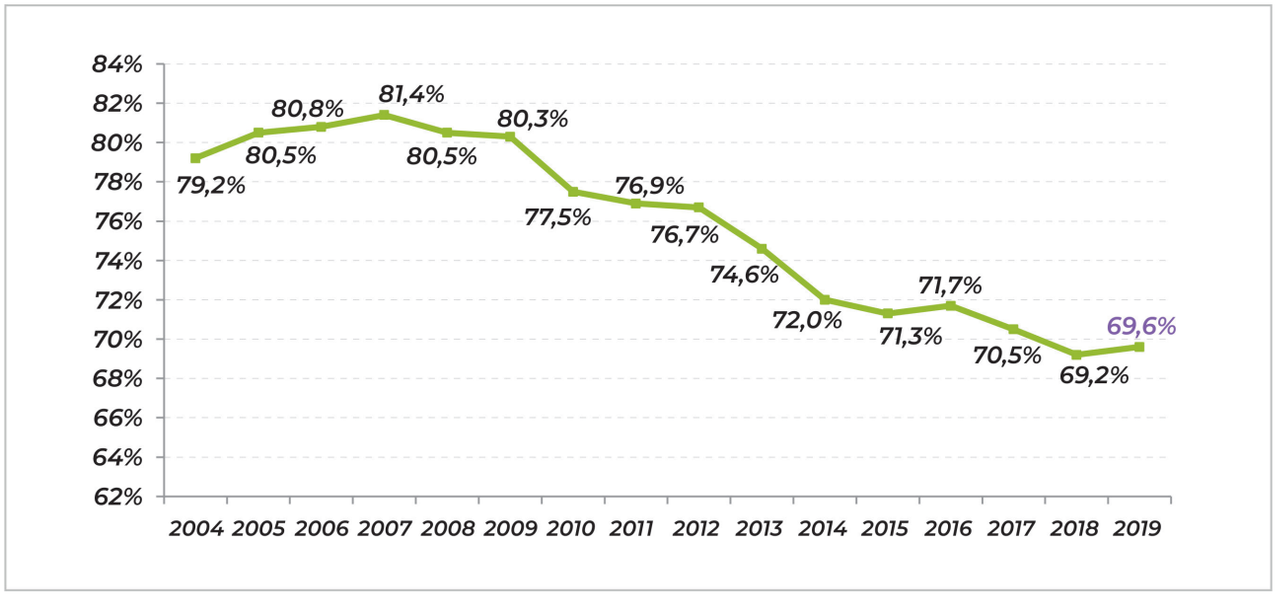
Adjusted sown area: total, as well as cereals, including rice and legumes, in dynamics, 2004-2019, thsd. hectares.



SOURCE: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan. Dynamic tables. "Adjusted sown area of major agricultural crops".

Chart 1.3.

The share of grain areas in the total sown area, in dynamics, 2004-2019, in %.



SOURCE: Shares calculated by DAMU RG based on data from the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan: Dynamic tables. "Adjusted sown area of major agricultural crops."

According to the statistics, the total acreage increase happened due to fodder and oilseeds plots (see table 1.5.1. during the period under review (2004-2019).

Moreover, the area of oilseeds increased 4.3 times (from 665 thsd. ha in 2004 to 2861.1 thsd. ha in 2019 – see table 1.5.). The area for forage increased only 1.3 times.

If we consider the absolute values of the increase in acreage, then the highest increase in acreage is for oilseeds and forage crops (see table 1.5.2). The indicator for cereals is much lower.

Table 1.5.1.

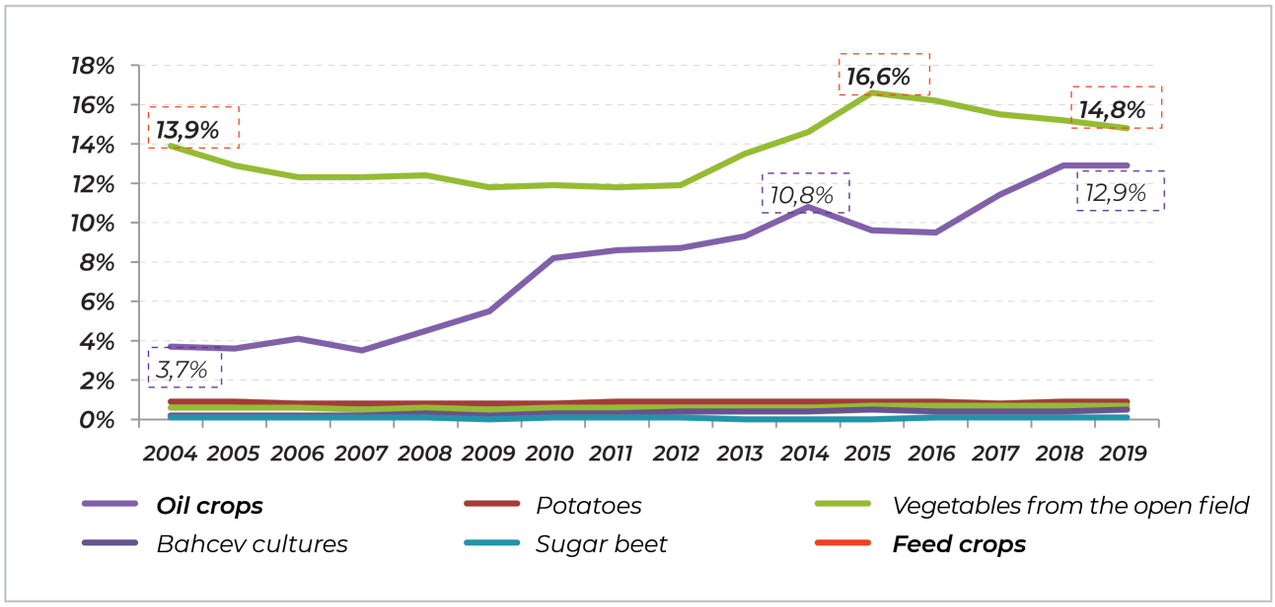
The share of the area occupied for the cultivation of the main agricultural crops (oilseeds, potatoes, vegetables, melons, sugar beets, fodder) in the total sown area, in dynamics, 2004-2019, in %.

Year	Oilseed crops	Forage crops	Potatoes	Vegetables	Melons and gourds	Sugar beet
2004	3,7%	13,9%	0,9%	0,6%	0,2%	0,1%
2005	3,6%	12,9%	0,9%	0,6%	0,2%	0,1%
2006	4,1%	12,3%	0,8%	0,6%	0,2%	0,1%
2007	3,5%	12,3%	0,8%	0,5%	0,2%	0,1%
2008	4,5%	12,4%	0,8%	0,6%	0,3%	0,1%
2009	5,5%	11,8%	0,8%	0,5%	0,2%	0,0%
2010	8,2%	11,9%	0,8%	0,6%	0,3%	0,1%
2011	8,6%	11,8%	0,9%	0,6%	0,3%	0,1%
2012	8,7%	11,9%	0,9%	0,6%	0,4%	0,1%
2013	9,3%	13,5%	0,9%	0,6%	0,4%	0,0%
2014	10,8%	14,6%	0,9%	0,6%	0,4%	0,0%
2015	9,6%	16,6%	0,9%	0,7%	0,5%	0,0%
2016	9,5%	16,2%	0,9%	0,7%	0,4%	0,1%
2017	11,4%	15,5%	0,8%	0,7%	0,4%	0,1%
2018	12,9%	15,2%	0,9%	0,7%	0,4%	0,1%
2019	12,9%	14,8%		0,7%	0,5%	0,1%

SOURCE: Shares calculated by DAMU RG based on data from the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan: Dynamic tables. "Adjusted sown area of major agricultural crops.

Chart 1.4.

The share of the area occupied for the cultivation of the main agricultural crops (oilseeds, potatoes, vegetables, melons, sugar beets, fodder) in the total sown area, in dynamics, 2004-2019, in %.



SOURCE: Shares calculated by DAMU RG based on data from the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan: Dynamic tables. "Adjusted sown area of major

Table 1.5.2.

Increase in the sown area for the period of 2004-2019[20].

Total adjusted cultivated area	Cereals (including rice) and legumes	Oilseeds	Potatoes	Vegetables	Melons and gourds	Sugar beet	Fodder crops
22,7%	7,8%	330,2%	14,7%	42,9%	134,1%	-32,0%	30,3%

*SOURCE: Growth calculated by DAMU RG based on data from the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan. Dynamic tables. "Adjusted sown area of major crops" according to the formula: ((final value * 100%) / initial value) -100%.*

However, along with the size of the sown area, it is necessary to consider the yield per hectare. Data analysis showed grain yields were not stable during the period under review (2004-2019), although the overall dynamics were positive (see Diagram 1.5).

If we analyze in detail the dynamics of the yield of major crops during the period. In 2004-2019, the increase in grain yield was one of the lowest (40%) among other crops (see Table 1.6).

Chart 1.5.

Productivity of grain crops (including rice and legumes, in weight after processing), in dynamics, 2004-2019, centners per hectare.

SOURCE: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan. Dynamic tables. Productivity of major crops

Table 1.6.

Productivity of the main agricultural crops, in dynamics, 2004-2019, centners per hectare.

YEAR	Cereals (including rice) and legumes (in weight after processing)	OIL SEEDS	POTATOES	Vegetables of open ground	MELONS AND GOURDS	SUGAR BEET (in weight after processing)
2004	8,8	6,2	134,0	186,0	153,2	197,4
2005	10,0	7,0	150,0	196,0	159,3	209,2
2006	11,7	6,6	153,6	201,0	167,1	240,8
2007	13,3	7,2	155,8	211,0	171,7	248,9
2008	10,1	5,5	143,7	204,0	158,9	204,3
2009	12,6	6,5	160,0	218,7	161,1	182,9
2010	8,0	5,0	143,0	214,4	177,0	174,3
2011	16,9	6,7	167,2	222,9	186,1	188,2
2012	8,6	6,1	165,9	234,0	206,8	168,2
2013	11,6	8,0	181,5	238,7	212,4	267,7
2014	11,7	7,8	184,3	243,0	217,1	240,6
2015	12,7	8,1	185,5	245,8	221,0	232,5
2016	13,5	9,6	190,4	250,0	221,4	285,5
2017	13,4	9,7	194,2	253,7	224,2	274,4
2018	13,5	9,7	197,9	257,3	224,2	305,3
2019	12,3	9,3	203,4	260,5	234,6	324,5

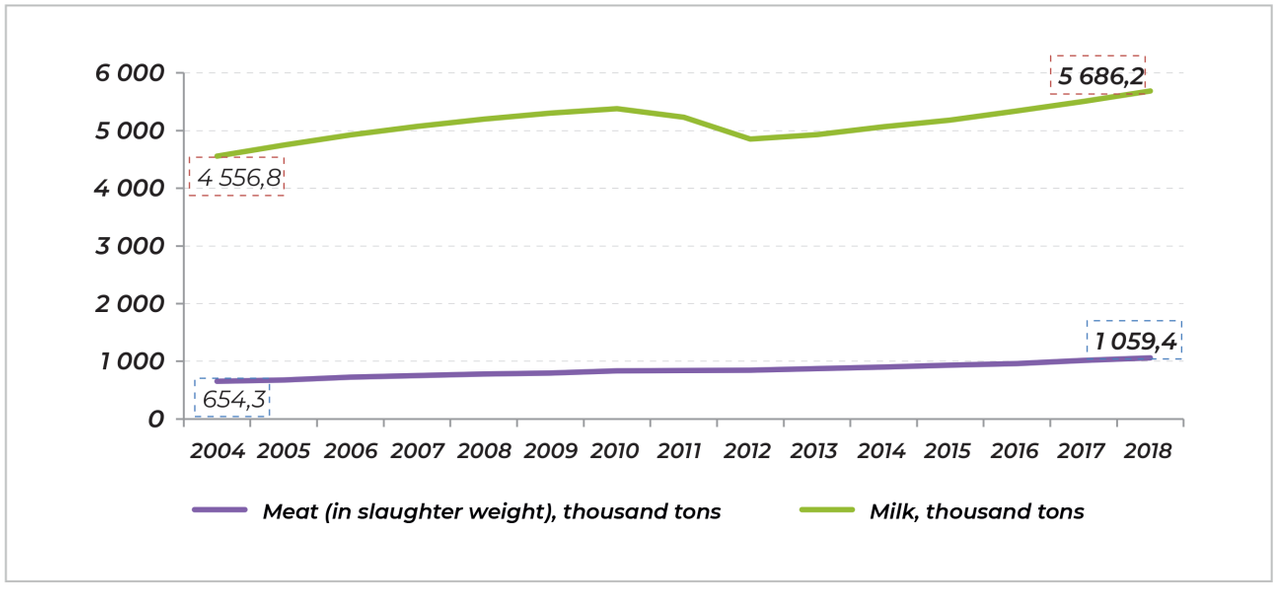
SOURCE: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan. Dynamic tables. Productivity of major crops[16]

[16] *The increase was calculated by DAMU RG on the basis of data from the Committee on statistics of the Ministry of national ECONOMY of the Republic of Kazakhstan. The dynamic table. "Yield of the main agricultural crops" according to the formula: ((final value*100%)/ initial value) -100%.*

The production of livestock products, particularly meat, during 2004-2018, steadily increased; the increase was 61.9%, and the increase in milk production for the period was 24.8%. However, it is worth noting that milk production (thsd. tons) significantly exceeds meat production (thsd.

Chart 1.6.

Production of certain types of livestock products (meat in carcass weight and milk), in dynamics, 2004-2018, thsd. tons.



SOURCE: Committee on statistics of the Ministry of National Economy of the Republic of Kazakhstan. The dynamic table. "Production of certain types of livestock products"

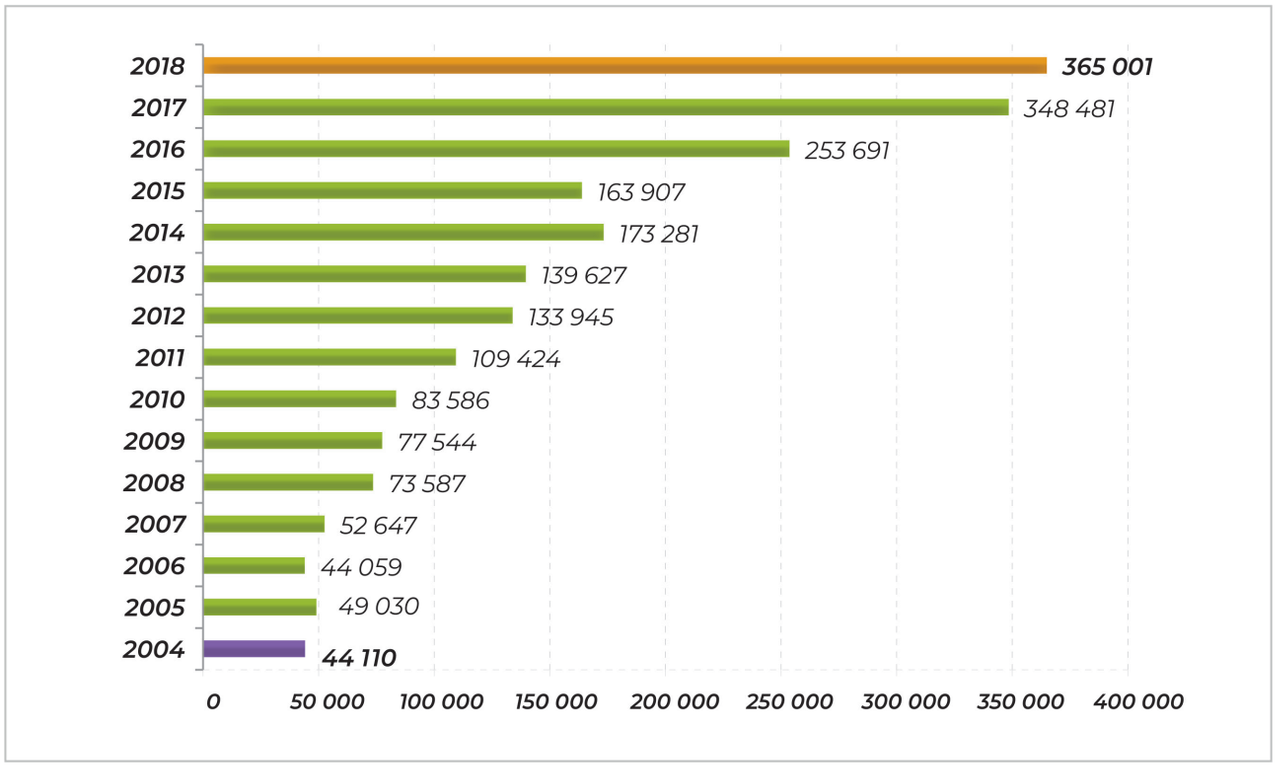
[17] *Meat in slaughter weight.*

[18] *The increase was calculated by DAMU RG on the basis of data from the Committee on statistics of the Ministry of national economy of the Republic of Kazakhstan. The dynamic table. "Production of certain types of livestock products" according to the formula: ((final value*100%)/ initial value) -100%.*

tons) in absolute terms. A significant increase in agricultural output would have been impossible without investments in the industry. Investments in fixed assets (agriculture, forestry, and fisheries) have steadily increased over the entire period 2004-2018 and increased 8.2 times.

Chart 1.7.

Investments in fixed assets by areas of use (agriculture, forestry and fisheries), in dynamics, 2004-2018, mn. tenge



SOURCE: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan. Dynamic tables. "Investments in fixed assets by areas of use"

However, there is a problem of disparity between the volume of investment in the industry and the volume of agricultural production (the economic effect of the industry).

As shown in Diagram 1.7, the annual rate of investment in agriculture often significantly exceeds the annual growth rate of 19 gross agricultural output, for example: in 2008, 2012, 2016, and 2017.

Table 1.7.

Agriculture: investments in fixed assets (in million tenge) gross output (in current prices, million tenge), in dynamics, 2004-2018

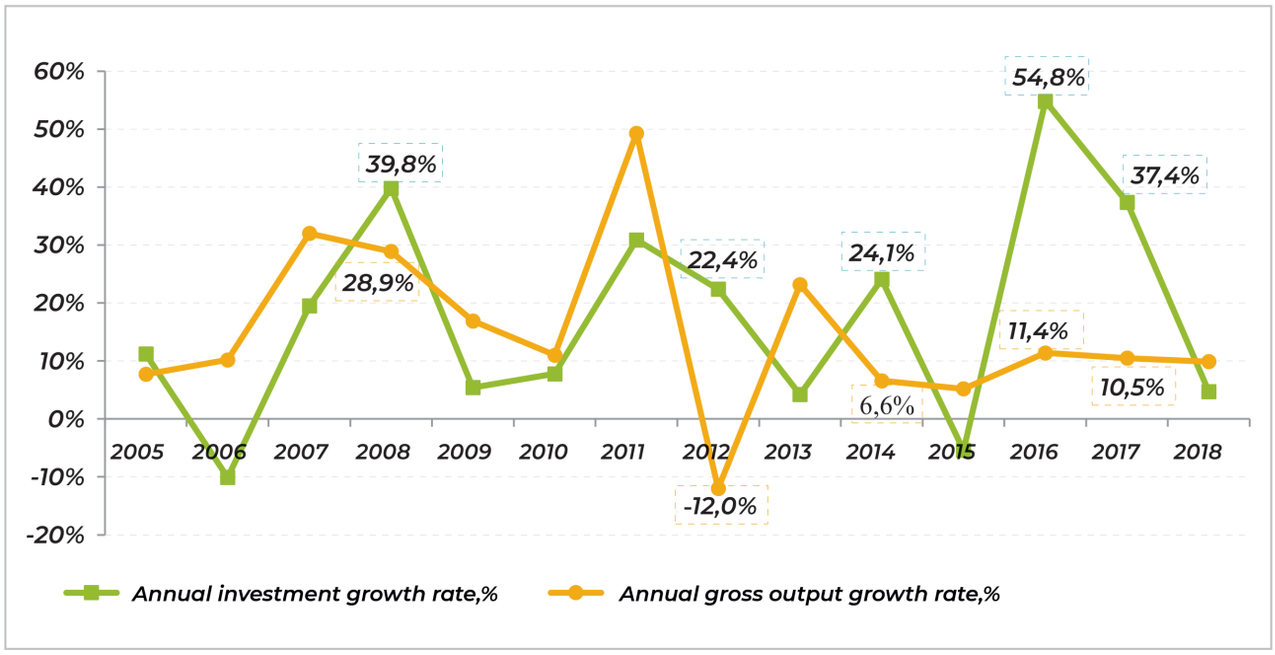
Year	Investments in fixed assets by areas of use (agriculture, forestry and fisheries), million tenge	Annual growth rate of investments in fixed assets (agriculture, forestry, fisheries), %	Gross output of agricultural products (services), in current prices, million tenge	Annual growth rate of gross output, %
2004	44 110	-	695 801	-
2005	49 030	11,2%	749 078	7,7%
2006	44 059	-10,1%	825 557	10,2%
2007	52 647	19,5%	1 089 384	32,0%
2008	73 587	39,8%	1 404 493	28,9%
2009	77 544	5,4%	1 641 352	16,9%
2010	83 586	7,8%	1 822 074	11,0%
2011	109 424	30,9%	2 720 453	49,3%
2012	133 945	22,4%	2 393 619	-12,0%
2013	139 627	4,2%	2 949 485	23,2%
2014	173 281	24,1%	3 143 678	6,6%
2015	163 907	-5,4%	3 307 010	5,2%
2016	253 691	54,8%	3 684 393	11,4%
2017	348 481	37,4%	4 070 917	10,5%
2018	365 001	4,7%	4 474 088	9,9%

SOURCE: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan. Dynamic tables. "Gross output of agricultural products (services)" and "Investments in fixed assets by areas of use"

[19] *Annual growth rates calculated by DAMU RG on the basis of the data of the Committee on statistics of MNE of ROK (data from Table 5) by the formula: ((current value – previous value) / previous value)*100*

Chart 1.8.

Annual rate of investment in agriculture and annual growth rate of gross agricultural output, in dynamics, 2004-2018, %.



PRIVATE OPINION OF EXPERTS ON AGRICULTURE IN KAZAKHSTAN

2.

SERGEI MOGILNY

(former vice-rector of S. Seifullin Kazakh Agro Technical University)

OVER THE PAST FIVE YEARS, WHAT MAJOR, IMPORTANT CHANGES HAVE TAKEN PLACE IN KAZAKHSTAN'S AGRICULTURE.

First, I would highlight the development of beef cattle breeding. Although there is much discussion around this initiative, and much remains to be done. Large investments have come in this industry. We must admit that we have achieved particular results, e.g., the number of livestock in general and the share of breeding stock, in particular, are growing, the quality of livestock genetics has improved, and beef production is increasing, especially for export markets. There are new farms, and farmers formed the basis for building a modern meat industry.

Secondly, I cannot but mention the digitalization of agriculture. Fields are being "digitized" and the monitoring of agricultural land usage switched to remote methods. Some public services related to agriculture also use electronic format now. More and more farms are using various precision farming elements, feeling the benefits of such technologies in practice. Animal husbandry widely uses automated management systems and information systems for breeding records. Most importantly, the competence in applying digital technologies in the agricultural sector is growing, and companies of the appropriate profile appear on the market.

Thirdly, I would highlight the opening of new markets for agricultural exports, particularly China and Iran. China's potential is far from being exhausted, and the steps taken to open the

market will have a large and long-term effect.

China's market is large and diversified, the demand is heterogeneous, and it can accept different products in large volumes.

The growing demand can support a further increase in production in Kazakhstan and expand the range. There may be new niches in the sales market that we have not considered before as a priority.

It is also probably worth noting the ongoing diversification in crop production. However, this policy is present for many years, and, in my opinion, the potential for diversification is far from exhausted. The production of alternative crops to wheat, such as flax, rapeseed, legumes, and forage crops, is expanding. Diversification in crop production is important because it means new opportunities for farmers, new export niches (China, for example), and more sustainable crop rotations, both economically and environmentally.

Again, these are new competencies for farmers.

IN YOUR OPINION, AT WHAT STAGE OF THE TECHNOLOGICAL CHAIN CAN WE EXPECT SIGNIFICANT CHANGES SOON?

I would again, first of all, highlight digitalization in agriculture. In a broad sense, it is an extra set of computer technologies that complement various technological stages in agricultural production as a tool for optimizing decision-making processes and improving the quality of management decisions.

This process is limitless. The range of well-known and used digital agricultural technologies in the world is vast. For example, precision farming technologies do not have borders either in theory or in practice, and their range depends only on the available resources and economic efficiency in specific conditions.

The effectiveness of digitalization can manifest itself both in the macro- and microeconomic context, and in the technological, social, and environmental aspects.

To summarize my answer to your question: digitalization can affect changes in any of the stages of the technological chain in agriculture, as well as in the technological chain as a whole, starting, for example, from preparation for sowing and ending with commodity distribution.

In crop production, I want to add biotechnological methods of selection to digitalization. So is in the animal husbandry sector. For example, breeding livestock by embryo transformation allows for more precise planning and implementation of plans for the herd's composition and size. In crop production, these can be technologies for accelerated creation of varieties and hybrids of crops, which, in particular, are already used in S. Seifullin Kazakh Agro Technical University.

Kazakhstan has developed a specific competence in agricultural biotechnology, and if this direction

is supported, the effect can be felt quite quickly (by agricultural standards) – in five years.

Opening up new markets and increasing competition within the country and in exports will certainly accelerate the penetration of biotechnology into the agricultural sector and further develop local competence in these matters.

HOW MUCH TIME WILL IT TAKE THE "DIGITAL" TO BECOME POPULAR IN THE DOMESTIC AGRICULTURAL INDUSTRY?

As I said, a rigid framework of digitalization does not exist in General. Here, the time that needs to be spent on large-scale technology development is inversely proportional to the volume of funds invested.

If we are talking about making electronic soil maps for each field, then if we allocate significant funds for this, it can be done in two or three years.

Moreover, if you wait for farmers to find the resources themselves, the process will drag on for a couple of decades. It relates to precision seeding technologies. In addition, the upgrade of existing agricultural machines with the appropriate equipment can be done relatively quickly. For example, you can upgrade existing seeders by installing GPS packages for Russian or Belarusian equipment. And if you wait for farmers to get rich and buy their own John Deer-level equipment that comes out of the factory with such equipment, it will take many years.

To sum up: we can say that everything depends on the resources. If we wait for farmers to get them, it will take more time; if there is a specific state program (even on a return basis or co-financing), changes will happen quicker. The same is with biotechnology.

However, I want to emphasize that one needs to understand what to expect from both digitalization and biotechnology before investing.
For example, you can even buy a robot tomorrow that walks around the field and uproots the weeds.

However, it is unlikely to be a profitable investment in our situation. We need a clear, detailed statement of tasks, a high quality, comprehensive strategy for their implementation, and specific indicators of what result we are striving for.

We need a strategy that says, for example, that we see Kazakhstan as a successful producer of oilseeds. A strategy that would indicate which specific oilseeds we intend to produce and for which markets. Based on this, it will become clear what production's economy should be for the business to go in this direction and successfully compete in the target market.

The next step is to determine the strategy parameters in terms of acreage, a market share that we can occupy, etc. In addition, it is necessary to build a comprehensive policy through the system, starting from training and research, finishing with subsidies and the development of related industries.

Unfortunately, we do not have such strategies. This work is neglected in Kazakhstan. In my opinion, this is the reason for the inefficiency of many seemingly correct initiatives. We always strive to get results "right now," and this does not happen, especially in agriculture. If we start developing digitalization without a strategy, it will be "burying" money in the ground. However, if, for example, we say that the goal of our policy should be to reproduce soil fertility, then our next steps will be clear: we should invest in differentiated fertilization and the creation of soil maps. Accordingly, the state and private owners should build the investment policy.

IN WHAT SECTORS OF AGRICULTURE IS THE SITUATION BETTER OR WORSE?

If you look at agriculture in details, there are four main categories of specialists:

- agronomists,
- zootechnicians,
- engineers, and
- specialists in the field of processing of agricultural raw materials.

The agronomist's mission is to implement the entire process from pre-sowing seeds and soil preparation to post-harvest processing with maximum efficiency.

The mission of a stockbreeder is to make profitable growth livestock and products (meat, milk, wool, etc.).

The engineer's job is to make the work of agronomist and breeder easier by optimal use of appropriate technical means.

The task of specialists in processing of agricultural raw materials is to increase the benefit, efficiently and efficiently produce products with the necessary properties.

These specialties have always been, and they will always be, because this is the basis of the production process in the agro-industrial complex.

Unfortunately, as far as I can remember, there has always been a shortage of specialists in these professions, their quantity and quality. The latter, in my opinion, is the most important.

There is also a large range of specialties related to agriculture in such fields as:

- veterinary medicine,
- plant protection,
- economy,
- sales,

- logistics,
- energy supply,
- the same digitalization,
- and so on.

Moreover, there too is a certain lack of specialists, especially in terms of quality. Though these specialties will not disappear, there is a problem that the content of work for each category of specialists will change and is continually changing.

Technologies are being improved, market conditions are changing, and therefore there is a demand for new competencies.

This is what I previously called the lack of specialists in terms of the quality of training. For example, at KATU, we started teaching agronomists geographical information systems (GIS), because today, they should at least read electronic field maps. These skills are necessary for agronomists to apply "precision farming" technologies. In animal husbandry, we need to train students more deeply in basic knowledge and skills in biology and biotechnological methods of animal reproduction: leaching, storage, embryo transplantation, survival assessment, and so on.
If we talk about the missing if you are interested in specializations, you can probably select the specialty "rural sociology."

For example, in the United States, graduates of this specialty are vital, highly paid specialists who help to develop agricultural policy correctly at all levels, develop rural communities, turning them into a better place for residents.

They do everything to make residents want to do their own business and develop. From the US experience, I would also adopt the specialty "Agricultural education," which trains agricultural teachers for schools and specialists-consultants for agriculture.
If we start teaching the basics of agriculture in high schools in rural areas, it will help retain talented young people in the field.

WHAT DO YOU THINK IS THE FIRST PROBLEM TO BE SOLVED FOR THE DEVELOPMENT OF AGRICULTURE?

When we worked with the University of California, Davis, a well-known professor from this University, stressed at a meeting with the Minister of Agriculture of Kazakhstan that the country had started to develop agriculture in the wrong way. We invest in livestock, fertilizers, machinery, etc., and agriculture is primarily about people.

We should have started investing in people, creating a comfortable living environment for them, educating them. Then agriculture would have begun to develop on its own.
As soon as a person has a comfortable life, they will start thinking about innovations, increasing productivity, and diversifying production. In the US, this is exactly what happens, and we

do not put the cart before the horse.

Therefore, I would do everything to radically improve the quality of life in rural areas, and turn villages into attractive places for living and business development.

First of all, I want to have high-quality roads to the nearest city from the villages, thus opening market opportunities for each villager. This is how agriculture developed in the United States, where a good road comes to almost every farm. Then, I would provide the necessary infrastructure in the villages, including water supply, sewerage, heating, permanent electricity, paved sidewalks, and streetlights. We will do this, and then doctors, teachers, and other professionals will be attracted to the village, ensuring the development of social infrastructure. Yes, it is expensive and may take a long time, but we must do it!

This is the 21 century, and most of our villages still live in the last century, if not the ancient times. We should take actions in those villages where investment projects are being implemented or planned to be implemented. We must put these places in proper conditions. Otherwise, no subsidies or other efforts to develop agriculture will produce results.

Look at the farms that everyone in Kazakhstan knows about:

- AF Rodina LLP,
- SK agro 2050 LLP,
- Ivan Zenchenko LLP – all these are very good farms with good infrastructure.

The infrastructure of the Rodina farm is no worse than in any city. Their example makes the relationship between the life quality in the countryside ("good village") and the results of production ("good economy") obvious.

I want to add that a few years ago we conducted a study that found out that young people are not willing to go to work in agriculture.

Approximately 37% of the respondents said that they want a wage up to 120 thsd. KzT per month, which can help them to conduct private farming. In addition, they need good roads to the city, modern utilities ("when you don't need to put coal into the stove three times a night in winter"), doctor, school.

Another problem is public administration in rural areas.

There is no official course that prepares rural akims in Kazakhstan. There is a State and Local Administration training program - I myself graduated from it - but its content does not provide sufficient knowledge and skills for working in rural areas as an akim.

When a person comes to a village, everything is completely different there than in a University classroom. Let us say there are only 200 people in a village, but you see them every day, and no one else can solve their problems. If there is no water,

then people go to the akim, or if something happens, and then people go to him again.

Figuratively speaking, the rural akim is the Ministry of Emergency Situations, the Ministry of Internal Affairs, and health care, and education.

Therefore, a rural akim must have appropriate communication skills and knowledge in various areas (from land management and housing and communal services to social security, law enforcement, and others). However, students majoring in State and Local Administration do not study about that and do not have those skills. We had an idea to create a special master's program for training rural akims. A few years ago, we conducted a small training on agricultural cooperation for rural akims.

They were mostly people aged 45-55 who are ready and willing to learn. They are such a grateful audience, practitioners who need specific answers to specific questions, and most importantly, they know what they want.
If we can organize a master's program – even online - for such people or offer an elective course, I think the effect will be positive.
For example, usually, universities do not include the rules for subsidizing agricultural specialistes (agronomists, animal breeders, even economists) into their curriculums.
A university graduate knows that there are subsidies, but does not know how they are distributed and applied.

There is another example. I studied public and administrative law, but in the field, when we got to the regulatory framework, I discovered new documents for me. There are hundreds of rules, ranging from budgeting to the case nomenclature. Therefore, reality is completely different.

WHERE WOULD YOU LIKE TO INVEST?

First of all, I would like to invest in rural infrastructure. As I have said before, if there are high -quality living conditions in rural areas, specialists will go there. They will start making themselves busy, thereby developing the village. Secondly, I want to invest in training agriculture specialists in colleges, universities, and the system of knowledge dissemination. I would probably invest less in certain industries making direct subsidies. Instead, I want to work more to reduce the cost of credit resources. Because substituting direct investments to market-motivated decisions of farmers is ineffective. In my opinion, the most effective investment is creating comfortable life in rural areas, so that people can live and normally work, teach people to make the right decisions, and manage their farms.

ANUARBEK URAZALINOV

EXECUTIVE DIRECTOR
OF TASK HOLDING LLP

If we talk about the current state of the industry, the main problem is the sale of agricultural products. The level of the industry now, in my opinion, is not satisfactory. Those who are goal-oriented, achieve results in agrobusiness. There are also problems with subsidies, and we do not always get proper funding. There are problems with equipment, because it is very expensive, and loans are unprofitable.

For the last 5-10 years, we have been actively developing our company, increasing the yield by introducing scientific methods and bringing new funding. But, of course, there are companies on the market that are close to bankruptcy, especially in vegetable and potato production. They have a difficult situation because these companies cannot sell their products.

It should be noted that the system of vocational training in Kazakhstan today is absent as such.

The industry has a high need for specialists in various fields:

- machine operators,
- agronomists,
- zootechnicians,
- veterinarians.

Many young people who are currently studying in agricul-

tural specialties do not want to work in the sector.

We also see staff turnover, and many good specialists are leaving abroad. We don't have time to prepare a replacement for them. Often the equipment stays unused because there is no one to work on it, and there is no one to drive a tractor.

Our equipment is very expensive, the price reaches 250-300 thsd. euros, and a stranger will not be allowed to work on such equipment. It must be a highly trained professional.

We try to train young people by the side of an experienced mechanic that they can learn from the professional. We also encourage good specialists by increasing their salaries during sowing, harvesting, and cultivating periods.

An incredible shortage of personnel is in animal husbandry. There are no enough milkmaids, stockmen, and shepherds. Of course, today, some technologies can replace people. However, until now, we hire both milkmaids and stockmen - they are still in demand. To improve and radically change the situation with professionals in the industry, it is necessary, first of all, to create, or rather restore, a system of vocational and technical education. Perhaps not to the same extent as it used to be in the Soviet Union. However, yes, we still need to have it!

Training centers should be located in every major city and regional center as well. It is easier

for young specialists to get 60 thsd. KzT in the city than 100 thsd. KzT in the village because there are no proper living conditions there. One needs to heat the stove, take care of kids because not every even small town has a kindergarten. Social and cultural life is low.

The problem is not in introducing new technologies in our company. If the technology saves money and human resources, then, of course, it is implemented, and we train our specialists to use it.
In the future, I think we will use JPS tracking for plowing, cleaning, even, perhaps, without the direct participation of the machine operator. There are technologies now that first scan the field and create electronic field maps. Some equipment with software already works independently without human intervention.

We are going to introduce some high-tech equipment in dairy production, feed production, and feedlots because new technologies can save money and human resources.

Implementation of particular technologies will have a positive effect on the entire industry. However, all these innovations are costly, and we have no domestic analogs. They are coming mainly from Europe.

If we talk about trends, we see that the world population is growing and resources are decreasing. Therefore, crops will be in demand at all times, and the need for food and nutrition will not disappear.

The current trend is to consume less but natural products, without GMOs, organic.

We can say that running an agricultural business can be a risky activity. Many factors affect a company's income, including weather conditions and competition. So not everyone will risk investing a lot in agribusiness.

Several specific problems have always accompanied farmers:

- climatic conditions,
- plant and animal diseases, but now the risks have increased.

We try to reduce the impact of climate disasters by irrigating fields, but global warming still affects us.

Plant and animal diseases have always been and will remain. However, an influx of diseases and pests grows now due to migration between countries. Today these problems are coming from outside.

Of course, we are dealing with all these inconveniences, introducing plant protection products, insecticides. Nevertheless, the nature of problems is continuously changing and this is our reality.

KOZHEVNIKOV VLADIMIR

EXECUTIVE
DIRECTOR OF THE ALE
"MILK UNION OF KAZAKHSTAN".

The level of development of dairy processing in Kazakhstan is currently quite good, especially at our large factories, such as “Food Master," "Emil," "Natizhe."

These companies use the most modern technologies and equipment. Of course, all this equipment is still imported, mainly American, Israeli, and Swiss. Neither Kazakhstan nor Russia produces such equipment for processing dairy products.

To assess the level of development of our dairy processing, just go to any store in Kazakhstan, where it is impossible to distinguish, on the packaging of our imported products. In addition, the recipes and technologies are classic, standard, but everyone has their own developments. There are various standards, state, European standards, and standards of the organization itself.

THE MAIN PROBLEM IN OUR FIELD IS THE INSUFFICIENT QUANTITY OF HIGH- QUALITY DAIRY RAW MATERIALS. THIS PROBLEM IS WELL-KNOWN, AND EVERYONE KNOWS IT. OUR HERD STRUCTURE IS ARRANGED SO THAT MORE THAN 70% OF MILK COMES FROM PRODUCERS FROM SUBSIDIARY FARMS.

We can say that we went into subsistence farming, though 25 years ago, dairy farms produced everything, everything was regulated there, and the quality of raw materials was well monitored. A cow always gives good

milk wherever it is, but the storage and transportation system is another matter.

The milk collected from small producers eventually loses its quality. Because every grandmother comes with her own bucket (washed or not, we do not know), strained or not strained milk (we do not know either), and in the process of collecting and transporting, the quality is lost.

Factories, of course, have to work very hard with this milk to bring it up to certain standards that determine the quality of milk. Of course, such milk is not expensive to buy. However, during processing, milk becomes more expensive because you need to do a complex cleaning using the separators to apply deeper, harsher pasteurization methods at the temperature of 95-97 degrees.

We do all of this to achieve guaranteed product safety indicators. Of course, many people are aware of this problem, and various programs aimed at solving it are already being introduced. Now, we have lost a good training of specialists in processing raw materials. Now we have only the Shakarim University in Semipalatinsk and the Almaty Technological University that train specialists in dairy processing.

UNTIL RECENTLY, WE HAD GREAT TRAINING QUALITY AT THE TVET LEVEL. VOCATIONAL EDUCATION AND VARIOUS TECHNICAL SCHOOLS WORKED IN PAVLODAR, EAST KAZAKH-

STAN REGION, AND SHEMONAIKHA.

UNFORTUNATELY, KAZAKHSTAN EDUCATIONAL INSTITUTIONS TRAIN A FEW SPECIALISTS.

Of course, some people go to study in Omsk, but this applies mainly to dairy production technologists.

Now we have a huge shortage of engineering and technical workers, primarily electronics engineers, because all the equipment is quite complex, especially the imported one. So we need highly trained electronics engineers, operation specialists, fitters, electronics fitters, technologists, and so on.

The company sends its young personnel for training, pays for this training, and then the young specialists undergo practical training at the enterprise. Only large enterprises can afford this practice, and not all of them, because it is expensive. Therefore, I believe that we need high-quality basic education and then improve students' skills with additional courses.

THEREFORE, I BELIEVE THAT WE NEED A HIGH-QUALITY BASIC EDUCATION, AND THEN ALREADY IMPROVE THEIR SKILLS IN ADDITIONAL COURSES.

For example, our company conducts annual courses on the safety of sanitary control and so on. We have poor training of basic specialists.

Many of our companies now use modern methods of work.
For example, the Collect Mobile is a system for tracking transport and monitoring pastures. Although this is not entirely related to processing plants, we work with utilities and farms. We try to ensure that they implement this system and track the movement of livestock, how pastures are kept, and the diet of animals. There are also robotic farms where four human operators serve more than 400 cattle heads, where everything is fully automated.

Our colleagues from Belarus came to us, we went to Croatia to watch it, and I can tell you that our products and production are no worse, and in some cases even better.

IN TERMS OF "WHITE" PRODUCTS, SUCH AS MILK AND SOUR CREAM, WE CAN FULLY ENSURE FOOD SECURITY. HOWEVER, IN TERMS OF DEEP PROCESSING, WE ARE STILL LAGGING BEHIND AGAIN DUE TO RAW MATERIALS' QUALITY. WE ARE IMPORT-DEPENDENT ON CHEESE, BUTTER, AND MILK POWDER.

THESE PRODUCTS SECTORS WE HAVE LOST OVER 20 YEARS, HAVING ONCE GONE INTO SUBSISTENCE FARMING, AND NOW WE NEED TO RESTORE IT.
FARMING, AND NOW WE

[20] *Source: "A simple IT solution for the dairy industry of Kazakhstan". http://www.fao.org/*

KAIRAT BISETAEV

CHAIRMAN OF THE ALEIE "UNION OF POTATO AND VEGETABLE GROWERS OF KAZAKHSTAN"

Our Union includes producers of agricultural products that grow potatoes and vegetables for irrigation. Our farms are mainly represented in the North of Kazakhstan and are large agricultural producers. The level of development of the industry now in Kazakhstan leaves much to be desired.

There is a global market, and there is a local market.

The local market is the countries of the former Soviet Union plus the East, which includes

- Iran,
- Pakistan,
- Afghanistan,
- India,
- China

and in this local market, unfortunately, we are losing our previously high position. In early 2000s in the post-Soviet space, we looked quite favorably against the background of Russian agriculture, Belarusian and Ukrainian.

The problems are all subjective because all objective ones affect other countries as well. State policy in the field of agriculture, which does not achieve its goals, the financial system of Kazakhstan, in which banks are in a permanent difficulty condition. They cannot properly finance the economy in general and agriculture in particular.

In the 2000s, the banking system of Kazakhstan was one of the leading in the post-Soviet space, and banks were very active.

At that time, agriculture was one of the promising sectors where people actively invested. However, after the crises of 2008-2012, banks were shaken and were forced to finance industries with much less risk and where funds turn over faster.

Agriculture still has seasonal specifics, the risks are very high, and we receive products on average once a year. It is quite clear that with the small amount of money that our banks currently have, they invest in completely different industries, not in agriculture. Therefore, our industry is experiencing a huge shortage of cash.

Agriculture and processing cannot be considered separately today. The future of Kazakhstan's agriculture mainly depends on two things. This is working capital, which we lack in any sphere of agriculture and the economy as a whole. The second point is the processing of agricultural products.

We produce much more than the domestic market requires. For the further agriculture development, we can increase the area of crops, but we do not do this because we face a problem of sales, exports constrain us, and the export of raw materials is quite difficult. Therefore, if there is no recycling, we will have nowhere to grow. We are being asked to grow, but it has come down to processing. In addition, it is needed for export.

In the era of globalization, all processed agricultural products are under large multinational companies that have huge production facilities in different countries.
Today, mini- processing at small enterprises has sunk into oblivion. So today, we need not invent a bike and make mistakes.

We need our market to become attractive to large players in processing, and they are most often owned by multinational companies, so we can reach other markets through these giants.

If it is done, our agriculture will develop without public money, without various subsidies, simply by working to meet these world giants' demand in the processing market. Moreover, the needs of these enterprises will spur the growth of the quality of our products. For example, we sell potatoes. They must be large, high quality, and with specific characteristics that processing plants require. This is how they work in the world markets. Customers' base and our competence will grow.

To attract large processors, we have several trump cards, such as stability in the country, something that is not available, for

example, in Ukraine, in Russia. In addition, there is a huge potential for land resources and good potential for water resources. This is something that can really attract multinational companies.

Staff shortages and turnover is another serious problem that we face.

If we say that there are problems with personnel in the city, then it is compounded and tripled in the village. The fact is that a young person, who is more or less clever, can work on a computer, knows technology, and a good educator would rather leave the village.

Our farm is ready to hire everyone who wants to work, but there are few. At our faculties in cities, you can see this trend: there are more girls than boys. Girls understand that their chances to study at economic, legal, or some more prestigious departments are low, and they come to us. They finish their studies, stay, and work in agricultural laboratories or other numerous organizations relating to agriculture, and there they settle down.

Today, employers in the agricultural sector prefer young personnel. Life now forces you to take anyone. They hire two or three people hoping that at least one will stay. Working in agriculture has its own characteristics that conflict with the habits of the young generation.

This generation does not want to submit to any rule, they do not want routine, need freedom, want to work creatively and hope to get an easy income.

In addition, this works well in marketing or other related sectors. However, agriculture requires a strict technological regime and discipline. You need to get up early, do something every day, and not leave whenever you want. The working day can be 10-12 hours. Moreover, today's young people are not very used to it.

In our time, the routine had its own romance. We liked to get up before dawn and work until sunset.

Regarding new technologies, many of our farms are dealing with digitalization issues.

We are now all working through Qoldau.kz, where we send an electronic map of our fields, where their borders and coordinates are indicated, and where we must enter the history of the fields. Many now use GPS, tractors work themselves, and an error is only 2-3 centimeters.

Specialists, who install this equipment, retrain tractor drivers. It is not difficult. In addition, modern equipment irrigates

[21] *https://www.qoldau.kz/*

most of our fields. The applications are installed on the phone, and a person can see how the field is watered in the system. The same happens with the climate control in our potato storage. The special equipment monitors and regulates storage conditions via an app on your phone.

Such a process is no longer a mystery for us. Of course, not all agricultural enterprises use it, but their number grows. In addition, the further you go, the better you understand that you need people who are proficient with technology. They should live in rural areas, not coming from the city.

We are ready to pay good salaries. Today, a qualified rural agronomist can receive 250 - 600 thsd. tenges per month. However, people still leave, because, in addition to a good salary, they need better living conditions.

For example, a reliable and experienced specialist, who is 32-35, has a son or a daughter 7-8 years old. Of course, he wants his children to receive a quality education, study languages. However, it is not available in many villages, and the spouse wants to go shopping in a shopping center, not in a bazaar.
The problem is not for wages. We have had individual specialists who came from the city, set up all the programs, and left. Again, that was for the villages that are close to the city.
.
As a result, I want to say that we need the right living conditions in rural areas. The other issues agricultural enterprises are ready to solve themselves.

Our industry is quite paradoxical; it seems to be located in the village, where there is much manual labor and poor conditions. You need to work 12 hours a day during the harvest season. At the same time, new technologies fit our sector quite well. Agriculture is open to receive innovations.

Therefore, if the state takes up the development of our villages, then everything else will be solved.

EXPERTS' VIEW ON THE FUTURE OF THE AGRICULTURAL SECTOR IN KAZAKHSTAN.

3.

EXPERTS' VIEW ON THE FUTURE OF THE AGRICULTURAL SECTOR IN KAZAKHSTAN.

Today, the government of Kazakhstan relies on the agricultural sector. We clearly see the future in which hydrocarbons are valued and consumed less and less, and "green" energy is slowly gaining a leading place in the developed countries, the current primary consumers of oil.

It is no longer possible to postpone the solution to the problem of diversification of the economy of Kazakhstan. That is why agriculture is assigned the role of the driver of the entire economy of the Republic. However, achieving this goal will not be easy.

The share of agriculture in the country's GDP is only 4.5%, compared to mining and quarrying – 14.4%. The industry will take on the role of the locomotive of the entire economy only if production and labor productivity in the agricultural sector grow several times. Now gross value added[23] in agriculture less the national average is only a third of the GVA for the Republic.

The industry will still rely on people's labor for the foreseeable future, so the level of wages should also increase. Currently, the average monthly wage in the agricultural sector is less than two-thirds of the national average. To overcome the long-term stagnation period when the level of investment significantly outstripped the economic effect of the industry, agriculture in Kazakhstan needs qualitative changes.

On the one hand, the key to success is people's desire to work on the land. Therefore, the quality of life in rural areas must be changed.

On the other hand, the industry's technological and technical equipment must meet the new realities of the Fourth Industrial Revolution.

Until recently, the agricultural sector has remained one of the most conservative in the world. But we see how new technologies and new ideas enrich the ancient traditions.

Future events will show whether the agricultural sector of Kazakhstan can take advantage of the Fourth Industrial Revolution's opportunities to stay afloat, get out of the vicious circle, and become the main driving force of the Republic's entire economy.

To hear the "voice" of the industry and understand the general development prospects, we interviewed more than a hundred Kazakhstani agricultural experts who work for 10 – 15 years in the industry.
For better clarity of the obtained data, we calculated a simple index ranging from -100 to +100. The legend of the index values for each forecast is below.

[22] *Source: https://forbes.kz/process/expertise/novaya_neft_stanet_li_selskoe_hozyaystvo_lokomotivom_ekonomiki_kazahstana/*
[23] *Gross value added per employee.*
[24] *For more information, see the section "Agricultural industry of Kazakhstan".*

Table 3.1.

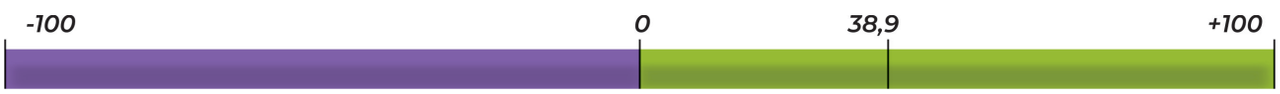
"Index Values Legend"

Forecasts	Index values from -100 to 0	Index values from 0 to +100
Forecast 1. Assessment of the future of the industry.	The ratings "Negative" and "Uncertain" prevail.	The ratings "Positive" and "Stable" prevail.
Forecast 2. Assessment of the main problems of the industry.	The ratings "Weak influence" prevail	The ratings "Strong Impact" and "Medium Impact" prevail.
Forecast 3. Estimates of the current situation in the industry.	The assessments “Crisis situation”, “Unsatisfactory situation” prevail.	The ratings "Excellent position", "Good position", "Satisfactory position" prevail.
Forecast 4. Assessment of the industry's readiness for changes.	The prevailing ratings are "Definitely not ready" and "Rather not ready"	The ratings "Definitely ready" and "Rather ready" prevail.
Forecast 5. Assessment of the impact of potential major events on the industry	The ratings "Will have a weak effect" and "Will not have an impact" prevail.	The ratings "Will have a strong impact" and "Will have an average impact" prevail.
Forecast 6. Assessment of the likelihood of future risks.	The prevailing ratings are "Low probability of risk"	The ratings "High probability of risk" and "Average probability of risk" prevail.
Forecast 7. Assessment of the likelihood of obtaining new opportunities in the industry.	The prevailing ratings are "Low likelihood of getting new opportunities."	The prevailing ratings are “High probability of obtaining new opportunities” and “Average probability of obtaining new opportunities”.

1 FORECAST
THE FUTURE OF THE AGRICULTURAL SECTOR IN KAZAKHSTAN IS POSITIVE.

The general opinion of experts about the future of the agricultural sector in the Republic is positive. However, the index value is 38.9 points, almost halfway to the zero (border), which separates the positive rating from the negative rating zone.

Figure 3.1.
"Index for assessing the future of the industry"



Since 2004, Kazakhstan continues to be a net importer of agricultural products. Moreover, the lion's share of agricultural products produced in Kazakhstan is exported as raw materials and sold with a low added cost. The industry is experiencing difficulties that do not allow it to reach the next level of development. Primarily, the living conditions in rural areas deteriorated significantly. The numbers of social infrastructure and services objects went down. Rural labor ceased to be attractive. Reduced labor markets in villages increased the outflow of people from rural to city areas. Secondly, local executive bodies' decisions on granting agricultural land are not transparent. Thirdly, the lack of "long" money contributes to the industry problems.

As we can see, the agricultural sector will have to solve the industry's accumulated problems in the near future. It is clear why experts are cautious about the future of the industry.

[25] *Source: https://www.zakon.kz/5010349-bogatoe-selo-bogatyy-kazahstan-chto.html*

2 FORECAST

THE MAIN PROBLEMS OF THE INDUSTRY THAT HINDER ITS DEVELOPMENT ARE URBANIZATION, LOW PROFITABILITY, AND FINANCIAL PROBLEMS

Some problems were tested for the degree of negative impact to identify those that may have the greatest impact on the sector's development.

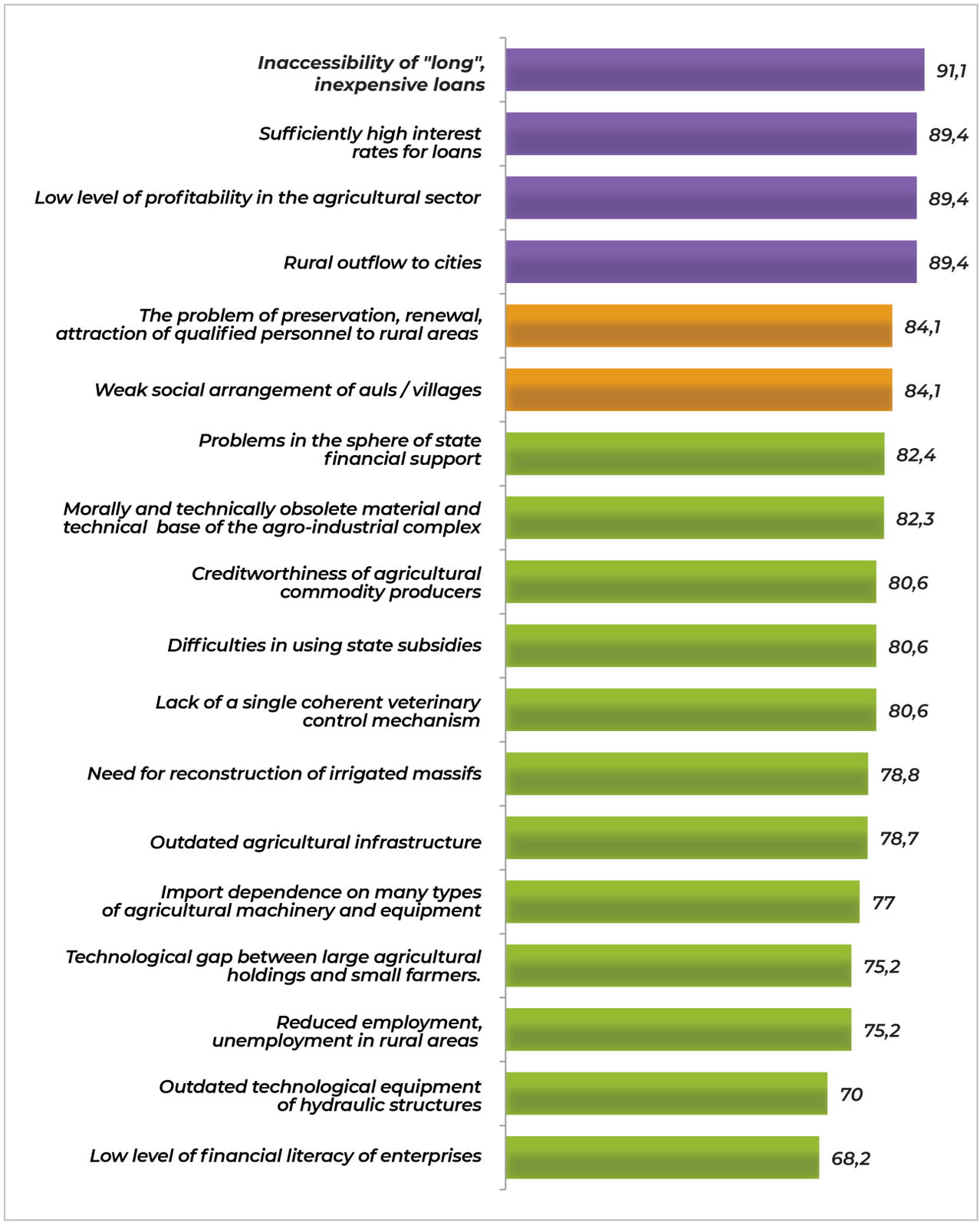
The fundamental factors that hinder the development of the industry are the outflow of rural residents to cities, the low level of profitability in the agricultural sector, high-interest rates on loans, and the unavailability of "long", low-cost loans.

Index values for almost all positions are in the zone from 0 to +100, where "Strong impact of the problem" and "Average impact of the problem" categories prevail.

In short, the urbanization processes, low profitability in the industry, and financial problems in the industry are the obstacles that will continue to hinder the industry development.

Chart 3.1.

"Index for assessing the impact of problems on the industry".[26]



[26] *The higher the index value, the more experts attached the problem a high or average value.*

3 FORECAST

THE CURRENT SITUATION IN AGRICULTURE MUST CHANGE TO INCREASE THE INDUSTRY'S READINESS FOR THE INEVITABLE CHANGES

The most vulnerable areas of Kazakhstan's agricultural sector at the moment are:

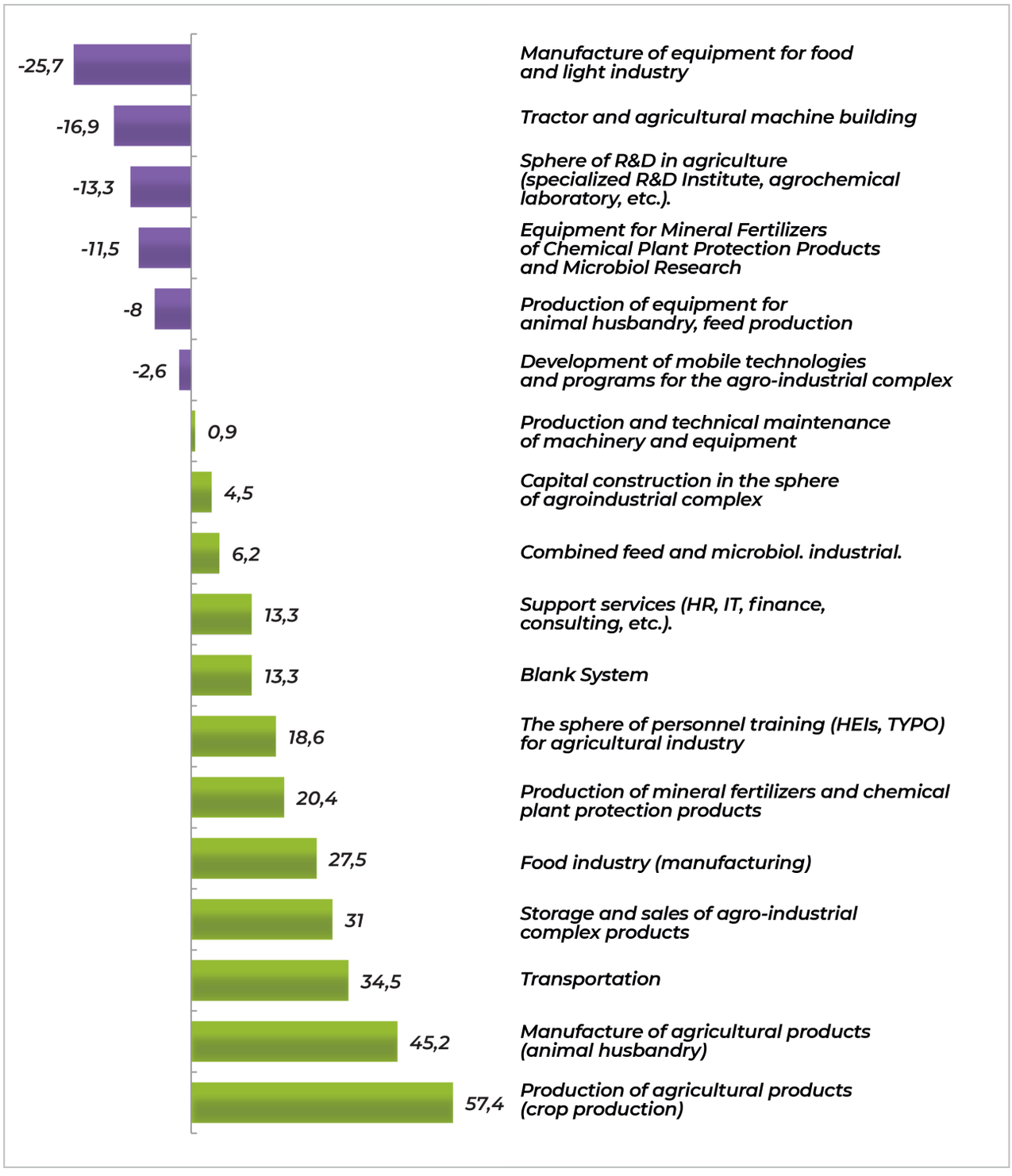
1. Production of equipment for the food and light industry,
2. Tractor and agricultural engineering,
3. R & D in agriculture (specialized research institutes, agrochemical laboratories, etc.),
4. Production of equipment for the production of mineral fertilizers, chemical plant protection products and microbiological research,
5. Production of equipment for animal husbandry, feed production,
6. Development of mobile technologies and software for use in any field of the agro-industrial complex.

THE INDEX VALUES FOR THESE SIX POSITIONS ARE THE AREAS WHERE THE RATINGS "CRISIS" AND "UNSATISFACTORY SITUATION" PREVAIL (THE ZONE OF INDEX VALUES FROM 0 TO -100).

IN SHORT, TO ENTER A NEW ERA, THE AGRICULTURAL INDUSTRY MUST ACTIVELY DEVELOP HIGH-TECH PROCESSING, ACTIVELY ESTABLISH EQUIPMENT PRODUCTION AND DEVELOP R & D IN THE INDUSTRY.

Chart 3.2.

"Index for assessing the current situation in the domestic industry". [27]



[27] *The lower the index value, the fewer experts gave a positive or neutral assessment.*

In the meantime, experts are very cautious in assessing the readiness of the agricultural industry to change, the index took a value of 18.6 points, very close to the zone of prevalence of negative assessments ("Definitely not ready" and "Likely not to be ready").

Figure 3.2.
"Index for the assessment of Industry Readiness for Change".

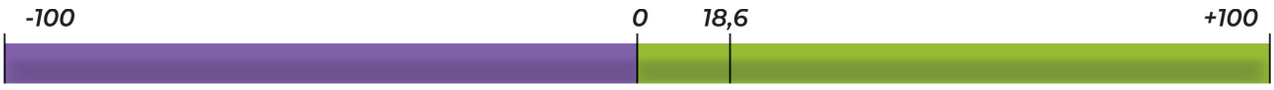
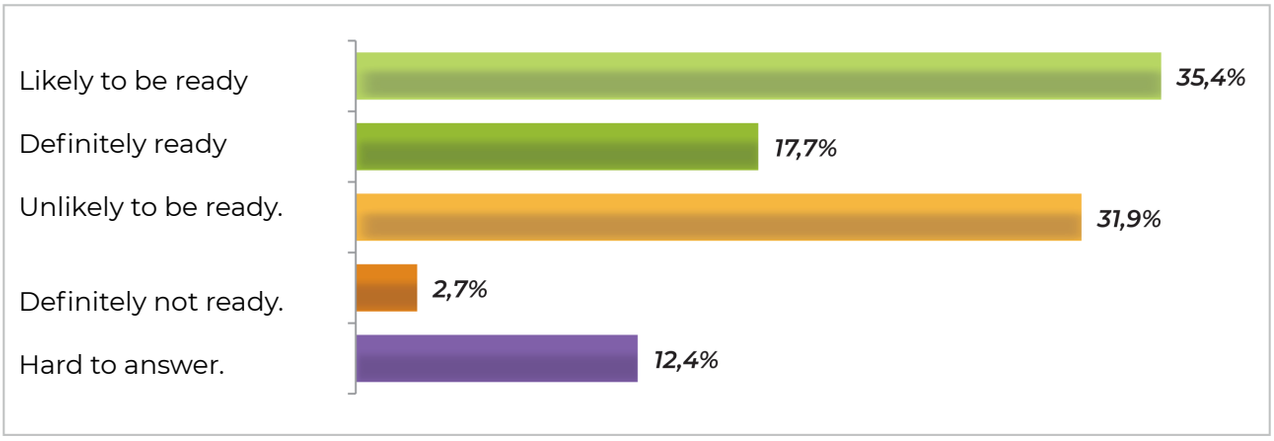


Figure 3.3.
"Do you think the agricultural industry of Kazakhstan is ready for the upcoming changes in the industry?".



4 FORECAST

THE AGRICULTURAL SECTOR WILL CRITICALLY DEPEND ON HUMAN RESOURCES, INSURANCE AVAILABILITY, AND PROPER MONITORING AND SUPERVISION BY THE AUTHORIZED BODY.

The expert community clearly points to the need to develop high-tech industries, actively establish the equipment production, and build R & D in the industry. However, all this cannot be done without qualified personnel.

Therefore, when assessing the impact of potential major events on the development of the industry in the coming years, experts primarily highlighted the transfer of the right to form a state order for training specialists from the Ministry of education and science to the Ministry of Agriculture (MoA).

According to the MoA, this "innovation will allow us to form a state order, reasonably determine the amount of funding, conduct a fair selection of universities that conduct training and, in General, correctly concentrate grants by specialty, and not disperse them".

This event will have a very strong impact on the industry: the index of 80.4 points is close to the maximum value of +100 points in the "Will have a strong impact" rating zone and "Will have a medium impact."

The formation of a state order for training specialists by the relevant Ministry and other innovations were outlined in the Law "On Amendments and Additions to Certain Legislative Acts of the Republic of Kazakhstan on the Regulation of the Agro-Industrial Complex" on the fall of 2019.

Experts are confident that many of these innovations will have a serious impact on the development of the industry soon:

- transition from subsidizing insurance payments to insurance premiums, which "will increase accessibility insurance for subjects agribusiness, because the insurance policy can be an additional security for obtaining loans from banks";
- return to the authorized body of control and Supervisory functions from local Executive bodies and customs authorities to ensure

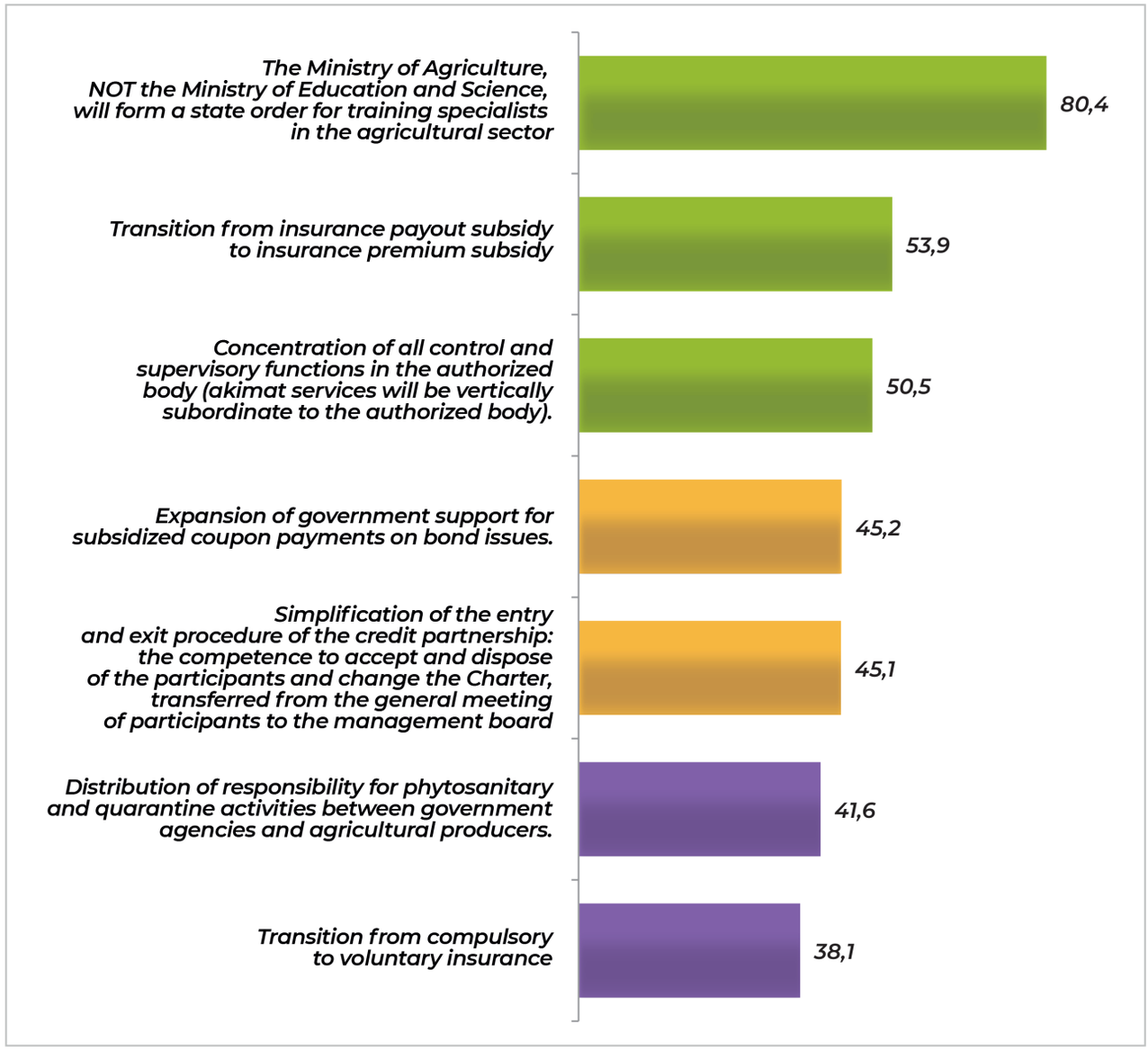
[28] *Source: https://liter.kz/13713-minselhoz-poluchil-pravo-formirovat-granty-po-selskohozyaystvennym-spetsialnostyam/*
[29] *Source: https://bossagro.kz/kazaxstan-perexodit-k-dobrovolnomu-straxovaniyu-v-apk/*

veterinary safety; now the veterinary services of local executive bodies will be directly subordinate to the MoA;

- expansion of state support through subsidizing coupon interest on bond loans, to build favorable conditions for “KazAgro” JSC loans.

Chart 3.4.

"Index for assessing the impact of potential major events on the industry".



[30] *Source: https://www.inform.kz/ru/kazahstan-perehodit-ot-obyazatel-nogo-k-dobrovol-nomu-strahovaniyu-v-apk_a3569518*

5 FORECAST

RISKS IN THE DOMESTIC MARKET ARE HIGH, AND ANY RISK CAN SIGNIFICANTLY AFFECT THE INDUSTRY IN THE FUTURE.

What are the risks of the future of the industry? What scenarios can shake the industry? We've tried to gather all the internal risks into several groups.

1ST GROUP OF RISKS. STATE INFLUENCE:

- Inefficient state regulation of the industry (for example, frequent changes in the state agriculture development program).

2ND GROUP OF RISKS. LACK OF PERSONNEL, MATERIAL, AND TECHNICAL RESOURCES:

- The shortage of personnel in rural areas will continue (for agricultural enterprises, farms).
- Most agrarian businesses, farms will NOT be able to update machines and equipment.

3RD GROUP OF RISKS. DIFFICULTIES IN THE DEVELOPMENT OF THE AGRICULTURAL SECTOR:

- Constant changes of external and internal prices for equipment, fertilizers, feed, veterinary drugs, and energy resources.
- Increase in the cost of delivering products to target markets due to critical infrastructure deterioration.
- The cost of local production will remain high.
- Kazakhstan's processing (food) industry will not receive proper development. The industry will not be able to reduce the level of dependence on imports for many types of agricultural machinery and equipment.
- The potential of organic production (in animal husbandry, crop production) will not go on a large scale throughout the industry.

4TH GROUP OF RISKS. IMPACT OF GLOBAL WARMING, THE

SPREAD OF DISEASES AND PESTS:

- Increase of desert and semi-desert lands, water scarcity, instability of weather conditions due to global warming.
- Reduced the industry's productivity, reduced export potential of the industry due to the spread of animal and plant diseases, pollution of the natural environment, spread of parasitic species of plants, animals, fish, and insects.
- Depletion of the land potential, water, and biological resources, and the genetic potential of animals, plants, and fish (as a result of the pursuit of profit, lack of funding, and non-compliance with scientific recommendations).

5TH GROUP OF RISKS. UNDEVELOPED R & D, AND PROBLEMS OF PROFESSIONAL EDUCATION:

- R & D does not meet the needs of the industry, critical deterioration of training quality (Universities, TVET).
- Financing of local R & D in agriculture will not increase, the effect of R & D will remain low.

The implementation of any risk can significantly affect the industry. The index values for all risks are higher than 70 points. They are close to the maximum value of +100 points in the "Average risk probability" and "High-risk probability" ratings. Experts agreed that the sources of the greatest danger to the industry are the cost rise of delivering products to target markets, inefficient state regulation of the industry, and changes in external and internal prices for equipment, fertilizers, feed, and veterinary drugs and energy resources.

[31] *The higher the index value, the more experts believe that the probability of risk occurrence is high or medium.*

Chart 3.4.

"Index for assessing the likelihood of risks in the industry." [31]

6 FORECAST

THE AGRICULTURAL SECTOR SHOULD AND CAN TAKE ADVANTAGE OF NEW OPPORTUNITIES FOR ITS DEVELOPMENT.

How can the agricultural industry prevent the implementation of negative scenarios? How to respond to potential risks in the industry? What new opportunities can agricultural companies get?

According to experts, three opportunities that the agricultural industry can and should take advantage of will contribute to its development shortely:

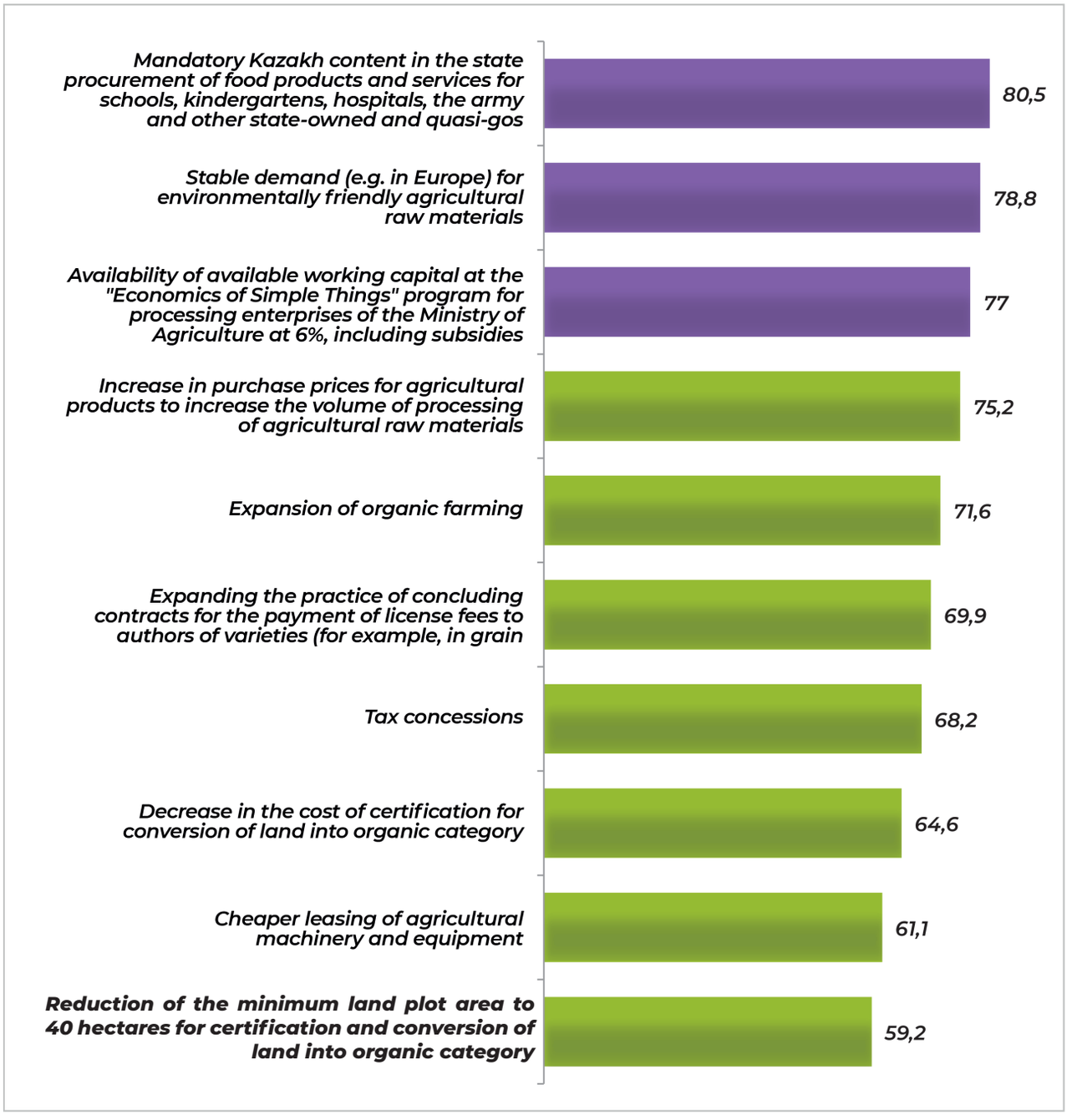
- Provide processing enterprises of the MoA with available working capital under the program "The Economy of Simple Things" at six percent, taking into account the subsidy;
- Stable demand (for example, in Europe) for organic agricultural raw materials;
- Mandatory Kazakhstani content in state purchases of food and nutrition services for schools, kindergartens, hospitals, the army, and other state and quasi-state organizations.

The index value for these three positions came close to the maximum value of +100 points in the rating area;

- "High probability of getting new opportunities"
- " Average probability of getting new opportunities»

Chart 3.6.

«Index for assessing the likelihood of new opportunities for companies in the agricultural sector»[32].



[32] *The higher the index value, the more experts believe that the probability of new opportunities for companies is high or medium.*

GLOBAL AND SECTORAL TRENDS IN THE AGRICULTURAL INDUSTRY

4.

4.1.
MODERNIZATION OF THE INDUSTRY WITH A FOCUS ON DIGITAL TECHNOLOGIES

In the modern world, the boundaries between the physical, digital and biological worlds are blurred. This is the essence of the Fourth industrial revolution ("industry 4.0"), which we are witnessing.

The synergy of new achievements, e.g., artificial intelligence (AI), robotics, Internet of things (IoT), 3D printing, genetic engineering, quantum computing, etc., creates a wave of technologies under The Fourth Industrial Revolution, which changes people's daily lives and radically transforms entire industries and industries economies.

The influence of the phenomenon of "Industry 4.0" on the agricultural sector is still minimal. The industry still has to rework the value

chain-from the work of crop and livestock farmers in the field to the processing of agricultural products-under the influence of new technologies.

However, we can already say that some of the Fourth Industrial Revolution's fundamental technologies are also being applied in the agricultural sector. The introduction of some new technologies does not require significant financial investments and quickly pave the way to the industry. Innovations can only be available to major players in the market due to their relatively high cost.

Of all the technologies that are already being used or are just beginning to be used in the global agricultural industry, only some are likely to come to Kazakhstan in the medium term. Let us explain the reasons for this selectivity. In 2018, almost half of the total production of agricultural products (services) fell on the personal farms of Kazakhstanis. Nearly a third of the total volume of products (services) produced) - peasant or farm farms. Agricultural enterprises accounted for just over twenty percent of the total. At the same time, the volume of investments in domestic agriculture amounted to only 3.27% of the total investment in fixed assets.

Objectively, Kazakhstan's agricultural sector is ready to adopt technologies that do not require significant financial expenditures.

Digital technologies are primarily among these rapidly penetrating innovations. The rapid penetration of digital technologies is also facilitated by the state's understanding of the importance of digitalization of the economy of Kazakhstan (The Digital Kazakhstan program was adopted in 2017).

Turning to the global trends in the agricultural industry, which are inextricably linked with the phenomenon of "industry 4.0" and the introduction of new generations Y and Z to the market, we can distinguish the following several trends.

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[33] *Read more in the section "Agricultural industry of Kazakhstan".*

TREND
THE GROWING DEMAND OF THE AGRICULTURAL INDUSTRY FOR TECHNOLOGICAL RENEWAL

Agriculture in the twenty-first century must meet several formidable challenges: meet the growing demand for food for the growing world population, preserve existing land, water, and biological resources and protect them from complete depletion, and do all this against the backdrop of global warming.

To solve these problems, agricultural producers need to apply innovative approaches to increasing productivity. It must be done within the framework of sustainable development.
In fact, the Fourth Agricultural Revolution or Agriculture 4.0 has already begun. Each previous agricultural revolution of its time was radical. The first one represented a transition from hunting and gathering to sedentary agriculture; the second one was the British Agricultural Revolution of the XVIII century. The third one or the post-war productivity growth associated with mechanization and the Green Revolution in developing countries. Technological innovation, therefore, is nothing new for agriculture.

Modern technologies, such as the Internet of things, cloud computing, robotics, and AI can change agriculture beyond recognition.

Kazakhstani experts during the foresight sessions noted the importance of the technological renewal of the agricultural industry in Kazakhstan.

AGRICULTURE SHOULD BECOME ONE OF THE MAIN DRIVERS OF ECONOMIC GROWTH IN THE REPUBLIC. THEREFORE, THE SCIENTIFIC AND TECHNICAL COMPONENT OF THE INDUSTRY SHOULD PROVIDE AGRICULTURAL PRODUCERS WITH NEW MODERN DOMESTIC TECHNOLOGIES AND SCIENTIFIC SPECIALISTS (A MICROTREND "GROWING NEED FOR THE RESULTS OF THE DOMESTIC SCIENTIFIC DEVELOPMENTS FOR AGRICULTURE").

We want to add that the new technologies of the Fourth Industrial Revolution are primarily digital technologies. Let us take an example of the following industry trend called "Growing demand for digitalization of the agricultural industry" and consider the relationship between data and the agricultural industry.

[34] *Source: https://www.frontiersin.org/articles/10.3389/fsufs.2018.00087/full*

2 TREND
GROWING DEMAND FOR DIGITALIZATION OF AGRICULTURE

Agriculture is finally entering a new technological era. The onslaught of digitalization in the industry is growing all over the world.

Although players in the agricultural industry are still confused and cautious about changes and new technologies, it is already necessary to develop a digitalization strategy to stay on the crest of the wave in the future.

Methods of "smart" agriculture are already being used: differential application fertilizers, pesticides, and herbicides determining the optimal time for planting crops, for example, using Cortana, a Microsoft's Intelligence Suite, robots and AI in dairy production, electronic field maps, unmanned tractors for plowing fields, drones for identifying weeds and robots for removing them.

Agribusiness around the world is increasingly interested in ensuring that the Fourth Agricultural Revolution's innovations are developed and implemented faster and on a larger scale. The growing demand for food can be satisfied only using new technologies.

For example, AgFunder, a venture capital company from Silicon Valley, focused on startups in agrifood technologies. The company's ecosystem includes more than 75 000 participants and subscribers all over the world.

The company's Technology Department has formed a knowledge base that consists of almost 30,000 startups in the field of agrifood technologies. Specialists in this Department creates AI and machine learning algorithms to help the company's investment team identify as fully as possible new investment opportunities. With the help of AgFunder, 499 agricultural technology companies attracted $ 4.6 bn. in investment in 2015, which is almost twice the amount invested in 2014[36].

[35] *Source: https://www.pma.com/~/media/pma-files/tech-trends/technology-trends-2016.pdf?la=en&la=en*

Another example from Europe. The UK's Secretary of State for Business recently announced a £ 90 million investment to bring about a “tech revolution” to transform food production, putting the UK at the forefront of sustainable agriculture. Greece has announced the digitization of agriculture, with a particular focus on Big Data and the Internet of Things. Most of the investment will go to the development of "smart" technologies, their use will increase exponentially over the next ten years. Similar agro-technological revolutions are predicted around the world, for example in Japan, other parts of Asia, Ireland and Australia. [37]

During the foresight sessions, Kazakhstani agricultural experts also noted the “growing demand for digitalization” as an important industry trend. Micro-trends were highlighted: the growing demand for the implementation of software for monitoring the entire technological chain, the growing demand for robotics in the food and processing industries.

Microtrends were identified: the growing demand for the implementation of software for monitoring the entire technological chain, the growing demand for robotics in the food and processing industries.

[36] *Source: https://research01.agfunder.com/2015/AgFunder-AgTech-Investing-Report-2015.pdf*
[37] *Source: https://www.frontiersin.org/articles/10.3389/fsufs.2018.00087/full*

EXAMPLES OF TECHNOLOGIES AND TRENDS USED

Now let's take a closer look at technological innovations that are already used in the agricultural industry or are just beginning to be used.

COVER CROP

According to the 2017 agricultural census, the crop area increased in US $ to 15.4 mn. acres. This trend is likely to continue due to their role in soil health, nutrient regulation, and carbon sequestration. "Agriculture is the only industry that can prove that it can capture more carbon than Mother Nature already does," says Lowell Catlett, a former economist at the University of New Mexico.

CARBON FARM

In the next decade, private companies or government programs will be willing to pay farmers to keep carbon in the soil. Farmers will switch to No-Till sowing, where the destruction of the soil structure is minimal. The global carbon quota market is estimated at 160 bn. US dollars, according to the study Refinitiv.

HYPER-ACCURACY

Precision farming allows you to maximize profits by using the exact amount of resources to maximize profits. According to the company's data Grand View Research, the global precision farming market is expected to reach $ 10 bn. by the middle of the decade. Experts say that combining these investments with technological advances, data processing, and AI will spur continuous innovation.

MICROBIAL AGRICULTURE

Microbes such as bacteria, fungi, and protozoa have the potential to increase field productivity. Many fields could be more productive if they had an optimal supply of nutrients. Bacterial enzymes could improve the situation, but they are often too unstable to have a long- term effect. However, solutions to this problem already appear on the market. According to MarketsandMarkets research data, the agricultural microbe market will be worth $ 6 bn. by 2022.

5G INTERNET

More than 40% of the world's countries do not have access to the Internet. As investment in rural broadband and 5G deployment flows in, there will be new opportunities for connected farms on the Internet. In ten years, the industry will be run by people (generation Z), who did not know the world without modern digital technologies.

SENSORY REVOLUTION

New sensors help monitor and manage livestock and crop production. David Hanson, a biology professor at the University of New Mexico, attaches needle-sized sensors to plant leaves monitoring of intracellular fluid. He hopes that one day he can only give the plant as much water as it needs.

THE INTERNET OF THINGS AND THE BLOCKCHAIN

By the middle of the decade, connected devices could exceed 75 bn. In the next decade, everything from cattle to fields will be connected to the Internet. Data collected and transmitted over the Internet will need its language and will need constant monitoring. Blockchain will help keep all this in an orderly and manageable way and allow farmers to share data with other farmers securely.

ARTIFICIAL INTELLIGENCE

AI and machine learning algorithms will help farmers sift through data to get valuable information to improve efficiency, productivity, and yield.

CRISPR (GENE EDITING)

Using the bacterial immune system to edit or cut and replace DNA sequences, CRISPR-Cas9 allows for faster and cheaper genetic changes. The revolutionary system will help protect plants from droughts, diseases, or insects and help people fight cancer or eliminate genetic diseases.

GENOME SEQUENCING (NEW PLANT AND ANIMAL TRAITS)

Over the past decade, scientists have completed sequencing many of the world's most important food genomes. Sequencing of plant and animal genomes has a huge potential for use in agriculture. This specific knowledge, combined with advances in genetics, can be used to develop stronger, drought-resistant, disease-resistant, and insect-resistant crops, improve the quality of livestock, which will make them healthier, more resistant to diseases and more productive.

PRECISION ROBOTICS

The evolution of low-cost sensors, advanced GPS, and self-learning machines is helping robots become mainstream. Some of these robots are big, clunky, and expensive today, but robotics will become much smarter thanks to sensor technology, artificial intelligence, and 5G con-

nectivity in the next decade. Nowhere is robotics more evident than on American dairy farms. According to research conducted by the company Wintergreen Research, by the middle of the decade, the production volume of milking robots will be 30 bn. US dollars.

MICROBES (ENDOPHYTES) INSTEAD OF NITROGEN FERTILIZERS

Nitrogen is necessary for plants to develop naturally. Mineral nitrogen fertilizers are currently widely used in crop production. Much natural gas or coal is used for their production, and a huge amount of carbon dioxide is emitted. However, you will not be able to do without nitrogen fertilizers, as the yield will decrease by half. Therefore, scientists are exploring the possibility of using certain microorganisms that convert nitrogen from the air into a form that it is absorbed by plants (nitrogen fixation). According to a report by the American Academy of Microbiology, microbes can reduce the use of pesticides and fertilizers by 20% in 20 years.

RECOGNITION TECHNOLOGY

Increased computing power combined with machine learning and artificial intelligence helps farmers track every animal movement. The software can detect lameness or abnormalities in the animal's condition about two days before a trained animal technician can do it.

Recognition technology helps to track the state of animal health and monitor the treatment of animals by technicians.

Fitness trackers: fitness tracking is now finding its application and in animal husbandry. With the help of trackers, you can track feed or forage consumption, monitor your health status, and predict the probability of calving.

PLANT PROTEIN REVOLUTION

By the end of the decade, laboratory-grown and plant-based proteins had made their way to the meat market. The global market for vegetable proteins, which in 2019 comprised from 8 to 18.5 bn. USD, is projected to reach 40 bn. USD by 2025. It is expected that the proportion of vegetable proteins will be 2-3%. This will be a significant volume, both physical and financial. Some of the largest agricultural companies, e.g., Cargill, ADM, and DuPont, are already targeting the vegetable protein market.

[38] *Source: https://aggeek.net/ru-blog/mikroorganizmy-vmesto-azotnyh-udobrenij*
[39] *Source: https://www.agprofessional.com/article/20-mega-trends-2020-and-beyond*

EXAMPLES OF TECHNOLOGIES PROPOSED BY KAZAKHSTANI EXPERTS

Professionals of the domestic agricultural industry made several accents, discussing at foresight sessions the spread of digital technologies and other new technologies in agriculture Kazakhstan:

- robots;
- 3D printing;
- monitoring of technological process:
- blockchain,
- drones,
- specialized software;
- artificial intelligence, satellites,
- equipment;
- nanoparticles are in the package; embryo transplantation KRS;
- information databases.

The technology group “Robots" includes:

- Milking robots in animal husbandry.
- Robot veterinarians in animal husbandry.
- Robots for performing non-specialized, monotonous, heavy work, such as stacking goods in pallets.

The 3D printer technology group includes:

- 3D printers, for example, for creating spare parts for equipment in production

The technology group "Technological process monitoring" includes:

"BLOCKCHAIN":

- Blockchain combined with chipping: enable the consumer to trace the entire chain through a QR code or barcode production of a product / product, starting from the cultivation of plants/ animals to the appearance of the product/product on the counter; or online тbroadcast of the technological process, for example, broadcast of the entire milk production process from pasture to "milk bottle".

"DRONES":

- Drones for monitoring the process of processing raw materials and the general condition of the enterprise, as well as for the consumer to monitor the process of processing agricultural products.
- Drones for monitoring and increasing pasture yields (creating a solid feed base).

AND ALSO:

- Chipping of animals (refusal of tags) to track the location of the animal: facilitates breeding registration, prevention of theft of animals
- Monitoring the safety of beehives located in mountainous, dangerous areas using drones, remote control, video recording, etc.

The group of technologies "Specialized software, artificial intelligence, satellites, equipment" includes:

- Artificial intelligence (AI) for dairy farms:

AI collects information using sensors, video cameras, and other devices, analyzing and providing results and forecasts for technological processes (for example, milking, reproduction, health status, feeding, productivity, staff work, etc.).

- Artificial intelligence (AI) for food production

(in combination with the automation/robotization of processes and data analysis): for example, the specialist creates a recipe-ready product, and the AI analyzes and determines compliance recipe to regulation (standards, etc.).

- Sensors, ultrasound sensors, boluses collection status information
- Software for developing / calculating the feeding ration of farm animals and birds (in combination with equipment for preparing and distributing feed).
- Software, equipment, and remote control for automatic metered syrup filling for bee feeding (beekeeping).
- Geoinformation technologies for precision farming.
- Virtual warehouse: facilitates the search and sale of goods, using special gadgets, barcodes/ QR codes that allow you to see complete information about products.
- Permanent weather stations: a specific weather forecast for a specific area of the field. A weather station consists of sensors, sensors, a server, and a user with a gadget.
- Autopiloted agricultural machinery.

The group of new (non-digital) technologies includes:

- Vacuum packaging with nanoparticles for dairy products: there is no need to use antibiotics; products can be stored for up to six months.
- Embryo transplantation to increase the livestock.

[40] *https://milknews.ru/longridy/prostymi-slovami/prosimi-slovami-isskusstveniy-intellekt-na-molochnoy-ferme.html*

The group of technologies "Information databases" includes:

- Specialized software in combination with a single database (local and international) for selecting cattle producers (for example, bulls).
- "Cloud" technologies for food producers. Those in Kazakhstan who wants to create a product for export in accordance with the norms and standards of the importing country. Information about Kazakh products is available in the cloud for consumers in the importing country. They can make sure that the imported product is from Kazakhstan, the product meets the norms and standards adopted in their country.
- Database of agricultural enterprises of the Republic and their clients, which is administered by the relevant state body. Entrepreneurs can use this database to get complete information about state rules, requirements, norms, etc. for the product and production of the product and the sales market (potential customers).
- Electronic source of information on interchangeable raw materials. The database contains proven laboratory data on the properties of "new" products, such as detailed information about soy meat, its differences from natural meat and useful properties. Information can be presented in video or audio format (podcasts), using virtual reality or voice assistant.
- A digital platform administered by a relevant government Agency that allows to regulate the interaction of science, production and sales in the industry.

THE AGRICULTURAL INDUSTRY IS VITALLY INTERESTED IN TECHNOLOGICAL RENEWAL; SOME TECHNOLOGIES ARE ALREADY AVAILABLE. NOW LET US LOOK AT WHAT SPURS THE AGRICULTURAL BUSINESS TO START WORKING IN A NEW WAY. AMONG THE DRIVERS OF NEW SOLUTIONS AND CHANGES FOR THE BETTER ARE LOW PROFITABILITY, LACK OF STAFF, DEPLETION OF NATURAL RESOURCES.

4.2.
CLIMATE CHANGE AND THE DEPLETION OF RESOURCES IN THE INDUSTRY

***Climate change.** According to the latest estimates from the Intergovernmental Panel on Climate Change (IPCC), published in 2014, the level of anthropogenic greenhouse gas emissions is at its highest ever. Agricultural production and its impact on land use are the main sources of these emissions.*

The effects of climate change are expected to be mostly negative in low-and middle -income countries, where millions of people depend on agriculture and are vulnerable to food insecurity.

In their latest assessments, IPCC experts have stated with a high degree of confidence that climate change will permanently and negatively affect yields in countries close to the equator. In Northern latitudes, the impact of global warming on agricultural production is more uncertain; there may be both positive and negative effects. If the volume and frequency of precipitation change significantly, as well as the frequency of droughts and floods, then yields will generally decrease.

Of course, higher temperatures can improve crop growth, but according to research, yields are significantly reduced if the daytime temperature exceeds a certain value.

One possible solution to this challenge is an agronomic adaptation[41].

However, the effectiveness of this adaptation varies from region to region, depending on the specific conditions. Using the same agronomic adaptation practices can produce opposite results in regions with different impacts made by climate change.

The IPCC notes that agronomic adaptation can increase yields by an average of 15-18%.

The results of efforts to adapt to climate change will depend on how fully small-scale producers in the industry begin to use sustainable land, water, fish, and forest management methods in their work.

GLOBAL WARMING AND THE DEPLETION OF NATURAL RESOURCES IS INTERRELATED.

THE PLANET IS NOT ABLE TO SUPPORT CURRENT PRODUCTION AND CONSUMPTION PATTERNS. WITHOUT SIGNIFICANT GLOBAL ACTION, AVERAGE TEMPERATURES ARE PROJECTED TO RISE BY MORE THAN TWO DEGREES. CELSIUS – THE THRESHOLD AT WHICH SCIENTISTS BELIEVE SIGNIFICANT AND POTENTIALLY IRREVERSIBLE ENVIRONMENTAL CHANGES WILL OCCUR. AT THE SAME TIME, PRESSURE ON RESOURCES WILL INCREASE SHARPLY[42].

3 TREND
GROWING DEPLETION OF NATURAL RESOURCES

According to forecasts, agriculture will experience a growing shortage of natural resources until 2050. Increased competition for these resources can lead to the overexploitation, while irrational use will lead to environmental degradation. Moreover, the development of this scenario can create a destructive cycle in which resource degradation leads to increased competition for the remaining available resources, leading to even greater

[41] *For example, the use of irrigation or fertilizers*
[42] *Source: https://www.pwc.co.uk/issues/megatrends/climate-change-and-resource-scarcity.html*

degradation of nature.

More than a third (33%) of all agricultural land in the world is depleted, with the degree of depletion varying from moderate to high depletion. The degradation of farmland is particularly severe in drylands, negatively affecting the quality of life of the local population and the state of ecosystems in these regions. To date, there are few opportunities for further expansion of agricultural areas.

Moreover, most of the remaining land cannot be put into agricultural production, which will involve great environmental, social, and economic risks.

The intensity of natural resource usage ("load on natural resources") will depend not only on changes in consumer demand but also on climate change.

Precipitation and temperature values are predicted to vary significantly with climate change, all of which will lead to droughts that are more frequent. This will significantly affect small-scale farms irrigated by rain in mountainous areas and the tropics.

These farms account for 80 percent of the world's arable land and produce about 60 percent of the world's total agricultural output. In many areas with low precipitation, for example, in the Middle East, North Africa, Central Asia, India, and China, farmers use most of the water resources leading to serious depletion of rivers and aquifers. Given these restrictions, the expansion rate of irrigation land is significantly slowing down (growth will be 0.1%). It is interesting to note that irrigated land in the world increased at a rate of 1.6% worldwide between 1961 and 2009 year[43].

Kazakhstani experts during the foresight sessions also noted the depletion of natural resources as one of the key trends in the agricultural industry. A microtrend "the increase in the number of polluted reservoirs in Kazakhstan due to oil products and heavy metals" was also highlighted.

NATURAL RESOURCES ARE NOT THE ONLY RESOURCE THAT IS NEEDED FOR PRODUCTION IN THE AGRICULTURAL SECTOR. PEOPLE WHO LIVE AND WORK IN RURAL AREAS ARE ALSO VITAL CAPITAL. LET US TAKE A CLOSER LOOK AT THE SITUATION WITH LABOR RESOURCES IN THE NEXT INDUSTRY TREND CALLED "REDUCING THE NUMBER OF EMPLOYEES IN THE AGRICULTURAL INDUSTRY."

[43] *Source: Food and Agriculture Organization of the United Nations, Rome, 2017. The future of food and Trends and challenges agriculture стр.37.*

4 TREND
REDUCTION IN THE NUMBER OF EMPLOYEES IN THE AGRICULTURAL SECTOR

According to the World Bank estimates[44], in many middle-income countries (Kazakhstan belongs to this group of countries), as well as in high-income countries, the absolute number of agricultural workers has decreased over time.

The population in rural areas consists mostly of adults and older people. The shortage of agricultural labor in some sub-sectors has become a feature of the agricultural landscape at certain points in time.

Over the seventeen years of the new century, the share of people employed in agriculture in Kazakhstan decreased from 36.12% in 2000 to 18.05% in 2017, according to estimates of the International Labour Organization. The same processes are taking place in the world as a whole, in OECD and CIS countries (table 4.1

Table 4.1.

Dynamics of employment in agriculture, 2000-2017 (% of total employment)[45].

	2000 year	2017 year	Absolute change	Relative change
The whole world	39.01%	26.47%	-12.54%	-32%
OECD member countries	6.84%	4.71%	-2.13%	-31%
Kazakhstan	36.12%	18.05%	-18.08%	-50%
Uzbekistan	39.81%	21.91%	-17.91%	-45%
Kyrgyzstan	49.72%	26.69%	-23.03%	-46%
Turkmenistan	26.20%	8.24%	-17.96%	-69%
Russia	14.49%	6.70%	-7.79%	-54%

SOURCE: International labour organization, ILOSTAT database.
Data received on June 21, 2020.

[44] *Source: Luc Christiaensen, Zachariah Rutledge, J. Edward Taylor. World Bank Group. Policy Research Working Paper 9193. The Future of Work in Agriculture.*
[45] *Source: https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=AM*

includes only some of them).

Among global trends is the reduction in the number of people employed in the agricultural sector against the growing demand for food products.
Whatever the specific response to this challenge, measures to increase agricultural productivity should be at the heart of any solution. Investments in agriculture aimed at increasing profitability should be carried out in parallel with labor withdrawal from the industry.

Historically, agricultural productivity has increased in today's high-income countries, investment in infrastructure, marketing, and road construction has contributed to the outflow of rural labor. Competition between agriculture and other industries for workers has intensified. All this has led to the fact that the level of wages in the agricultural sector has become comparable in other sectors of the economy[46].

DURING THE FORESIGHT SESSIONS, KAZAKHSTANI EXPERTS ALSO NOTED THE "REDUCTION IN THE NUMBER OF EMPLOYEES IN THE INDUSTRY" AS A KEY TREND. A MICROTREND "REDUCING THE INTEREST OF RURAL YOUTH IN WORKING IN THE AGRICULTURE OF KAZAKHSTAN" WAS HIGHLIGHTED.

As we can see, the reduction in the number of people employed in agriculture will not be a serious problem in itself if this trend is offset by an increase in the profitability of production through the introduction of new technologies.

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[46] *Source: Luc Christiaensen, Zachariah Rutledge, J. Edward Taylor. World Bank Group. Policy Research Working Paper 9193. The Future of Work in Agriculture.*

5 TREND
THE SLOW-GROWING PROFITABILITY OF THE INDUSTRY DOES NOT MEET THE GROWING NEEDS FOR FOOD, FEED, FIBER AND BIOENERGY

Data from the Economic Research Service of the US Ministry of Agriculture shows that the aggregated Total Factor Productivity (TFP) of the industry is not growing fast enough to meet the steadily growing demand for food, feed, fiber, and bioenergy needed in 2050.

The world's TFP rate is growing at an average rate of 1.63 percent per year. In order to double the volume of agricultural production due to productivity growth, the TFP indicator should be 1.73 percent[47].

Maintaining the growth in agricultural production will be more difficult than in the past due to climate change, depletion of natural resources, insufficient investment in agriculture, and technological backwardness. If farmers continue to use outdated management methods, more land and water resources to increase production, it will inevitably put even more pressure on natural resources that are already under threat from climate change. The key to sustainable growth is to use the land, labor, and other resources more efficiently. Innovations are designed to solve two main tasks: to increase the efficiency of agricultural production and to preserve and conserve natural resources.

DURING THE FORESIGHT SESSIONS, KAZAKHSTAN EXPERTS HIGHLIGHTED THE FOLLOWING MICROTRENDS AIMED AT IMPROVING THE ECONOMIC EFFICIENCY OF THE INDUSTRY:

- "the growing need for accessible and understandable financial instruments for agriculture",
- "growing demand for domestic breeds of cattle and MDD,
- the need for their breeding and selection",
- " the growing need to expand the market for Kazakh agricultural products»,

[47] *Source: https://globalagriculturalproductivity.org/wp-content/uploads/2019/01/2019-GAP-Report-FINAL.pdf*

- "the growing need for accessible and understandable financial instruments for agriculture",
- "diversification of agricultural production: the growing need for the development of domestic beekeeping as an export-oriented industry".

FOR KAZAKHSTAN, THE MOST OPTIMAL SOLUTION, WHICH IS ALREADY GAINING MOMENTUM, IS THE DEVELOPMENT OF "GREEN" AGRICULTURE.

THE INDUSTRY'S EFFORTS ARE LIKELY TO FOCUS ON THE DEVELOPMENT OF THIS TREND IN THE NEAR FUTURE.

4.3.
COURSE ON GREENING

6 TREND
THE GROWING POPULARITY OF "GREEN FARMING"

According to the International Federation of Organic Farming movements in 2018[48], organic farming was practiced in 186 countries around the world. On the eve of the new Millennium, in 1999, only 11 mn. hectares were organic agricultural land in the world. Almost twenty years later, in 2018, 71.5 mn. hectares have already become organic agricultural land. In 2018, the most organic agricultural land was in the following regions of the world: Oceania (36 mn. hectares, the half of the world's agricultural land) and Europe (15.6 mn. hectares, 22%).

Latin America has 8 mn. hectares (11%), followed by Asia (6.5 mn. hectares, 9%), North America (3.3 mn. hectares, 5%), and Africa

[48] *https://www.ifoam.bio/ Source: FiBL & IFOAM – ORGANICS INTERNATIONAL THE WORLD OF ORGANIC AGRICULTURE STATISTICS & EMERGING TRENDS 2020 / https://www.fibl.org/fileadmin/documents/shop/5011-organic-world-2020.pdf*

(2 mn. hectares, 3%). Despite an almost sevenfold increase in organic agricultural land area from 1999 to 2018, the share of organic land in the total area of agricultural land was only 1.5% (in 2018). In parallel with the expansion of organic land, protected and other non-agricultural land increased[49]: in 1999 – 4.1 mn. hectares, in 2018 – 35.7 mn. hectares.

The number of organic producers increased from 200,000 in 1999 to 2.8 mn. in 2018. Organic products market in 2000 the year was estimated at 15.1 bn. euros, and in 2018 – 96.7 bn. euros. For 2018, the total area of organic agricultural land worldwide increased by 2.02 mn. hectares or 2.9%.

The increase occurred in all regions of the world. In two countries, the area of organic land increased the most: in France, the area of "organic" increased by 16.7% (more than 0.27 in Uruguay - by 14.1% (almost 0.24 mn. hectares).

By regions of the world, the dynamics of increasing organic agricultural land is as follows[50]:

- in Europe, the area increased by almost 1.25 mn. hectares (an increase of 8.7%),
- in Asia, the area grew by almost 8.9% (0.54 mn. hectares),
- in Africa, the area grew by 0.2% (more than 4,000 hectares),
- in Latin America, the area grew by 0.2% (13,000 ha),
- in North America, growth was more than 3.5% (almost 0.1 mn. hectares),
- in Oceania, the area grew by 0.3% or more than 0.1 mn. hectares.

Organic farming is actively developing in Kazakhstan.

According to the International Federation of Organic Agriculture Movements, in 2018, Kazakhstan was ranked 37th in organic agricultural land areas out of 186 countries where "organic" is developing (table 4.2).

The rating leader is Australia with 35,687,799 hectares set aside for organic land. Let's remind that "organic" is 71 514 583 hectares in the world.

Kazakhstan exports organic farming products to the European Union. From 115 countries that export organic products in the EU, Kazakhstan is in 15th place (table 4.3.). The leader of this rating is China, which supplied the EU with 415,243 tons in 2018.

DURING THE FORESIGHT SES-

[49] *Other non-agricultural land: beekeeping, aquaculture, forests and pastures on non-agricultural land.*
[50] *Data for 2018. Data source: FiBL & IFOAM – ORGANICS INTERNATIONAL THE WORLD OF ORGANIC AGRICULTURE STATISTICS & EMERGING TRENDS 2020 / https://www.fibl.org/fileadmin/documents/shop/5011-organic-world-2020.pdf*

Table 4.2.

Dynamics of employment in agriculture, 2000-2017 (% of total employment)[51].

Rating	Country	Hectares
№1	Australia	35'687'799
№3	China	3'135'000
№7	USA	2'023'430
№16	Russia Federation	606'975
№37	Kazakhstan	192'134
Total in the world:		71'514'583

SOURCE: The Research Institute of Organic Agriculture (FiBL)
2020 survey, based on information from the Private Sector, Certification Bodies and Governments

Table 4.3.

Import volume of organic agricultural products in the EU in 2018 in the context of supplying countries (data are given for 21 countries out of 115).

Rating	Country	Tons[19]	Country's share in total EU organic imports (%)
№1	China	415'243	12,7
№7	USA	170'753	5,2
№15	Kazakhstan	50'250	1,5
№21	Russia Federation	34'069	1,0
№51	Australia	3'388	0,1
Всего в мире:		3'258'532	100,0

SOURCE: TRACES/European Commission 2019

SIONS, KAZAKHSTANI EXPERTS IDENTIFIED TWO MICROTRENDS OF GREEN INDUSTRY: "THE GROWING NEED FOR PROCESSING ANIMAL AND POULTRY WASTE" AND "INCREASING DEMAND FOR ECO-FRIENDLY PACKAGING IN THE FOOD AND PROCESSING INDUSTRY, THE GROWTH OF RECYCLING AND CONVENIENCE OF PACKAGING PROCESSING".

Organic farming is steadily gaining strength and popularity in the new Millennium. Kazakhstan's agricultural industry has already found its place in this global movement. It is safe to say that the trend will only increase under the pressure of new ideas from generation Y and Z.

[51] *Ton in the metric system.*

EXAMPLES OF TECHNOLOGIES PROPOSED BY KAZAKHSTANI EXPERTS

During foresight sessions, local agricultural experts pointed out a few topics discussing greening the industry in Kazakhstan. Among them are Green Technologies, Waste Processing, and Resource Conservation.

The Green technologies group includes:

- Green technologies: biopesticides, biofertilizers, destructors.
- Expansion of the development, production, and usage of eco-containers for food packaging, with subsequent processing of eco-containers.
- Biologization of agriculture: industrial production of bio humus and development of vermiculture.
- Improve soil fertility through Microbiology.

AN INTEGRAL PART OF NATURE AND GREEN FARMING, WHICH IS DEVELOPED IN, OF COURSE, THERE ARE BEES, THEIR ROLE IN MAINTAINING LIFE IS DIFFICULT TO OVERESTIMATE. IN ADDITION, BEES ARE A KIND OF INDICATOR OF ENVIRONMENTAL CLEANLINESS AND SAFETY OF THE NATURAL ENVIRONMENT.

Therefore, Kazakhstani experts have identified beekeeping technologies in a separate block:

- Conveyors for automatic printing of honeycombs in beekeeping, lines for pumping honey.
- Use of permaculture technologies for beekeeping: planting and growing honey plants for the production of organic honey.

- Honey conveyors for planting honey plants for continuous production of bee products.
- Biotechnologies for keeping bees in industrial apiaries, for example, the use of elite queens raised by genetic selection, especially equipped hives.
- Breeding technology for breeding species of honeybees, also including the breeding of bees domestic breeds.
- Technologies for the production of honey wines: the microelements of honey contained in this wine are useful for digestion and immunity.
- Monitoring the health of bees and the bee family (hive as a whole): track the temperature of bees to get information about the disease, and bees' readiness to fertilize.

The group of technologies "Waste Processing" includes:

- Processing of farm animal waste, such as technologies and equipment for producing biogas using anaerobic bacteria.
- Processing of down-feather, bone, blood, and the raw material for the production of animal feed origin.
- Filtration of contaminated water using microorganisms for animal watering.
- Use of proteins and enzymes for feed production from waste from grain processing and other industries (for example, barley wort, beer pellets).
- Waste-free production/ reduce waste to a minimum. For example, whey left from cheese production will be processed into beverages for people with lactose intolerance or used in cosmetology.

The Resource Saving technology group includes:

- Water-saving technologies: injection irrigation, drip irrigation, hydroponics (low-volume hydroponics), the effect of drizzling rain in feed production, vegetable growing.
- A number of technologies noted by Kazakhstani experts are already known and widely used, but these technologies are still important for agriculture in Kazakhstan:
- Targeted diagnostics and management of soil fertility, taking into account the biological characteristics of crops,
- Zonal technologies for soil fertility management
- Integrated technologies for managing ecological and meliorative processes on irrigated lands;
- Technology for developing meadow-salt complexes for creating pastures and hayfields using a paraglider.

4.4.
THE COURSE ON GREENING

7 TREND
THE GROWING NEED FOR A NEW GENERATION OF PROFESSIONALS AND WORKERS IN THE INDUSTRY

Agriculture worldwide is facing a challenge: increasing productivity in a sustainable development environment in a changing climate. Technological innovations and environmental values of the 21st century will contribute to the development of agriculture in a new direction. However, for all these changes to occur gradually in the industry, you still need people who work in the fields and farms.

We have already said that the outflow of people from rural areas – this is a global trend. However, if no efforts are made to attract the younger generation, this sector may experience a crisis that it will not solve. People in agriculture are still irreplaceable.

An example from the UK can illustrate the situation in the industry. A new study by Barclays Bank has shown that Britain

could be on the brink of a crisis in agriculture if the younger generation does not come to farming. The study found that the average age of farmers in the UK is 55, and the number of people under the age of 25 running farms continues to decline. In fact, over the past ten years, the percentage of those who are under 25 and manage farms has fallen by 63%. In the most agricultural region, for example, in Wales, where 88% of the land is used for agriculture, only 3% of farmers are under 35. The future of the industry is uncertain, as only 3% of people under the age of 30 believe that working in agriculture can provide the desired career[52].

In the technologically advanced United States, agriculture is part of the national identity and remains an important part of the American economy. In 2020, 3.19 mn. people worked in agriculture, fishing, and forestry (of which 1.13 mn. were employees, and the rest were farmers and their families)[53], and in 2019, the industry's gross output was $ 449.8 bn. However, the problem of attracting workers to the industry is also relevant for American agriculture. The low unemployment rate in the United States has added to the desperation of employers who are trying to find American workers willing to do manual labor, which is still plentiful in agriculture.

For many years, the response to the lack of labor in the US agricultural sector has been legal and illegal seasonal workers from Mexico and Central America[54].

However, the trends inherent in the agricultural labor market work equally for everyone, including migrants from less developed countries, searching for higher earnings. After a few years of working in fields and farms, many migrants who start their careers as agricultural workers in the United States, move to other sectors of the American economy. The unattractive nature of the agricultural sector means that fewer young migrants want to work in agriculture. As a result, the average age of immigrant agricultural workers increased by five years between 2008 and 2018[55].

Heavy manual labor, seasonal work, and attachment to land and animals all make agriculture less attractive in the eyes of young people compared to other sectors of the economy. It is interesting to note that the situation is not radically different in countries with varying economic development levels. The trends are actually the same. The new Millennium technologies are designed to cope with this problem, possibly by automating and robotizing production[56].

[52] *Source: https://www.agrirs.co.uk/blog/2019/01/britain-under-pressure-to-attract-more-young-people-into-agriculture*
[53] *Source: https://www.ers.usda.gov/topics/farm-economy/farm-labor/#size*
[54] *Source: https://www.bea.gov/data/gdp/gdp-industry*
[55] *Source: https://www.washingtonpost.com/world/the_americas/with-fewer-undocumented-workers-to-hire-us-farmers-are-fueling-a-surge-in-the-number-of-legal-guest-workers/2019/02/21/2b066876-1e5f-11e9-a759-2b8541bbbe20_story.html*
[56] *Source: https://www.ers.usda.gov/topics/farm-economy/farm-labor/#size*

8 TREND
CONSUMER PREFERENCES CHANGE UNDER THE INFLUENCE OF GENERATION Z

Generation Z is a new generation entering the labor market, and it is a new generation of consumers. The Z people, let's call them so, are very different from the post-war generation, generation X, and even from generation Millennials, first of all, for their values.

Let us take a closer look at who these people are and their difference in the example of the American segment of this generation. Currently, generation Z accounts for more than 25% of the total US population (representatives of generation Z now more than "baby boomers" or "Millennials"). This is the most ethnically diverse and tech-savvy generation in U.S. history.

Today, in 2020, they will make up 40% of all consumers. One day they will have the greatest purchasing power.

Why are these people different from other generations? The Z -people were born in a culture dominated by social media with access to technology and information. They have a much broader view of the world and a deeper understanding of the cultural and environmental burden on their shoulders. This generation clearly understands that the consumerist attitude to nature destroys the balance of planetary ecosystems. On a personal level, it brings more discontent and frustration.

How do the values of the new generation affect their consumer behavior? Research from Barclays shows that generation Z consumes 57% more tofu and 550% more non-animal milk (such as soy or almond milk) than the Millennials.

Many of them are part of a growing movement of the flexitarians[57] who consciously choose only rare consumption of meat and animal products. Almost 65% of the generation Z believe that plant-based food is more attractive and 79% are more likely to give up meat consumption altogether or reduce it to 1-2 times a week.

[57] *A flexitarian is a person who eats a predominantly vegetarian diet, but sometimes also eats meat or meat products.*
[58] *https://www.hartman-group.com/*

According to studies by the Hartman Group[59], young people moving to high school become more likely to eat a plant-based diet. The Hartman researchers believe that this trend will not weaken over time, and the popularity of plant-based food will only grow. If you understand the new generation's consumer preferences, it will become clear how to feed the world in the future.

- ***Generation Z cares about the well-being of people, animals, and the planet.*** Food brands that reflect these values use fresh plant-based ingredients grown "green" in the fields and greenhouses, and work with consumers through social networks, are more likely to become popular.
- ***The new generation's dietary preferences are more diverse*** than previous generations: they like food from different parts of the world.
- Being digital natives, the combination of social networks and e-Commerce for generation Z is the most convenient form. This generation values the convenience of online shopping and ***quick access to food via smartphone or tablet.***
- ***Generation Z values honesty***; marketing tricks cannot fool them. They will check all the seller's claims using the opinions of experts, influencers, watching videos on YouTube, and reading reviews on social networks. They value truth, not brand loyalty, so you can earn the trust of a new generation of customers only if you openly talk about the ingredients, the supply chain, and the impact on the environment, and so on[59].
- ***A new consumers' generation values fresh local products.*** Continued urbanization means that fresh food must quickly reach the city center.
- Millennials and generation Consumers are increasingly aware of the production seasonality and want to buy ripe, locally grown

[59] *Source: https://eftp.co/news/generation-z-future-of-food*

products. Processed foods are no longer in fashion. If farmers can deliver fresh produce to consumers in the city immediately after harvest, they will sell their products at higher prices.

- ***Consumers of the new generation value organic plants and origin animals grown on "green" farms, humanely.*** Organic products that do not contain GMOs, grown in free-range, in fields, using alternative energy, and on farms without a destructive impact on nature, will become increasingly important.
- ***The younger generation is changing the food landscape*** and the farm. To meet Millennials' and generations Z's requirements, farmers will need to produce more than a variety of products, track and certify them, and deliver fresh products to consumers in a simplified supply chain.
- Farmers investing in certification and technology now will benefit as soon as the Millennials and generation Z will take a dominant position in the economy[60].

DURING THE FORESIGHT SESSIONS, KAZAKHSTANI EXPERTS NOTED THE IMPACT OF CHANGING CONSUMER PREFERENCES ON AGRICULTURE IN KAZAKHSTAN. THE FOLLOWING MICRO-TRENDS WERE HIGHLIGHTED: "THE GROWING DEMAND FOR HEALTHY, FUNCTIONAL NUTRITION," "THE GROWING POPULARITY OF HOME-MADE PRODUCTS (CRAFT PRODUCTION, SMALL-BATCH PRODUCTION)."

As Kazakhstan experts focused on the following technologies:

- A specialized mobile app as a tool for developing correct eating habits ("healthy food"): the app recommends the diet based on the physical and social settings of the user (e.g., age, health, rod classes, etc.). Using the app, a user can analyze the composition of a dish and the degree of nutritional value (influence on health) of the food ingredients.
- Mobile laboratories to help craft production, for example, to simplify and speed up the certification process for products produced by a small bakery or cheese factory with a small production run. A mobile laboratory arrives at the production site, collects the required samples, and sends them to certification centers.

[60] *Source: https://agfundernews.com/changing-consumer-preferences-will-impact-the-farm.html*

5. THE IMAGE OF THE FUTURE AND FORECASTS FOR THE DEVELOPMENT OF THE AGRICULTURAL INDUSTRY IN KAZAKHSTAN

THE IMAGE OF THE FUTURE AND FORECASTS FOR THE DEVELOPMENT OF THE AGRICULTURAL INDUSTRY IN KAZAKHSTAN

Who shapes the future of a particular industry, and what forces influence the development of events?

First, the global MEGA trends that we discussed above. However, to complete the picture, it is necessary to consider the activities of companies, the dynamics of the spread of new technologies, and the role of the state. Many companies make up the industry itself. The spread of technologies worldwide is a major source of techno-

logical development and economic growth. The state, in turn, sets rules of the game that are mandatory for all market participants. The main "fabric" of the industry is still companies and their customers.

Previously, it was believed that the main and only goal of a particular company or corporation is profit making. But as the Fourth Industrial Revolution spreads, more and more business leaders take into account not only the interests of their corporations and take responsibility not only for the private interests of shareholders and stakeholders in the industry.

The new understanding of their role was revealed by world business leaders first at the Business Round table of the American Nonprofit Association, and then at the World Economic Forum in Davos in 2019.

The CEOs of the leading American corporations describe new working principles of their companies in the changing conditions of the 21st century this way, "... along the process of joint and sustainable value creation, the company serves not only to its shareholders, but to all stakeholders including employees, customers, suppliers, the local population and society all in all..."[61].

In short, companies are already guided in their work by something more than winning the competition and achieving a high EBITDA value.

When will this global movement ("Corporate social responsibility"[62]) begin to determine the vector of a particular industry development, for example, the construction industry? In fact, this is already happening.

In the fourth section of the Atlas, we told you, dear reader, about the global trends such as "The course for greening" and "Generation Y and Z and their rules of the game". Along with other MEGA trends, these forces are already in action; they already make an impact.

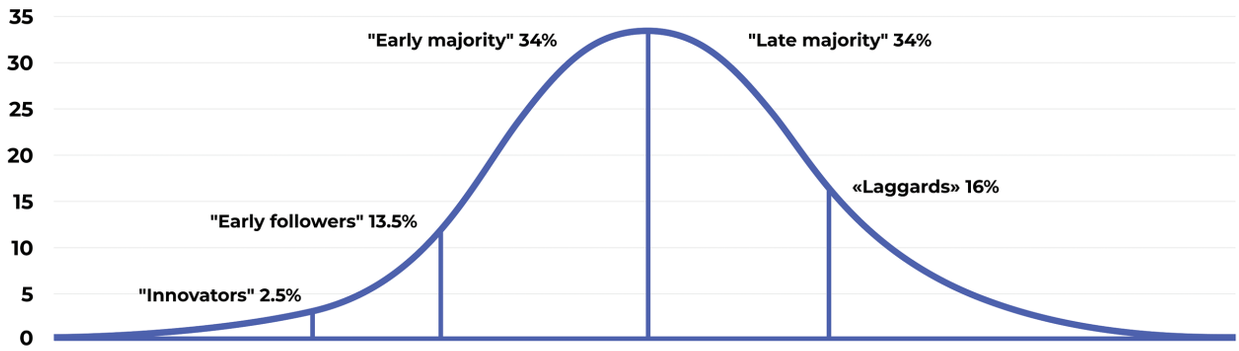
The awareness of the 21st century and the Fourth Industrial Revolution reality have already been achieved in the business community and society. It is now vital to adopt as many new technologies as possible that will allow specialists and industries to work within the new paradigm. In addition, here we come closer to the problem of introducing innovations.

Let us make a reservation right away that the primary sources of new technologies are a small number of developed countries that concentrate main efforts in research and development. This, in turn, means that most countries frequently rely on the introduction of technologies borrowed from abroad.

[61] *Source: https://www.weforum.org/agenda/2019/12/davos-manifesto-2020-the-universal-purpose-of-a-company-in-the-fourth-industrial-revolution/*
[62] *Source: https://www.unido.org/our-focus/advancing-economic-competitiveness/competitive-trade-capacities-and-corporate-responsibility/corporate-social-responsibility-market-integration/what-csr*

Figure 5.1.

Five Stages of Diffusion of Innovation by Everett Roges.



This is the current situation in the world.

For example, the OECD countries, which are mainly European, most often borrow new technologies.

Moreover, in most countries of the world, productivity grows to 90 percent or more depending on the availability of new technologies. Thus, the nature of technological change worldwide and the level of labor productivity depend largely on the scale of technology spread.

Under the right circumstances, new technologies will be distributed by diffusion, i.e., the transition from one technology or product to another occurs under a sigmoid, or cumulative, normal distribution.

According to Everett Rogers' classification, who formulated the theory of innovation propagation, there are five stages of innovation propagation.

At first, the speed of innovations is very low. Only 2.5% of the professional community in the industry adopt new technologies. These are innovators.

Then comes the connected companies (about 13.5% of them), which appreciate the benefits of innovations in the industry. Only after that the benefits of innovations disseminate widely in the industry, the massive introduction of new technologies begins ("earlier majority" and" later majority"[63]).

What should be the "right circumstances" for the innovation to unfold completely?

- First of all, the new technology should really be signifi-

[63] *The classification of Everett Rogers is given. Diffusion of Innovations (2003).*

cantly superior to the idea, program, or product than the one to replace.

- Second, the innovation must be consistent with the values, experience, and needs of potential participants.
- Third, the innovation should not require significant efforts for understanding and implementation.
- Fourth, the innovation can be tested or experientially used before its implementation becomes mandatory.
- And the last is innovation should produce tangible results[64].

Now is the time to reveal the role of the state in the process of placing or erecting barriers to new technologies. The government can actively promote the introduction of new technologies or completely block this process. For example, suppose the state is interested in promoting new technologies. this often happens on projects commissioned by the government or in areas where there is state participation (for example, air transportation). Subsidies are also an effective tool if the state is interested in the new technology being mastered "from scratch."

So what does the government's desire or unwillingness to help the process of innovation penetration depend on? The answer is simple and obvious. Barriers are erected when lobbying efforts by stakeholders outweigh the benefits of introducing new technologies.

However, the effect will be more destructive if the state, for some reason, considers the penetration of new technologies undesirable.

At the same time, the government fixes the existing status quo with specific measures (for example, laws or tariffs) to protect these interests.

We can explain the resistance to new technologies from specific interest groups that they own the assets that are intended for existing technologies. Another reason is a possible significant loss that innovations can bring to those groups[65].

Armed with the tools, let us first try to analyze the overall outlook for developing the construction industry in Kazakhstan in the medium term.

[64] *Source: http://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/BehavioralChangeTheories/BehavioralChangeTheories4.html*
[65] *Source: Technology Diffusion and the International System by Helen V. Milner, Princeton University and Sondre Ulvund Solstad, Princeton University*

THE GENERAL OUTLOOK FOR DEVELOPING THE AGRICULTURAL SECTOR IN KAZAKHSTAN FOR THE NEXT 10-15 YEARS.

All the forces that shape the industry's future in economically developed and politically free countries are standard or basic models.
Of course, it is not quite right to try this basic model on the Kazakhstan realities. We just will not get a live scenario of developments in the industry. Therefore, we will try to select those elements from the basic model relevant to our country.

In general, the company's basic model in its work considers its profitability and the interests of society as a whole. However, the Kazakh model focuses on the performance issue. However, at the same time, the Kazakh expert community already understands that the depletion of natural resources and the introduction of new technologies[66] will not change the domestic agricultural industry.

The adoption of new technologies worldwide remains an important resource for improving the productivity of the domestic industry. The technological advances of the Fourth Industrial Revolution will help. In this regard, our situation is no different from most countries in the world. However, there are certain nuances that we will consider later.

It is hard to define clearly the role of the state in promoting new technologies in Kazakhstan. On the one hand, at the end of last year, the President of Kazakhstan, in his Message, noted the need for an increase of irrigated area to 3 mn. hectares by 2030. The Government should fully support farmers in searching for and developing of foreign markets for their products, moving from the export of agricultural raw materials to the export of developed products[67]. On the other hand, the presence of latifundia and their negative role

[66] *Based on the data of a quantitative survey of agricultural industry experts conducted within the framework of this project (B. 21).*

are apparent[68].
After considering the impact of all factors on the development of agriculture in Kazakhstan in the medium term, such as megatrends, industry trends, companies' activities, the spread of new technologies, the state role, the special emphasis should be on such factors as:

- the industry profitability,
- staffing of the industry[69].

The problem of low profitability of the industry[69] has been relevant for many years. It is time now to solve this problem. The time for the proper diversification of the Republic economy has already come because oil rent will cease working in 10-15 years. However, over time, the issue of low returns to domestic agriculture will not be resolved by itself.

Moreover, the industry's resources of extensive development will soon be exhausted, and the problem of increasing the economic return of the industry will become more acute than ever. The industry itself and the government will realize that the problem needs to be solved by other means, namely, introducing new technologies and creating opportunities for technological re-equipment of medium and small farms.

Specific steps along the way efforts are already being made, for example, to promote precision farming and agricultural cooperation.

Another point. We can say that the agricultural sector of Kazakhstan uses the last opportunities to remain labor-intensive at the expense of capital intensity. So far, production relies more on human labor (especially in small and small farms) and less on new technologies (a new generation of machinery, equipment, digital technologies).

However, the further we push the forecast line, the more acute the industry transition becomes from a labor-intensive model to a capital-intensive one. What is the reason for this? Already, the population of Kazakhstan is considered to be aging according to the UN methodology. In 2019, the share of Kazakhstanis over 65 years of age exceeded the barrier 7% threshold[70] and amounted to 7.5%[71].

It means that fewer young people are entering the labor mar-

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[67] *https://primeminister.kz/ru/news/reviews/realizaciya-poslaniya-prezidenta-rk-v-apk-uvelichenie-investiciy-i-rost-proizvodstva-produkcii-zhivotnovodstva*
[68] *https://zonakz.net/2019/11/14/prezident-rk-ob-izyatii-zemel-u-latifundistov-rabota-prodvigaetsya-krajne-medlenno/*
[69] *Source: https://forbes.kz//process/property/stroitelstvo_v_usloviyah_krizisa/?*
[70] *Source: https://books.google.kz/books?id=A9DsejBZY8EC&pg=PA133&lpg=PA133&dq=7+per+cent+aging+population+UN&source=bl&ots=UUVdB41k8M&sig=ACfU3U1-H1I2mTkx0Pj-QQ_2djjsjx-QqA&hl=ru&sa=X&ved=2ahUKEwjniaHSlovqAhXPw6YKHW9ABsAQ6AEwDXoECAwQAQ#v=onepage&q=7%20per%20cent%20aging%20population%20UN&f=false*
[71] *Source: Ministry of national economy of the Republic of Kazakhstan.*
Committee on statistics. Women and men of Kazakhstan 2014-2018. The statistical compilation.

ket, so specialists and workers currently employed in the industry will work longer. Sooner or later, the number of employees in the industry will still decrease, people will retire, and replacing their work will be much more difficult[72].

The transition of the industry to a new era will not be easy. The introduction of new technologies will give the desired result only if the industry already has a certain level of expertise:

- qualified personnel,
- fairly well-developed R & D,
- developed system of professional training, etc.

Currently, the local high-tech industries (R & d in agriculture, production of equipment and equipment for agriculture, agricultural machinery, mobile technology development and software for agriculture) are already significantly behind in development.

There is a problem of lack of professional staff and low quality of their training. All this reduces the industry's readiness for the upcoming changes. Therefore, the professional community has already understood that investment in professional training and local production of agricultural products (crop and livestock) is essential.

It is quite expected that in the current conditions, the Government, in particular the MoA of the Republic of Kazakhstan, is interested in the rapid digitalization of the industry; pilot projects on the use of precision farming[73] are already being carried out in the industry. The period of extensive development of the industry is already coming to an end. Implementation of at least one risk (e.g., increasing the cost of delivering products to target markets, inefficient state regulation of the industry, constant changes in external and internal prices for equipment, fertilizers, feed, veterinary drugs, and energy resources) can be a shock to the industry.

You can reduce risks only if you actively use new opportunities. What are these opportunities? It includes the introduction and use of modern technologies and equipment, improving the quality of professional training and domestic production development. We can say that the circle is closed. The desire is to work with the old proven methods and rely on the state's generosity. It is quite understandable, but not promising. No matter how much the industry tries to follow recipes from the past, the state of affairs within the industry forces farmers to repeatedly answer the question, "Modernization or stagnation and decline?"

[72] *https://www.roboticsbusinessreview.com/news/5-ways-robotics-will-disrupt-construction-industry-in-2019/*
[73] *https://kursiv.kz/news/otraslevye-temy/2019-05/minselkhoz-kazakhstana-nadeetsya-povysit-urozhaynost-za-schet*

N 2020-30

Kazakhstan's agriculture will actively use the technological innovations that the Fourth Industrial Revolution can offer: information and" green " technologies. Kazakhstan agriculture actively uses "smart" animal husbandry and "precision" farming technologies.

«SMART" ANIMAL HUSBANDRY

Livestock farms actively use the Internet of things and sensor technologies, as well as robotics. The integrated use of these technologies on the farm will allow you to achieve the maximum economic effect, repeatedly reducing losses and production costs. Animals' implanted sensors (for example, cows) help to track the most important animal's indicators: starting from the cattle location, to health, physical activity, nutrition, etc.

"Smart" systems on the farm itself allow you to create the most optimal conditions for keeping animals (temperature, lighting, ventilation, and air conditioning) and feeding them (feed preparation and delivery, water supply, dosing). The collected data is presented as statistics for all controlled indicators, which, in turn, allows you to track production efficiency and adjust production processes.

On farms, robotics is actively used in combination with sensor technologies, artificial intelligence, and 5G Internet, for example: milking robots (the animal is kept without a leash, milking is voluntary), automated animal feeding systems, robotic manure harvesting.

A single digital platform manages the entire livestock farm as a single interconnected complex.

Livestock farms collect data (sensors, sensors, various devices). The information obtained in dynamics allows you to make forecasts about future produc-

tion efficiency. However, the use of data for predictive purposes does not stop there. To plan their production, farms (specialists of a certain profile) use tools such as the Internet of things, Artificial intelligence, big data, etc.) to understand that to produce, for whom to produce, and what are the chances of successful sales of products (at any market).

Organic waste from livestock and poultry production (for example, manure, manure) is completely processed, for example, using biofermentation at a specialized bio-complex; the output is environmentally friendly fertilizers and biogas.

The farm's energy needs are met mainly by alternative energy sources (biomass, solar, wind, and river energy). Farms try to reduce the burden on the ecosystem they work in. Farm picks up necessary environmental measures to reduce the negative impact of agricultural activities on agroecosystems (arable land, hayfields, pastures). The ultimate goal of this work is to maintain the balance of nutrients in the soil, pasture productivity, relatively high biodiversity – in short, to achieve the closest possible approximation of the agrobiocenosis to the natural ecosystem.

By 2035, Kazakhstan will increase the gene pool and diversity of domestic livestock breeds and stop importing imported species. Embryo transplant centers have been established and are operating animals. Elevators for growing high-value breeding producers have been created: specialized farms for growing breeding bulls obtained from custom-made mating to further use them at the main breeding enterprise.

By 2030-35, the country reaches a solid food platform, introduces aquaculture everywhere, and solves the watering issue. Vegetable feed for animal husbandry is produced based on organic farming.

«PRECISION FARMING

Crop farms actively apply technologies for the differentiated application of materials (e.g., seeds, fertilizers, plant protection products, irrigation, etc.) rating for optimal plant growth at the appropriate point and considering the potential of a particular field area. Farms ***have digital versions of their fields*** at their disposal. Digital fields have a high level of detail for each section of each field (indicators collect the detailed information, such as soil moisture and its chemical composition, productivity of arable land, etc.). Based on detailed maps, algorithms are created for working on each section of the field: how many seeds and fertilizers should be applied, what should be the irrigation rate.

Agricultural machinery works in the field throughout the entire cycle, from sowing to harvesting, mostly ***auto piloted***. On-board computers ensure that agricultural machinery implements recommendations/algorithms for field processing (sowing, protection, fertilization, irrigation).

Farmers will have to deal with a whole array of digital technologies: GPS systems and GNSS-navigation for agricultural machinery, precision irrigation technologies (round-the-clock humidity monitoring in combination with normalized irrigation of field areas in need), field sensors for monitoring important indicators (for example, humidity level), mobile applications combined with gadgets for monitoring indicators, a single digital platform (which allows you to control the entire crop production complex), auto piloted equipment/robots for sowing, harvesting, watering, tillage, and fertilization, etc.

Productivity in crop farms will increase significantly, while production costs and environmental impact will decrease.

Crop production will be biologically safe and environmentally friendly due to the use of vermicompost, reducing the list allowed to use mineral fertilizers, use of biotechnologies for quarantine, and plant protection.

The farms themselves will make a minimal negative impact on the environment due to the extensive use of alternative energy to meet the energy needs of the population, economy, and efficient transport logistics of products from the field to the product storage hubs. Farmers will actively use no-till crops when the destruction of the soil structure is minimal. It is important for carbon retention in the soil.

Cover crops will help to maintain soil health, regulating nutrients, and sequestering carbon.

Organic crop waste is completely processed, for example, using biofermentation at a specialized bio-complex. The product is environmentally friendly fertilizers and biogas.

Kazakhstan land has a high bonus score such as high soil fertility and high yield. Environmentally friendly technologies will highly likely be used to increase soil fertility, for example, by using agricultural

microbes (endophytes) or by grazing livestock (saliva and livestock manure infect the soil with microbes) or with the help of microbes (endophytes) that convert nitrogen from the air into a form that is absorbed by plants (nitrogen fixation). By 2030-2035, the agro sector will achieve self-sufficiency in seed quality.

Organic farming will continue to develop actively, despite the objective difficulties. In the medium term, the Republic will come close to the top five countries producing and exporting organic products to the European Union. Beekeeping in the Republic will develop in close connection with organic farming: with a high probability by 2025, Kazakhstan will become one of the largest producers and exporters of honey in the world. The production of bee products has been established. Kazakhstan's beekeeping is fully provided with bees' domestic breeding material, stopping the import of imported bees by 2025.

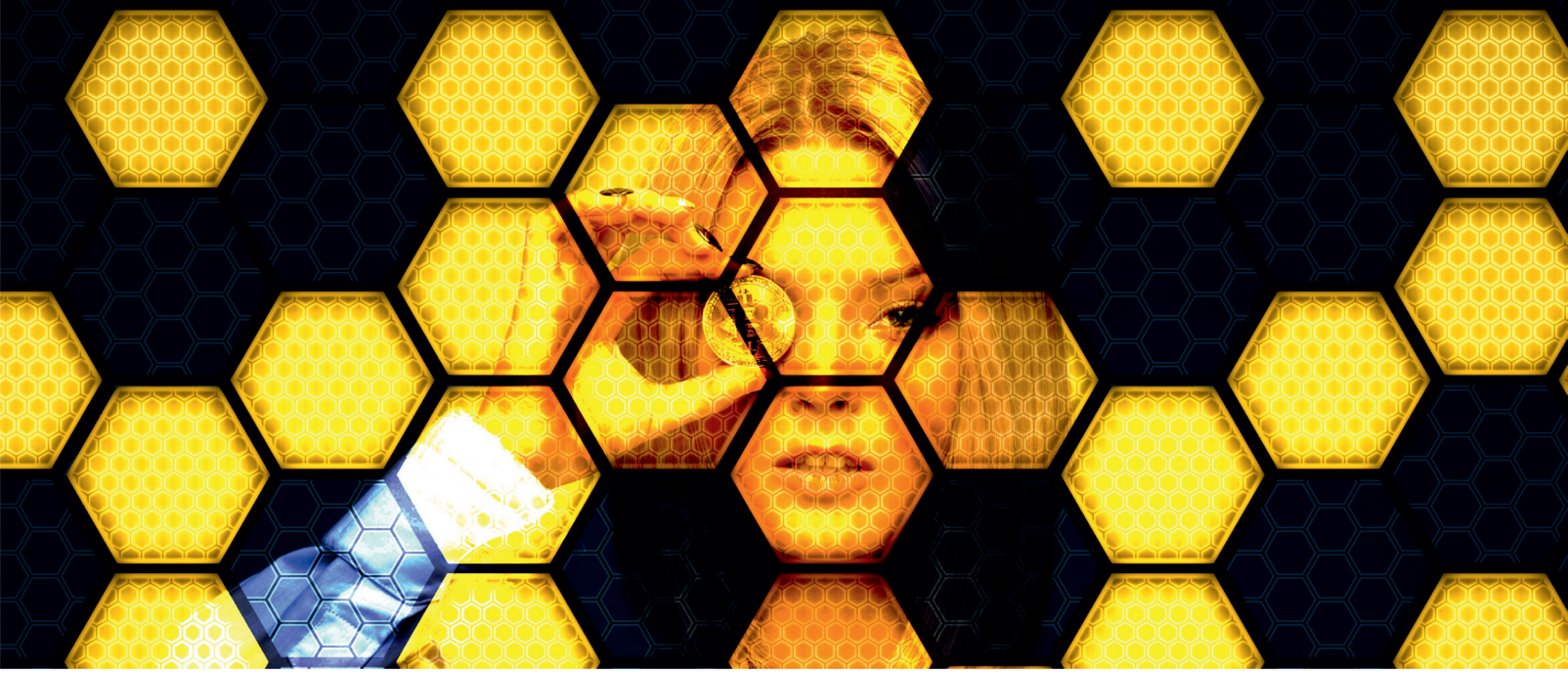
It is quite expected that agricultural science (research institutes and experimental stations) works in close cooperation with farms, with producers, in the development of new varieties and new technologies.

Maximum automation of production will be achieved in the processing of agricultural products. AI, Big data, machine learning, and machine-to-machine interaction will be actively used. As a result, simple and monotonous tasks will be performed by joint robotic systems. Production complexes, by using IT, will be managed as a single system. Equipment repairing will use 3D printing of spare parts.

Processing enterprises will be waste-free, actively using secondary raw materials in production. Products are packed in eco-containers. Among other methods, drones will rapidly deliver products on the principle of "from field to table." Thus the further development of the concept of "from field to store shelf" will go.

The processing of agricultural products will reach the advanced technological level. By improving food production technologies and using advanced equipment, domestic products will achieve high competitiveness. Kazakhstan will become a significant player in the finished products export market and not just raw materials export. It is expected that agricultural science, e.g., research institutes and experimental stations, will work closely with farms and producers, developing new varieties and technologies.

Kazakhstanis will have high-quality products from domestic producers. Under the influence of a new generation, consumers will widely demand production transparency. Digitalization of production in combination with consumers' requests will make the production stages as



transparent as possible. Using blockchain, chips, tags, sensors implanted in animals and embedded in products or other means, anyone can trace the entire technological chain from the field / farm to the shelf in the grocery store. In the future, Kazakhstani consumers know everything about the food they eat. They are confident about the quality of the product, because they have special devices that allow them to find out the quality of raw materials before processing. This information is in open access.

The agricultural processing industry itself is becoming an attractive place to work. The prestige of professions in the sector will increase due to technological re-equipment and the realization of export potential. Processing plants will stay closer to the sources of local raw materials, which means that there will be an influx of labor forces to the countryside, thus strengthening the position of small businesses in food and processing industries. There will be large, medium, and small size enterprises engaged in processing small quantities under unique recipes (homemade products), demanded worldwide.

Companies will have a smaller number of employees who will monitor automated jobs. Mobile laboratories will perform certification for homemade products. It will speed up and simplify the process.

The industry will reflect the variety of food preferences. Freeze-dried products for therapeutic and functional nutrition will become popular. Molecular cuisine with door-to-door delivery will gain popularity and development. Special mobile apps will help people regulate their diet, and consumers can replace any product themselves. At the same time, we understand all the risks and opportunities of the new product.

OVERVIEW OF THE INDUSTRY

- Agriculture in Kazakhstan is an ***efficient branch of the economy*** that takes care of natural resources, develops new technologies, meets both the needs of mass production of agricultural products and trends in environmental friendliness and safety.
- High-tech agricultural production with a ***full cycle of product processing***. Supply of products for export (meat, dairy products, fruits, vegetables, honey, berries) and the domestic market.
- The country's ***food security has been achieved***.
- ***Social and household infrastructure*** in rural areas is highly developed ("like in the city"). People have all necessary conditions to live and work. Children have the opportunity to receive a quality education. Settlements in rural areas are connected with each other and cities by high-quality roads. High-speed Internet is available everywhere. The number of working days/ weeks reduced.
- ***Work*** in rural areas is attractive and honorable. People who are engaged in agriculture have a high status and high wages. Specialists are highly qualified and have the opportunity to continue to learn (to learn new methods, techniques, and equipment).
- ***Agricultural Universities promptly respond to requests of producers***, including the professional development of specialists at different levels. In addition, Universities have begun their relocation from the large cities' centers closer to the" fields."
- ***All small farms are united in cooperatives and are more profitable***. Small farms serve end-users by bypassing intermediaries through drones (door-to-door delivery) and other technologies.
- The market for agricultural producers has at least two financial and credit institutions (not just KazAgro). These companies meet the needs of different producers: some work with large agricultural enterprises, others focus on medium and small producers.

The described image of the future can correlate to the complete industry scenario. It includes farmers striving to introduce innovations, technologies quickly penetrating the market, and specialists rapidly learning and applying them. The state only contributes to the modernization of the industry. However, the real course of events and the real future of the industry can develop according to one of three scenarios: "Middle way," "Ideal future," and "Stagnation and decline". Let's look at each of them in more detail.

SCENARIO FORECASTS FOR THE DEVELOPMENT OF THE AGRICULTURAL INDUSTRY IN KAZAKHSTAN FOR THE NEXT 10-15 YEARS

THE "MIDDLE WAY" SCENARIO

FUNDS.

In the near future, the agricultural sector of Kazakhstan will maintain positive growth rates. The industry, mainly large farms, will still be the largest recipient of subsidies and benefits for some time. The share of the agricultural sector in the Republic's GDP will remain at the current level of 4.5%, with the prospect of a slight increase (by 1-2%).

THE INDUSTRY COMPETENCE.

Large farms, the major players in the market, will support and build their employees' competence. They will work with new technologies, e.g., "precision" farming technologies or "smart systems" that help keep and feed animals.

In response to the threat of external and internal risks (devaluation of the national currency, rising prices for imported spare parts, equipment and special equipment, etc.), the government and large agricultural enterprises will invest not only in the development of Kazakhstan's agricultural science. They will focus on the needs of science, test innovations before their industrial implementation, and provide farmers with resources for their "run-in" new technologies.

TECHNOLOGY AND PROFITABILITY.

The rate of digital technologies spread in livestock and crop production (for example, the Internet of things, "smart" systems for keeping and feeding animals, milking robots, precision farming technologies, etc.) will be moderate. For example, despite unequal subsidies (less favorable) for robotic dairy farms, milking robots will slowly but surely spread in large livestock farms.

The creation of digital fields will be the basis for gradually increasing the possibilities of using "precision" farming technologies; farms will adopt not just individual elements of this technology but also try to make the most of this technology capabilities.

ECO-FRIENDLY PRODUCTION.

In the agro-industrial complex as a whole will slowly but surely

gain momentum, especially if the cluster of "green" farms in the Republic, as a real example of successful agricultural practice, will continue to develop dynamically.

The most progressive farms will solve the problems of feeding, fertilizing, and processing of organic waste in line with the industry environmental movement.

Cooperation among small producers will gain momentum, which will allow for at least partial technological re-equipment.

Kazakhstani producers will process agricultural raw material almost entirely in the Republic. Finished products, not raw materials will dominate exports. Kazakhstan is close to achieving food security.

The largest and most advanced processing enterprises will also actively use digital technologies, on the one hand, to support and increase productivity, on the other hand, to become part of the "transparent production" movement (the ability to trace all technological stages from the field to the counter). Some processing plants will move closer to the sources of raw materials, clusters for the production and processing of raw materials, and the production of end-products will begin to appear.

The work of KazAgro JSC will be radically reoriented, or this financial and credit institution will be liquidated and a specialized agrobank will replace it.

The gradual introduction of digital technologies at the initial stage will help to keep profitability in the industry from declining. Over time, the accumulation of competence in the industry - the growth of staff professionalism - will allow the use of digital technologies everywhere that will lead to moderate productivity growth.

LABOR FORCE.

According to the UNFPA (United Nations Population Fund) Kazakhstan forecast, until 2050, the population of the Republic will continue aging. However, due to the deformation of age pyramids, there will be fluctuations in some age groups.

In particular, "starting from 2022, the number of young people aged 20-24 will steadily increase until 2040. In the next 15 years, the proportion of young people aged 15-24 will increase from 20 to 27% in the share of the 15-64-year-old population."

Thus, soon, the labor resources' potential will grow, but the younger generation should be attracted to work in agriculture.

Farms that can make life and work in rural areas more attractive will have more young people to work. Working in large farms will be appealing for the younger generation because the production process will be at least partially modernized, and the level of social and household infrastructure will develop (it will

be consistently high).

In addition, market leaders will maintain and increase the level of professional training of their employees, which will also become a magnet for young professionals.

STATE.

The government will respond to the signals of lobbyists if some digital technologies (e.g., robotics) starts threatening the profit of certain interest groups. In other cases, the government will not erect barriers to new technologies in the industry.

THE "PERFECT FUTURE" SCENARIO

MONEY.

Agriculture in Kazakhstan will become the "new oil" for the country's economy. The share of industry in the Republic's GDP will grow steadily both in absolute and percentage terms annually.

THE INDUSTRY COMPETENCE.

Competence in the industry will be accumulated, on the one hand, in the private sector, e.g., in large and medium-sized farms. On the other hand, in agricultural science, in research institutes, and experimental farms.

Over time, the Republic's dual education will receive a new impetus: the experience of trust management of rural agricultural colleges by large agricultural enterprises will continue to thrive. Local educational institutions will almost completely satisfy the needs of agricultural producers for specialists. The academic freedom of higher education institutions will be limited to facilitate a flexible response to the market's needs . The increased level of competence in the industry will allow the quick implementation of complex and expensive technologies. The industry will be absorbing the latest digital technologies.

Market leaders will gradually move from investments in professional training of their personnel to full- scale investments in R & D. The scientific support for agricultural producers will grow significantly, and the share

[74] *http://abkaz.kz/modernizaciya-i-razvitie-agrarnoj-nauki/*

of farms using innovative developments will exceed by 25%[74].

TECHNOLOGY AND PROFITABILITY.

Borrowing new technologies will still be the main source of increasing profitability in the industry. However, as knowledge and experience in the domestic agrarian industry increase, responding to the needs of the market, domestic agricultural science and business will begin to produce local high-quality and popular intellectual products. The state will no longer be the main customer of scientific research and development. Scientific institutions will face the need to find new customers among agricultural producers and provide a high-quality intellectual product. The profitability of agricultural production will no longer be the only central problem for farmers and processing enterprises. A new understanding of their role in the economy and society will replace ideas of wild capitalism. Issues of environmental friendliness of production will move from the theoretical plane to the practical: "green" production in animal husbandry, crop production, and processing will only expand. Almost all manufacturers in the agro-industrial complex will use at least some "green" production technologies.

New generation requests using environmentally friendly production methods, ethical animal farming, and using organic feed. Organic fertilizers will spur production focused on exports, e.g., to the EU, and the domestic market. At the same time, production will be transparent at all technological stages, and customers will have access to this information.

The industry and farms will use digital tools thoroughly (IoT, AI, Big data, etc.) to predict the sales of products accurately and plan production accordingly. It will help avoid significant distortions in production, product deposits, and overall losses. The country will achieve food security.

LABOR FORCE.

Considering the forecasts of the UNFPA (United Nations Population Fund) Kazakhstan for the next 15 years and the favorable economic situation, the ratio of supply and demand in the labor market in the agricultural sector will change over time. At the beginning of the period, the industry will absorb all the labor supply. Over time, the demand for labor will gradually decrease due to automation and robotization of work.

STATE.

The government will actively promote the introduction of new technologies, provided they are proven to be effective (economic and environmental). However, along with economic and environmental efficiency, a particular new technology's social effect will be calculated.

TECHNOLOGIES .

It is possible that over time, the government will seriously consider the idea of introducing an "Unconditional basic income" for citizens of the Republic since efforts to retrain the released personnel may not be successful.

THE «STAGNATION AND DECLINE SCENARIO»

MONEY.

The state will continue to subsidize and provide benefits to large agricultural producers. The country's GDP will decline, as will the share of the agro industry in GDP.

THE INDUSTRY COMPETENCE.

The sector will shrink significantly, many farms (medium and small) will leave the market. There will only be a few big players left in the market, but their operational activity will decrease. Since the scale of the industry will significantly decrease, the scale of major players will also decrease accordingly. Maintaining and developing the industry's competence level will not work both for private agricultural producers and the state through professional training (Universities, TVET). Kazakhstan's agricultural science will remain completely disconnected from the needs of producers and will eventually degrade.

TECHNOLOGY AND PROFITABILITY.

The penetration of new technologies, especially digital ones, will slow down and stop expanding. However, the remaining large farms on the market will actively look for ways to maintain profitability at the level necessary for survival.

LABOR FORCE.

Considering forecasts by UNFPA (United Nations Population Fund) Kazakhstan for the next 15 years and the economic situation in the country and industry, the available labor force will flow from rural to urban areas immensely..

STATE.

The "economic pie" will shrink, so the struggle of influence groups for a share in this pie will escalate.

The government will severely block through legislation, subsidizing providing benefits, setting tariffs, regulations, and so on, any new technology that could jeopardize the industry's source of profit.

LIST OF PROFESSIONS IN THE AGRICULTURAL SECTOR OF KAZAKHSTAN

6.

LIST OF PROFESSIONS IN THE AGRICULTURAL SECTOR OF KAZAKHSTAN

The spread of new technologies of the Fourth Industrial Revolution, unprecedented demographic changes, socio-economic shocks. All these forces radically reshape the entire industry, business models, change the competencies and skills in demand in the market and reduce the "shelf life" of existing professional knowledge and skills.

The penetration of new technologies may affect professions that already exist in the industry in different ways. On the one hand, a particular job may become hopelessly outdated, and the need for it will be reduced to zero.

For example, the natural ice trade was an industry of the world economy for the entire 19th century. But as soon as artificial ice factories began to appear, the professions of extracting, transporting, and selling natural ice began to recede into the past, until they disappeared along with the industry itself.

On the other hand, new technologies can allow people to switch to other tasks that will, in turn, lead to a change and transformation of professions, but not to their complete disappearance.

The transformation of a profession and the emergence of a new job are often interrelated. New professions appear when employers need employees to perform tasks that have never been performed before. Usually, these new tasks are added to job responsibilities in existing professions.

However, if these tasks become more complex, their impact on the overall result of the work is enhanced. Over time a new profession is formed.
Let's demonstrate this process with an example. In 1990, scientists began to decipher the human genome collecting a staggering amount of biochemical data.

To organize this data, employers first turned to computer experts or biologists who had some computer knowledge. But as the need for specialists who know both biology and computer science grew, a new job of "bioinformatics" finally took shape in its own right profession.

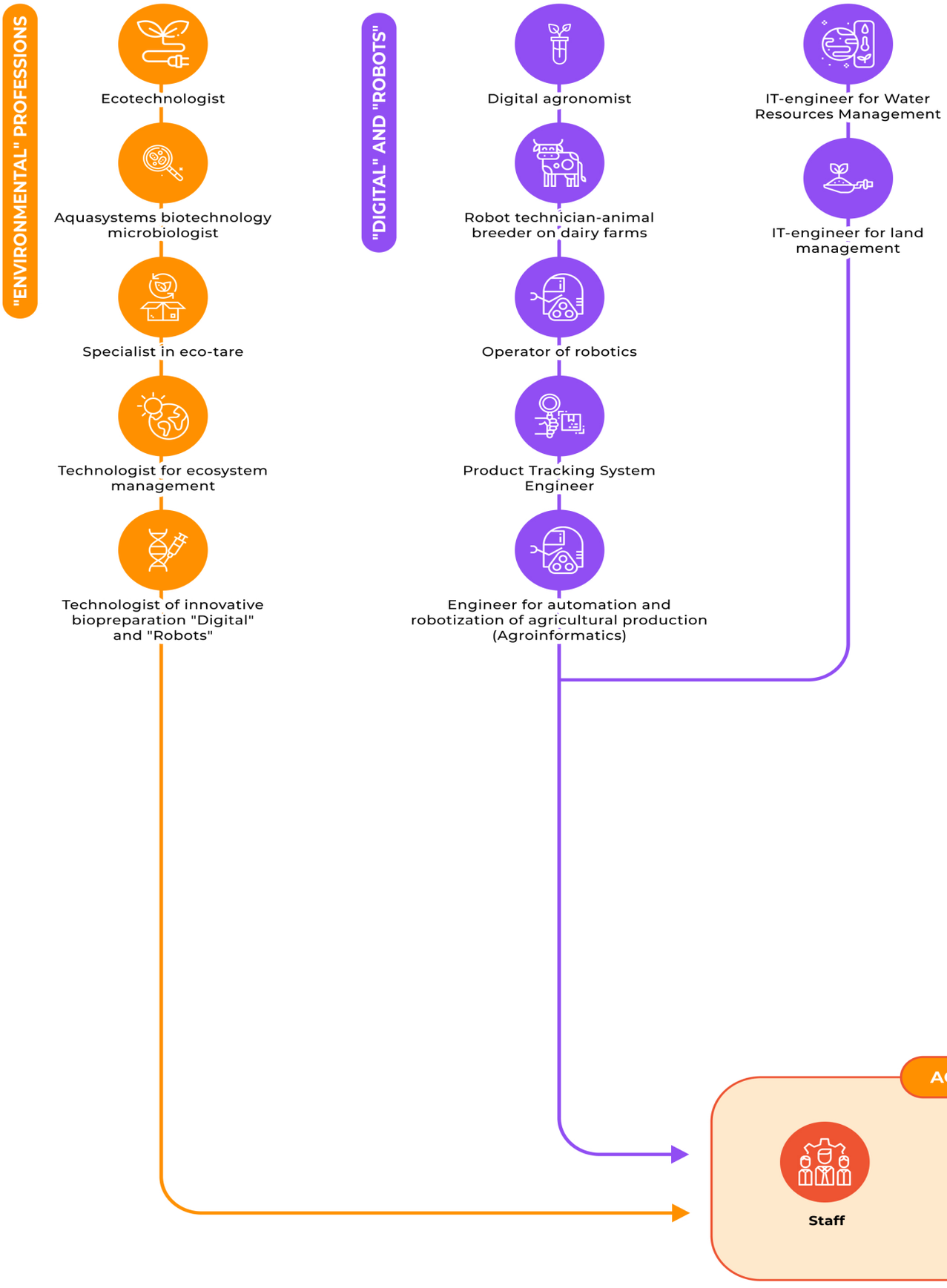
"A biologist who can process data arrays using computer programs." Bioinformatics has become a popular profession in the labor market and a training program in higher education institutions[75].

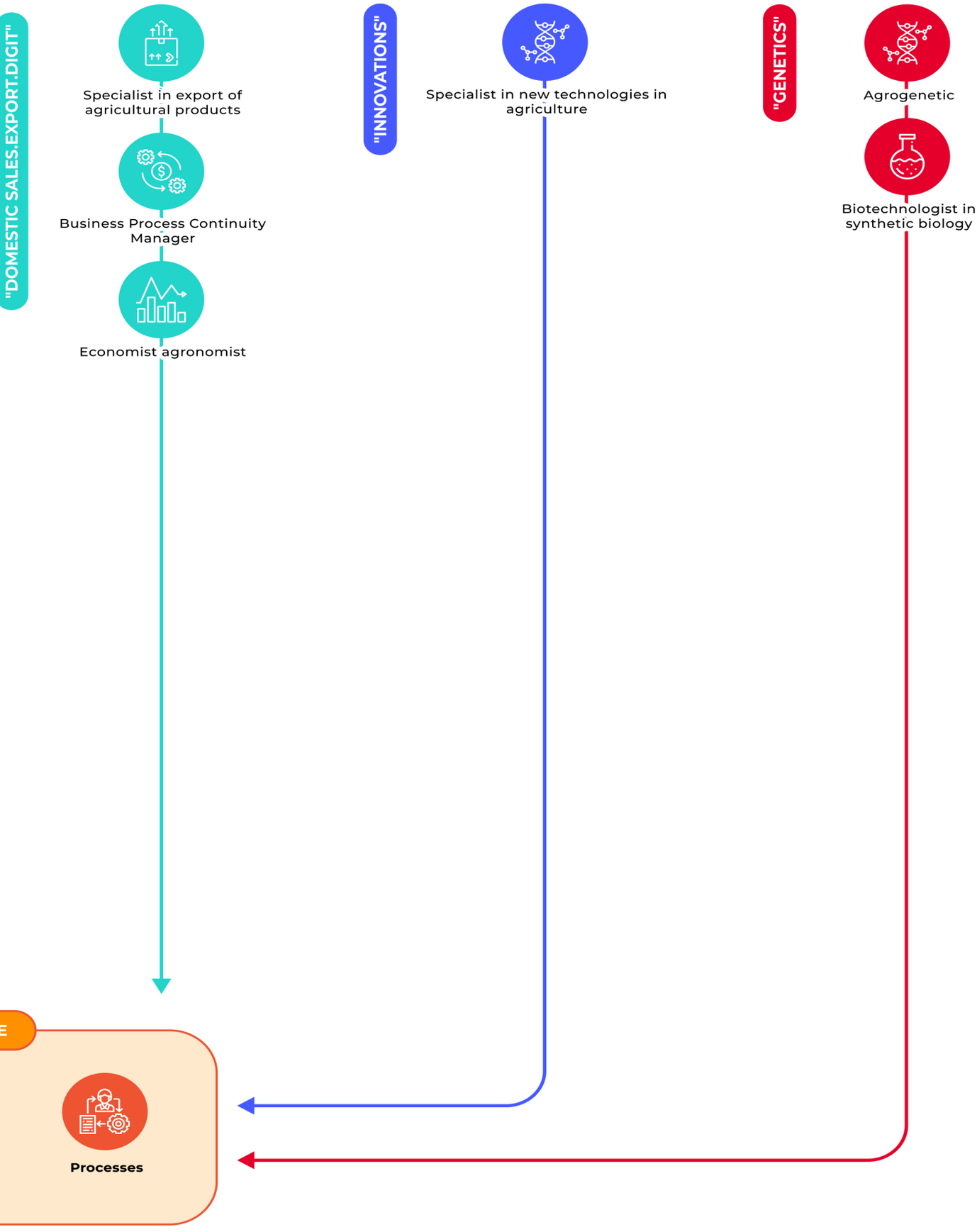
Considering all the trends and features of Kazakhstan's socio-economic and political situation, we tried to determine what new professions may appear in the agricultural industry within 10-15 years, what professions will be transformed, and which ones will disappear.will be transformed during this time, and which are likely to become a thing of the past.

[75] *Source: https://www.bls.gov/careeroutlook/2002/fall/art02.pdf*

NEW PROFESSIONS IN THE AGRICULTURAL SECTOR

6.1.


"ENVIRONMENTAL" PROFESSIONS
Ecotechnologist
Aquasystems biotechnology microbiologist
Specialist in eco-tare
Technologist for ecosystem management
Technologist of innovative biopreparation "Digital" and "Robots"
"DIGITAL" AND "ROBOTS"
Digital agronomist
Robot technician-animal breeder on dairy farms
Operator of robotics
Product Tracking System Engineer
Engineer for automation and robotization of agricultural production (Agroinformatics)
IT-engineer for Water Resources Management
IT-engineer for land management
AGRICULTURE
Staff
Equipment


"DOMESTIC SALES.EXPORT.DIGIT"
Specialist in export of agricultural products
Business Process Continuity Manager
Economist agronomist
"INNOVATIONS"
Specialist in new technologies in agriculture
"GENETICS"
Agrogenetic
Biotechnologist in synthetic biology
E
Processes

6.1.
NEW PROFESSIONS IN THE AGRICULTURAL SECTOR

During the foresight sessions, Kazakhstani agricultural industry professionals identified several groups of new professions:

- *"Environmental professions",*
- *"Digital" and "Robots",*
- *"Domestic Sales. Export. Digital",*
- *"Innovations"*
- *"Genetics".*

1. «ENVIRONMENTAL» PROFESSIONS

► 1

ECOTECHNOLOGIST

► Knows the technologies and equipment necessary for processing organic waste from livestock and crop production. Organizes and controls the processing process. The result of processing, e.g., biogas, electricity, organic fertilizers, animal feed, etc., can determine the narrow specialization of eco-technology.

APPEARANCE HORIZON ► **2025-2030**

KEY *competencies*

- A university degree in one of the fields such as chemistry, biology, biotechnology, ecology.
- Knowledge and skills in applying environmentally friendly methods of waste processing and preparing waste for recycling.

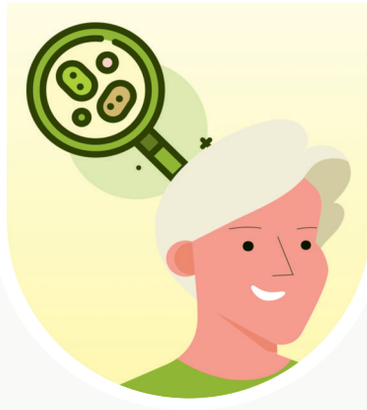
TRENDS

- Industry Greening

SUPERPROFESSIONAL *skills and abilities*

- Systemic thinking.
- Cross-industry interaction.
- Project management.
- Lean production.
- Design, programming and robots' maintenance.
- Ecological thinking.

► 2



AQUASYSTEMS BIOTECHNOLOGY MICROBIOLOGIST

APPEARANCE HORIZON ► 2025-2030

KEY competencies

- A university degree in one of the fields such as biotechnology, microbiology, and ecology.
- An ability to conduct sanitary and microbiological research of reservoirs.
- Organizes cleaning of reservoirs (waterholes).

- Elaborates methods for cleaning reservoirs (waterholes) using strains of microorganisms that can decompose all toxic substances, perform redox processes.

TRENDS

- The course on greening.

SUPERPROFESSIONAL skills and abilities

- Systemic thinking.
- Cross-industry interaction.
- Project management.
- Lean production.
- Design, programming and robots' maintenance
- Ecological thinking.

▶ 3

SPECIALIST
IN ECO-TARE

▶ Develops various types of biodegradable materials and packaging for food products (in this case, the materials and packaging can be easily recycled back into the packaging and / or quickly decomposed into natural components under various conditions).

APPEARANCE HORIZON ▶ **2025-2030**

KEY competencies

- Higher education in one of the fields such as chemistry of organic compounds, biochemistry, biotechnology, ecology.
- Practical skills in developing a technological scheme for the production of eco-containers and their hardware design.

TRENDS

- The course on greening.

SUPERPROFESSIONAL skills and abilities

- Systemic thinking.
- Cross-industry interaction.
- Project management.
- Lean production.
- Design, programming and robots' maintenance.
- Ecological thinking.

▶ 4

TECHNOLOGIST FOR ECOSYSTEM MANAGEMENT

APPEARANCE HORIZON ▶ 2025-2030

- The specialist selects the necessary environmental measures to reduce agricultural activities' negative impact on agroecosystems (arable land, hayfields, pastures). An Ecosystem Technologist/ Manager's ultimate goal is to maintain the balance of nutrients in the soil, pasture productivity, relatively high biodiversity, in short, to bring the agrobiocenosis closer to the natural ecosystem.

KEY competencies

- A university degree in one of the fields such as chemistry, biochemistry, biotechnology, ecology, natural resource management.
- An ability to assess the technological load on the environment of a particular production and its waste.
- Knowledge and practical skills in applying various environmental measures.

TRENDS

- The Course on Greening.

SUPERPROFESSIONAL skills and abilities

- Systemic thinking.
- Cross-industry interaction.
- Project management.
- Lean production.
- Design, programming and robots' maintenance.
- Ecological thinking.

► 5

TECHNOLOGIST
OF INNOVATIVE BIOPREPARATION

► The specialist develops biological substances for the needs of crop production (e.g., preparation of live beneficial microorganisms that have a positive effect on the soil-plant system) and for animal husbandry needs (e.g., feed additives for normalizing metabolism and strengthening immunity).

APPEARANCE ► **2025**
HORIZON

KEY
competencies

- A university degree in one of the fields such as biology, microbiology, biochemistry.
- Experience developing a technological chain for obtaining a biological product from the initial raw material to the end product.

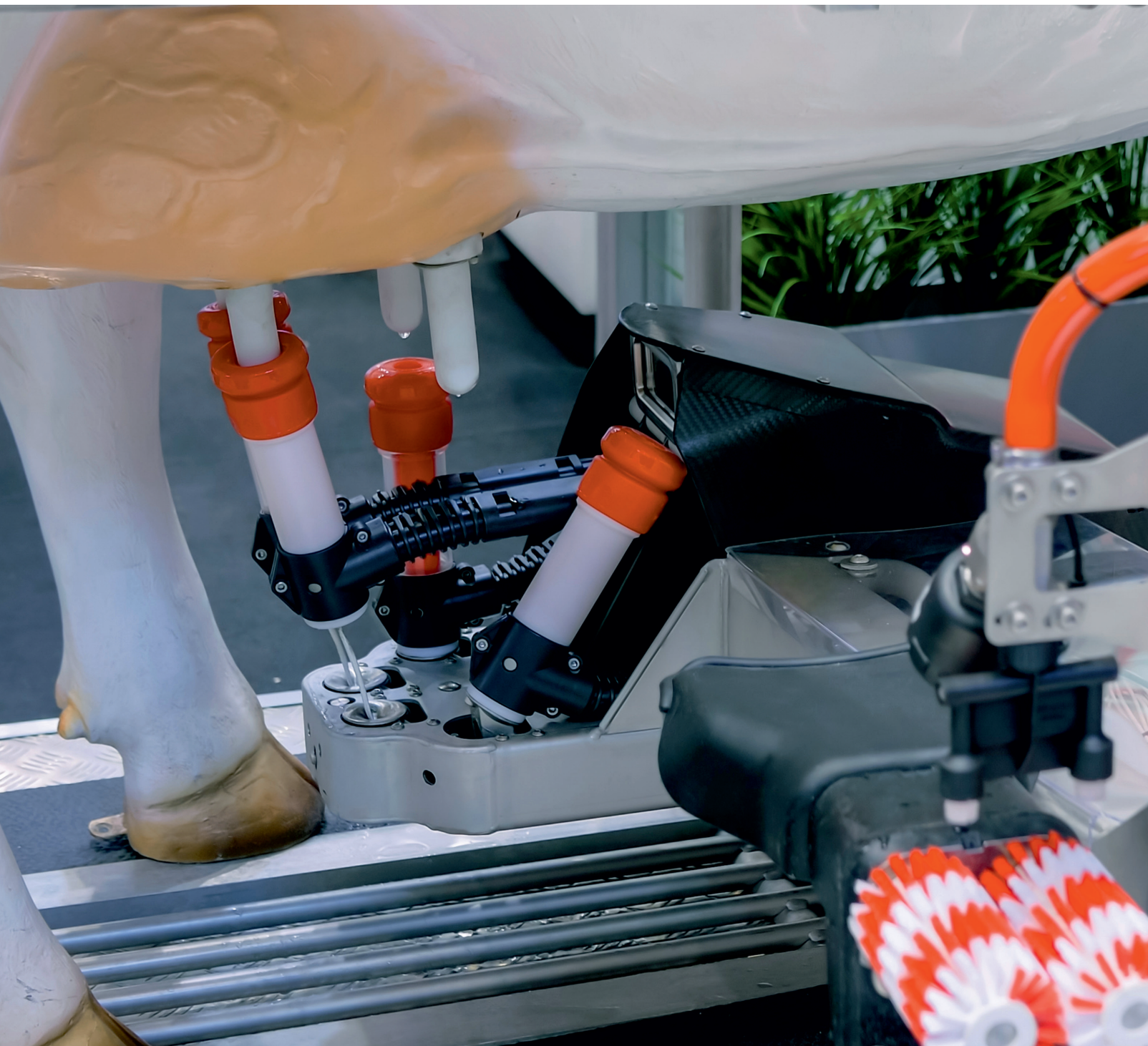
TRENDS

- The Course on Greening.

SUPERPROFESSIONAL
skills and abilities

- Systemic thinking.
- Cross-industry interaction.
- Project management.
- Lean production.
- Design, programming and robots' maintenance.
- Ecological thinking.

2. «DIGITAL» AND «ROBOTS»



▶ 6

DIGITAL AGRONOMIST

APPEARANCE HORIZON ▶ **2025-2030**

KEY competencies

- Majoring in agronomy.
- Ability to work with specially processed satellite field images to assess the productivity of arable land.
- Ability to build a route for a robot that will take samples at selected points in different parts of a field for agrochemical soil survey.
- Ability to program the operation of automated vehicles for differentiated application of materials (seeds, fertilizers, plant protection products, irrigation, etc.).
- Knowledge and understanding of different vegetation indices (for example, NDVI, EVI, GNDVI, CVI).

- The specialist evaluates the productivity of arable land, performs agrochemical examination of soils, manages differentiated application of materials (seeds, fertilizers, means of plant protection irrigation, etc.), does the satellite monitoring of vegetation, performs all types of field survey by means of digital technologies (e.g., digital maps, fields robot for suction of the soil samples, automated equipment for variable rate application of materials, etc.).

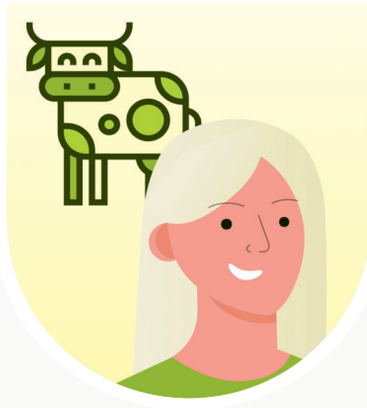
TRENDS

- Digitalization.

SUPERPROFESSIONAL skills and abilities

- Systemic thinking.
- Cross-industry interaction.
- Project management.
- Design, programming and robots' maintenance.
- Ecological thinking.
- Lean production.

► 7



ROBOT TECHNICIAN-ANIMAL BREEDER
ON DAIRY FARMS

APPEARANCE ► ***2025***
HORIZON

KEY
competencies

- Specialized professional education in agricultural mechanization.
- Skills in working with robotic systems.

- The specialist can manage robots on a dairy farm: milking robots, automated feeding systems, robots for manure harvesting.

TRENDS

- Digitalization.

SUPERPROFESSIONAL
skills and abilities

- Systemic thinking.
- Design, programming and robots' maintenance.
- Ecological thinking.

► 8

OPERATOR
OF ROBOTICS

► The specialist can manage different robots applied in agriculture for such operations as chemical analysis of the soil, weed control, monitoring of soil and crops conditions, planting seeds, etc.

APPEARANCE HORIZON ► **2025-2030**

KEY competencies

- A TVET degree in Operator of Machines with Program Management
- Robotic operations
- Setting up frames
- Writing, editing, and executing basic programs
- Offset, backup, restore, create and modify simulations.

TRENDS

- Digitalization.

SUPERPROFESSIONAL skills and abilities

- Systemic thinking.
- Design, programming and robots' maintenance.
- Ecological thinking.

► 9

PRODUCT TRACKING
SYSTEM ENGINEER

APPEARANCE HORIZON ► **2025-2030**

KEY competencies

- A university degree in one of the fields such as information and communication systems and the Internet of things, DevOps engineering in the administration of IT development infrastructure, Intelligent data analysis systems.
- Experience in cloud technologies (cloud architecture).

- The specialist sets up monitoring production processes at different technological stages, from the field to the store counter. The entire chain of transactions is saved to the cloud. The final product consumer can track (read in the cloud archive) all stages of the production.

TRENDS

- Digitalization.

SUPERPROFESSIONAL skills and abilities

- Systemic thinking.
- Cross-industry interaction.
- Project management.
- Design, programming and robots' maintenance.

► 10

ENGINEER FOR AUTOMATION AND ROBOTIZATION OF AGRICULTURAL PRODUCTION (AGROINFORMATICS)

APPEARANCE HORIZON ► 2025-2030

KEY *competencies*

- A university degree in one of the fields such as industrial robotics, mechatronics, applied Informatics.
- Ability to adjust automated and robotic systems to the specific conditions of the farm.

- The specialist is engaged in equipping / implementing farm automation and robotization systems, and in their maintenance.

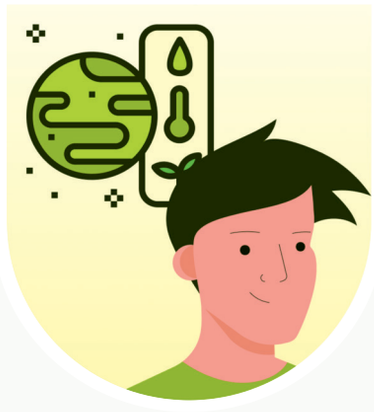
TRENDS

- Digitalization.

SUPERPROFESSIONAL *skills and abilities*

- Systemic thinking.
- Cross-industry interaction.
- Project management.
- Design, programming and robots' maintenance.
- Ecological thinking.
- Lean production.

► 11



IT ENGINEER
FOR WATER RESOURCES MANAGEMENT

APPEARANCE HORIZON ► **2025-2030**

KEY competencies

- A university degree in one of the fields such as geodesy and remote sensing, geoinformation systems.
- Experience in using the capabilities of geoinformation systems for water management.

- The specialist develops monitoring systems that allow to track water consumption volume, take into account and predict the water level in rivers, and find new water resources. Monitoring systems are based on the use of satellite sensing, sensors, and geographic information systems. The collected data helps to optimize and forecast water consumption.

TRENDS

- Digitalization.

SUPERPROFESSIONAL skills and abilities

- Systemic thinking.
- Cross-industry interaction.
- Project management.
- Design, programming and robot maintenance.

► 12

IT ENGINEER
FOR LAND MANAGEMENT

APPEARANCE ► 2025
HORIZON

KEY
competencies

- A university degree in one of the fields such as geodesy and remote sensing, geoinformation systems.
- Experience in using the capabilities of geoinformation systems for land management.

- The specialist develops GIS platforms that allow keeping a register, taking records, and performing the monitoring. GIS platforms have add-ons for working with land management and cadastral information.

TRENDS

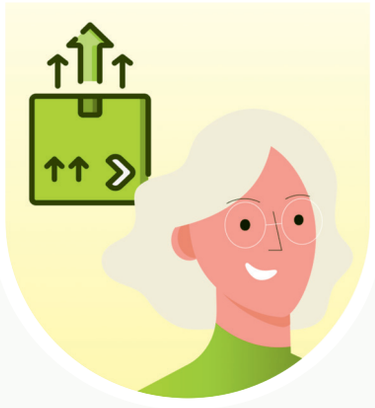
- Digitalization.

SUPERPROFESSIONAL
skills and abilities

- Systemic thinking.
- Cross-industry interaction.
- Project management.
- Design, programming and robot maintenance.

3. «DOMESTIC SALES. EXPORT. DIGIT.»

► 13



SPECIALIST
IN THE EXPORT OF AGRICULTURAL PRODUCTS

APPEARANCE ► **2025**
HORIZON

KEY
competencies

- A university degree in one of such fields as international trade, trade, world economy and international economic relations.
- Knowledge of foreign markets and customers, ability to reduce the risk of the "increased effect" for the exporter.

- The specialist knows the regulations, standards, and requirements of key partners, e.g., the EU and the Gulf countries, and China. The imported agricultural products, goods, and food products must correspond to them. The specialist helps farmers assess the possibilities of setting up production for export, advises at the planning and production stage so that the final product meets the regulations, standards, and requirements of the importing country. Information about a specific exporter and its products is available in the “cloud” for consumers in the importing country.

TRENDS

- Slowly growing profitability of the industry.

SUPERPROFESSIONAL
skills and abilities

- Systemic thinking.
- Cross-industry interaction.
- Project management.

► 14

BUSINESS PROCESS CONTINUITY MANAGER

APPEARANCE ► **2025**
HORIZON

KEY
competencies

- A university degree in one of the fields such as intelligent information systems and technologies, software and intelligent systems.
- Understanding different types of business logistics.

- The specialist uses AI, Big data, and proactive logistics to forecast product demand before purchasing. Manufacturers can adjust their production to meet customer needs in advance. The entire system is based on "long-term forecasting based on AI, logistics outsourcing, and end-to-end data exchange across the entire supply chain".

TRENDS

- Slowly growing profitability of the industry.

SUPERPROFESSIONAL
skills and abilities

- Systemic thinking.
- Cross-industry interaction.
- Project management.
- Design, programming and robot maintenance.
- Working in an unpredictable environment.

► 15

ECONOMIST AGRONOMIST

► The specialist collects and analyzes data on the enterprise's various production indicators, using the Internet of things, AI, Big data, etc. After analyzing, they plan further production ("what to produce, for whom to produce, and what are the chances of successful sales of products in a particular market").

APPEARANCE ► **2025**
HORIZON

KEY
competencies

- A university degree in one of the fields such as intelligent information systems and technologies, software and intelligent systems.
- Background in economics and marketing.

TRENDS

► Slowly growing profitability of the industry.

SUPERPROFESSIONAL
skills and abilities

- Systemic thinking.
- Project management.
- Design, programming and robot maintenance.
- Working in an unpredictable environment.
- Ecological thinking.

4. «INNOVATIONS»

► 16

SPECIALIST
IN NEW TECHNOLOGIES IN AGRICULTURE

APPEARANCE ► **2025**
HORIZON

KEY
competencies

- A university degree in any of the fields such as animal husbandry, crop production.
- Understanding of the economy of the enterprise.
- Fluent in English.

- Well versed in technological innovations available on the market and ready for farm implementation. A professional can specialize in a particular field, e.g., precision farming, organic farming, robotics, etc.
- Considering a customer's goals, the new technology specialist examines the possibility and recommends specific new technologies and materials that a particular farm can use.

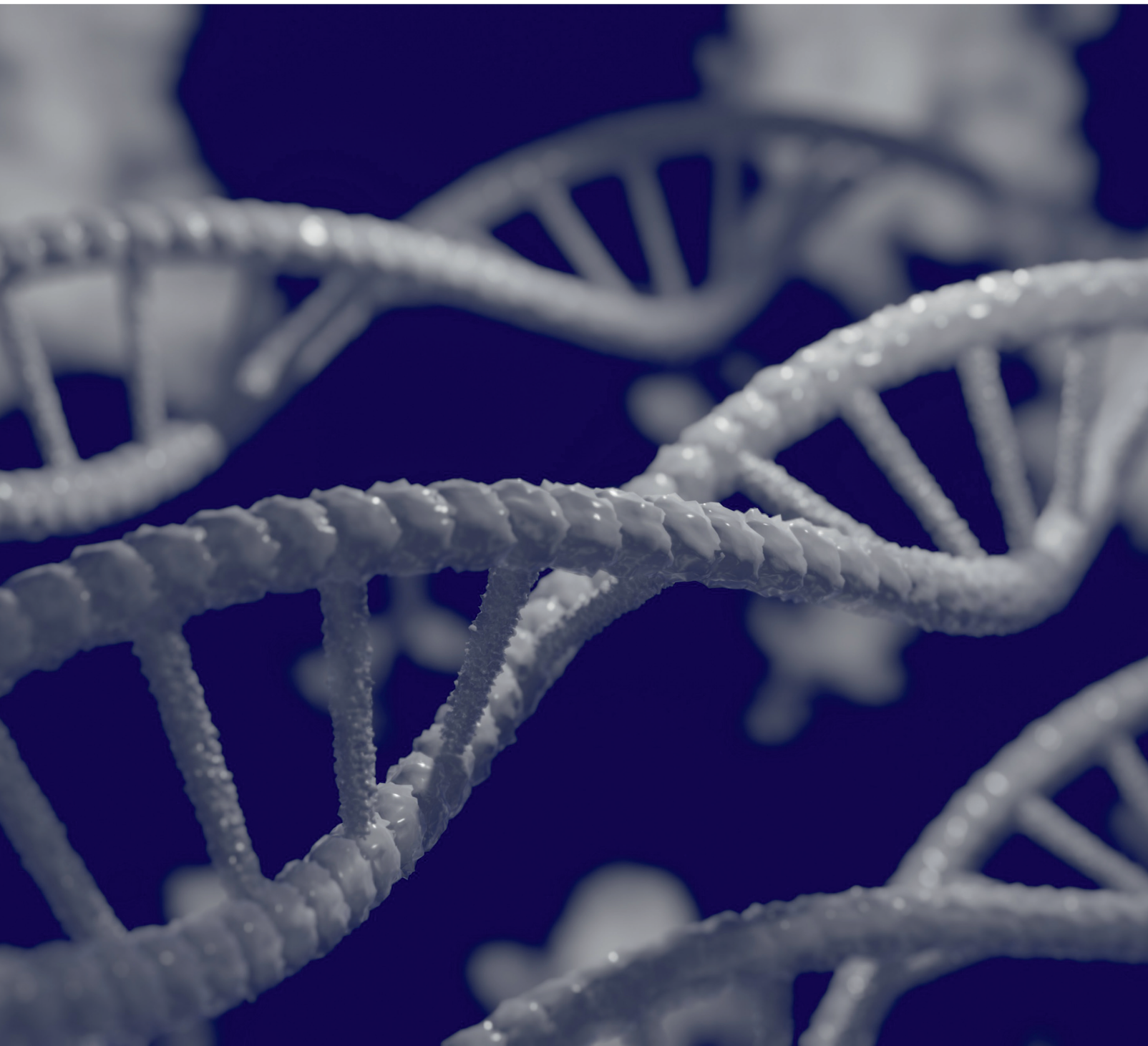
TRENDS

- Growing demand for technological renewal in the agricultural industry.

SUPERPROFESSIONAL
skills and abilities

- Systemic thinking.
- Cross-industry interaction.
- Project management.
- Lean production.
- Ecological thinking.
- Client orientation.

5. «GENETICS»



► 17

AGROGENETIC

► The specialist works on breeding new varieties of agricultural plants and animal breeds using genetic modification and selection to increase yields or increase milk production, increase disease resistance, and adapt to climate change.

APPEARANCE ► 2030
HORIZON

KEY
competencies

► A university degree in biology (genetics).

TRENDS

► Slowly growing profitability of the industry

SUPERPROFESSIONAL
skills and abilities

► Systemic thinking.
► Cross-industry interaction.
► Project management.
► Lean production.
► Ecological thinking.
► Client orientation.

► 18

BIOTECHNOLOGIST
IN SYNTHETIC BIOLOGY

APPEARANCE ► **2030**
HORIZON

KEY
competencies

- A university degree in one of the fields "biology (genetics)".

- Develops new plant varieties from start to finish by changing large clusters of genes and parts of genes (as opposed to genetic engineering, which modifies one or more genes). For example, more complex crops can be developed for growing in a changing climate: crops with high nutritional properties, crops that can cope with both drought and frost, crops that respond appropriately in response to certain environmental conditions.
- Develops new production methods for existing food products, for example, production of saffron-based yeast by fermentation, production of milk by introducing certain sequences of bovine DNA into yeast cells.

TRENDS

- Growing demand for the technological renewal in the agricultural product industries and consumer preferences changing under the influence of generation Z.

SUPERPROFESSIONAL
skills and abilities

- Systemic thinking.
- Cross-industry interaction.
- Project management.
- Lean production.
- Ecological thinking.
- Client orientation.

TRANSFORMING PROFESSIONS IN THE AGRICULTURAL INDUSTRY

6.2.

6.2.
TRANSFORMING PROFESSIONS IN THE AGRICULTURAL SECTOR

The speed of emergence and implementation of the most diverse technologies of the Fourth Industrial Revolution is unprecedented. There is no time to swing. It is necessary to modernize or leave the market. This is exactly what will happen or is already happening with the professions that now form the backbone of the agricultural industry. Despite the fact that the foundation of the industry remains unchanged - human labor and natural resources - the tools and ideas are already changing! Increasingly, between a person and the subject of his labor there will be a "smart" machine, which, however, still needs the guidance and care of a person, but this is not for long ...

2030

1.1

FIELD GUIDE AND VEGETABLE GROWERS

FIELD GUIDE 2.0, VEGETABLE GROWER 2.0

TRIGGER

- robotization of agricultural work.

- Robotics is already entering the fields. Over time, the cost of agricultural robots will vary, and the market will receive different modifications: complex and expensive, simple and affordable. A secondary market for robotics will appear which will make them even more affordable. Robots are already being used for chemical analysis of soil, weed control, monitoring the state of soil and crops, and planting seeds.

2030

1.2

FARMERS AND CULTIVATION WORKERS ON TREES AND SHRUBS

WINEGROWER 2.0, WINEGROWER-WINEMAKER 2.0, FRUIT AND VEGETABLE GROWER 2.0, FRUIT TREE WORKER 2.0, NUT CROP FARMER 2.0, TEA GROWER 2.0

TRIGGER

- robotization of agricultural work.

- Robotics and AI are changing the way farmers work in this sub-industry. For example, in France farmers use robots in vineyards for mechanical weeding and robots for mowing (mowing robots).

2030

1.3

FRUITGROWERS, GARDENERS AND WORKERS OF FRUIT NURSERIES

GARDENER 2.0

TRIGGER

- robotization of agricultural work.

- Robotics changes the horticulture. For example, the Helper Robotech (South Korea) assembles fruit and vegetables. Toshiba is developing a robot-gardener that will plant trees, prune branches and perform other work in the garden.

2030

1.4

FARMERS AND WORKERS OF MIXED PRODUCTION

CROP FARMER 2.0

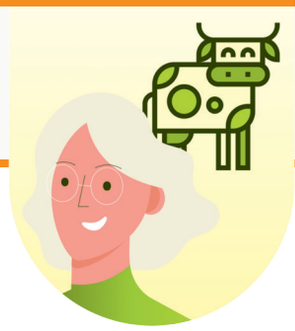
TRIGGER

- automation, digitalization and robotization of agricultural work.

- Robots involved in fields and gardens are already engaged in planting, pruning, transplanting, grafting, thinning, weeding, and harvesting.
- In addition, precision farming technologies are based on the differentiated application of materials (fertilizers, seeds, plant protection products, etc.) and electronic field maps with all field section's characteristics. Electronic maps allow creating precise instructions for the application of fertilizers, seeds, SPR, and water consumption for each field section. All operations are carried out by computerized agricultural machinery that operates using satellite navigation.
- Technologies for automating planting, breeding, and seedling care are currently being developed (for example, HETO Agrotechnics and Harvest Automation). Technologies for automated harvesting of apples, grapes, and peppers are also being developed (particularly the EU CROPS project).

2030

2.1



FARMERS AND WORKERS IN MEAT AND DAIRY FARMING, EXCEPT FOR SLAUGHTERING

FARMER-BREEDER 2.0

- Animal husbandry already uses a whole array of robotic systems, primarily robots-milkers, automated feeding systems, cleaning robots, feed trimmers. Poultry farmers and related workers.

TRIGGER

- automation, digitalization and robotization of agricultural work.

2030

2.2

BREEDERS AND RELATED WORKERS

POULTRY FARMER 2.0

- Poultry farming uses robotic systems that allow loading forage from storage to stationary vehicles, transport along the feeding line, dispense the feed to feeders and clean feeders.

TRIGGER

- automation, digitalization and robotization of agricultural work.

2030

2.3

BEEKEEPERS AND SILK BREEDERS

BEEKEEPER 2.0, FARMER-BEEKEEPER 2.0, SERICULTURIST 2.0

- A device that controls the temperature and humidity inside the hive to ensure optimal conditions is already in use. The device also captures sound using AI to identify behavioral features of bee colonies, such as preparing to leave the hive.

TRIGGER

- automation, digitalization and robotization of agricultural work.

2025-2030

2.4

FARMERS AND WORKERS IN THE PRODUCTION OF MIXED CROP AND LIVESTOCK PRODUCTS

FARMER 2.0

- Livestock and crop production already use a whole arsenal of information technologies and robotics for precision farming, robotic dairy farms, etc.

TRIGGER

- The penetration of robotics and informatization that change the production process and people's work.

2030

3

FORESTERS AND RELATED WORKERS

FORESTRY 2.0

TRIGGER

- automation, digitalization and robotization of forestry.

- Forestry has already been using drones, lasers, scanners, infrared sensors, 3D sensing and visualization, and the Internet of things.
- Sensors, cameras, and other electronic devices connected to equipment and vehicles exchange data and interact over the Internet and can be controlled and monitored remotely. This is already common for timber carriers, where advanced telematics has changed the management of the fleet, warehouse, and timber warehouse. In-cab cameras, load measuring equipment, sensors that monitor the driver and engine, and onboard computers that combine and analyze all incoming information allow managers to manage the operation in real-time via a gadget (smartphone, tablet, or computer). Montigny, a South Africa's largest forestry company, that manages 55,000 hectares of timber in Swaziland, has developed and uses a new forestry strategy in Usutu. The strategy is based on a comprehensive system that uses micromanagement of every action from the control room: issues detailed work instructions, sets time frames, and performs quality checks using satellite images and drone video recordings. This system allows you to make deliberate verified decisions prescribed in the following instructions reduces errors to zero.

2030

4

FARMERS AND RELATED WORKERS

FISH BREEDER 2.0

TRIGGER

- automation, digitalization and robotization of forestry.

- Fish farming has already been using robotic feeders (for example, in Japan) on the high seas. Automatic feeders can serve food on a fixed schedule and contain a feed demand sensor (this helps reduce feed losses, increase efficiency, and minimize any impact on the marine environment), underwater cameras, and sensors that measure dissolved oxygen and water temperature. All information is available on personal computers or mobile phones.
- The blockchain is already being used (for example, by Fishcoin) to exchange information about the origin, catch, processing, and delivery of fish, providing a transparent and verifiable origin of each aquaculture product. In addition, blockchain will help overcome the fragmentation of the supply chain in the industry.

2030

5.1

MEAT AND FISH PRODUCT OPERATORS

MEAT AND FISH PRODUCT OPERATORS 2.0

TRIGGER

- automation, digitalization and robotization of food production (processing of agricultural products)

- "The growing trend in meat processing is the maximum automation and robotization of main processes: from animals' immobilization to packaging to intermediate storage of finished products."

2030

5.2

DAIRY AND CONFECTIONERY PRODUCTS OPERATORS

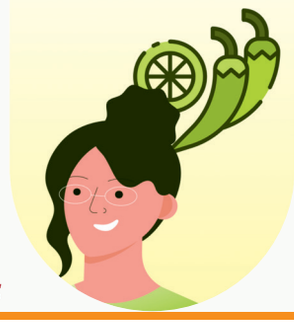
DAIRY PRODUCT MANUFACTURING OPERATOR 2.0, CONFECTIONERY PRODUCTION OPERATOR 2.0

TRIGGER

- automation, digitalization and robotization of food production (processing of agricultural products).

- "The Development of machine vision technologies, sensor systems, and AI help automation become more flexible and easier to adapt to the specifics of food production. Every year they increase their role in the food industry and its prospects."
- Just Born Quality Confections, a US company, has automated marshmallows production by using an automated pneumatic gripper.

2030



5.3

GRAIN PRODUCTS AND SPICES PRODUCTION OPERATORS

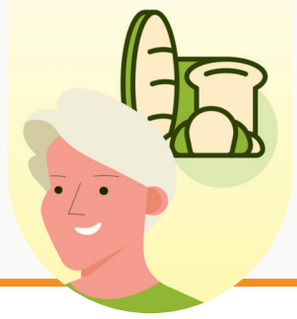
GRAIN PROCESSING AND PRODUCTION OPERATOR 2.0, SPICE PROCESSING AND PRODUCTION OPERATOR 2.0

TRIGGER

- automation, digitalization and robotization of food production (processing of agricultural products).

- Robotic systems are used to sort the product by quality or any other criteria. In recent years, the technology of automated sorting has developed rapidly. Sorting robots use lasers and various types of optics for detecting defects.
- A multispectral analysis is used to detect grains, seeds, and nuts contaminated with mycotoxins. For example, aflatoxins will fluoresce in ultraviolet light, allowing contaminated nuts such as almonds or peanuts to be removed from the process stream.
- Bühler, a Swiss multinational plant equipment manufacturer, has developed a system called LumoVision that uses such a technology.

2030



5.4

BAKERY AND GRAIN PRODUCTS OPERATORS

BAKERY PRODUCTS OPERATOR 2.0, GRAIN PRODUCTION OPERATOR 2.0

TRIGGER

- automation, digitalization and robotization of food production (processing of agricultural products).

- Bakery operations manage the process ("pick and place" robots) of moving pallets or sorting small-piece baked goods. Robotic systems with two robots are used for opening and unloading molds on the bread pan line. A robotic system is cutting dough pieces (loaves of bread).

2030

5.5

FRUITS, VEGETABLES, AND NUTS PRODUCT PROCESSING AND MANUFACTURING OPERATORS

FRUITS, VEGETABLES, AND NUTS OPERATOR FOR PROCESSING AND MANUFACTURING PRODUCTS 2.0

TRIGGER

- automation, digitalization and robotization of food production (processing of agricultural products).

- In automated raw materials laboratories, a robot, not a person, already determines the quality of sugar beet.

2030

5.6

SUGAR PROCESSING AND REFINING OPERATORS

SUGAR PROCESSING AND REFINING OPERATOR 2.0

- In automated raw materials laboratories, a robot, not a person, already determines the quality of sugar beet.

TRIGGER

- Automation, digitalization and robotization of food production (processing of agricultural products).

2030

5.7

BEVERAGE OPERATOR

BEVERAGE OPERATOR 2.0

- The production of beverages, such as tea, is also changing under the influence of robotics reducing labor costs. Raw materials are manually loaded into the line, and then the entire process of tea production is automated. The automated line performs drying of tea leaves, twisting, drying. The robot is also used for styling boxes with finished products on pallets.

TRIGGER

- automation, digitalization and robotization of food production (processing of agricultural products).

2030

5.8

FOOD, BEVERAGE AND TOBACCO OPERATORS

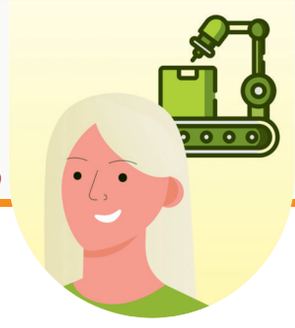
FOOD PRODUCTION OPERATOR 2.0, BEVERAGES PRODUCTION OPERATOR 2.0, TOBACCO PRODUCTS OPERATOR 2.0

TRIGGER

- automation, digitalization and robotization of food production (processing of agricultural products).

- Large food companies are actively cooperating with developers in automation, implementing their findings. The development of machine vision technologies, sensor systems, and AI helps robotics become more flexible and easier to adapt to food production.
- For example, a new cigarette packaging system that can handle the ever-changing shapes and sizes of tobacco products and packaging is already in use, developed by Siasun, a Chinese industrial robotics company. The new system uses a Delta robot to pack cigarettes in a package that is becoming increasingly unusual in its design.

2030



5.9

OPERATORS OF PACKAGING, FILLING AND LABELING MACHINES

PACKAGING MACHINE OPERATOR 2.0, FILLING MACHINE OPERATOR 2.0, MARKING MACHINE OPERATOR 2.0

TRIGGER

- automation, digitalization and robotization of food production (processing of agricultural products).

- Since robots do not get tired of performing repetitive tasks, they are the ideal solution for primary and secondary packaging, stacking finished products on pallets, as well as for industrial laser marking (robotic systems with machine vision).

DISAPPEARING PROFESSIONS THE AGRICULTURAL INDUSTRY

6.3.

▶ 2025

▶ 1

FEEDER (9211-2-003)

- Automated feeding systems for livestock, poultry farms and fish farms. Robots replace manual nursing labor.

▶ 2025

▶ 2

EGG RECEIVER (7511-9-046) (EGG SORTER)

- Robotic systems sort a product by quality or other criteria. Sorting robots use lasers and various types of optics to detect defects.

▶ 2025

▶ 3

TAGGER
(9321-0-001)

- Robots for industrial laser marking (robotic complexes with machine vision).

▶ 2025

▶ 4

WRAPPER
(MANUALLY) (9321-0-002)

- Automated and robotic systems are already being used for packaging chocolate bars, pralines, cookies, cakes, crackers, chips, and many other products.

▶ 2025

▶ 5

PACKER (MANUALLY) (9321-0-004) AND PACKER-PACKER (9321-0-005)

- One robot packer can perform the work of several human packers. Also, the robot can perform work without interruption 24/7. "The packaging robot interacts with the controller of an automated production line and a sensor system to detect incoming products, then captures the required number of product units and puts them in a container."

▶ 2025

▶ 6

SORTER
IN THE MANUFACTURE OF FOOD PRODUCTS (7515-0-003)

- Robotic systems are used to sort a product by quality or other criteria. Sorting robots use lasers and various types of optics to detect defects.

▶ 2025

▶ 7

WEIGHER
(4321-0-001)

- Van Aarsen has designed a mobile robot scale for automated bulk shipment

▶ 2025

▶ 8

STACKER-PACKER
(9321-0-003)

- We are already using robot packers and robot palletizers.

2025

9

MEAT PRODUCT PACKER
(7511-9-054)

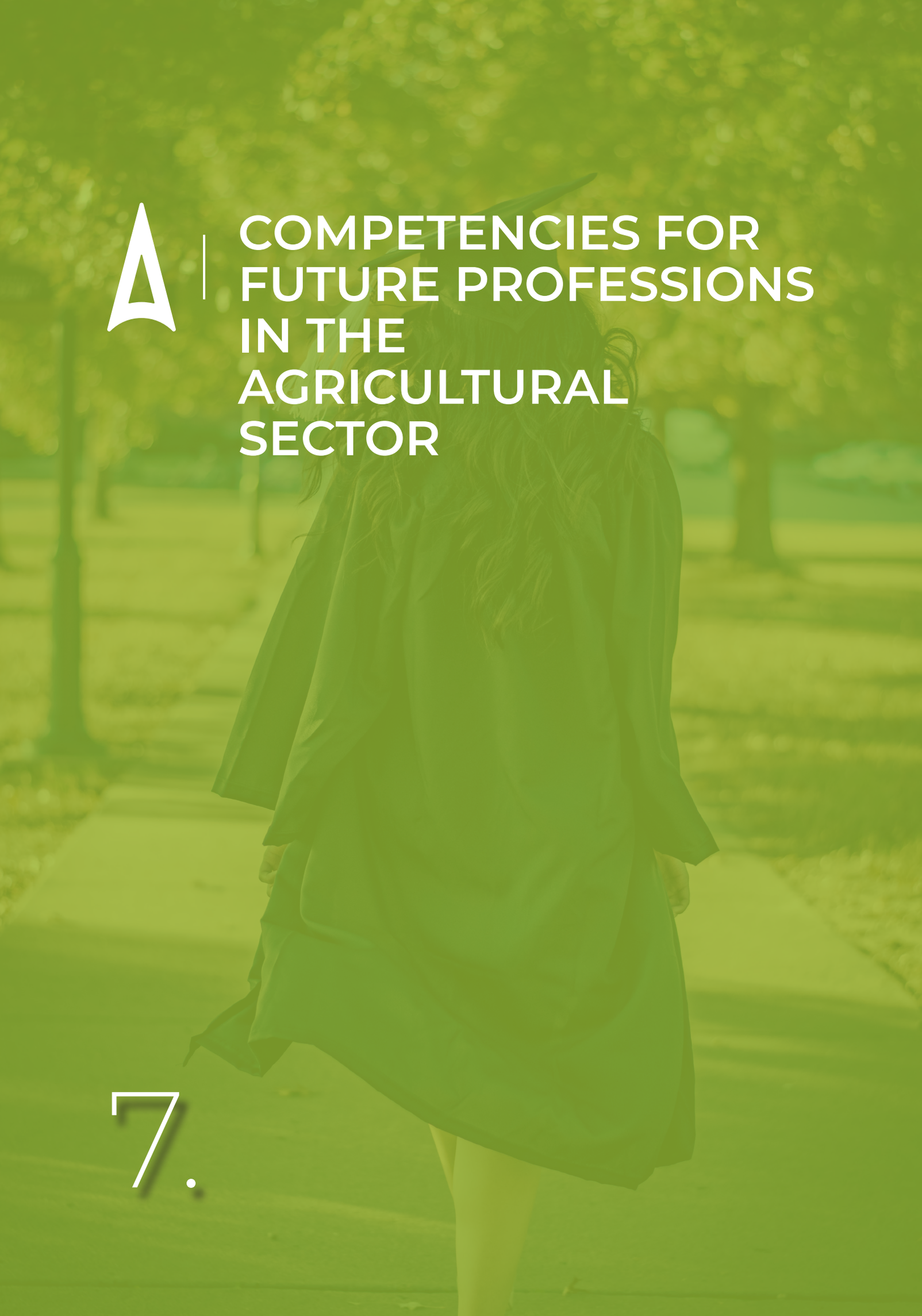
- Robotic butchering and slicing: fish butchering includes detecting and removing fish defects and slicing fillets to uniform shapes and sizes.

2025

10

LOADER
(9333-1-001) AND LOADER IN PRODUCTION (9333-5-001)

- Robotic loaders are already being used, and the robot is equipped with the necessary tools compatible with the truck and the product. Robots accurately and deftly perform loading/ unloading, while carefully handling the goods.



COMPETENCIES FOR FUTURE PROFESSIONS IN THE AGRICULTURAL SECTOR

7.

7.1.
COMPETENCIES FOR FUTURE PROFESSIONS IN THE AGRICULTURAL SECTOR

The rapid development of technologies of the Fourth Industrial Revolution, including digitalization, automation, expanding access to information, changing generations of specialists and workers in the industry, environmental standards-these are the driving forces that change the requirements for employees' professionalism in the agricultural industry.

The biggest challenge for future professionals, of course, will be digitalization, automation, and robotization of production. AI, robots, and autopilot technology will replace humans, but not in all sectors.

Therefore, not to get lost and find their place in the future labor market, young people today need to master the competencies and skills that will make their work irreplaceable. What does it mean? Of course, the need to master professional knowledge and skills at the Institute, vocational school, or University will not disappear.

It will be a kind of a passing ticket to the labor market. But to win the competition with machines, you need to develop the ability to communicate with different people and the ability to work in a team, train the willingness to solve problems, and the desire to think outside the box. These competencies are universal for all professional fields of activity.

Let's first understand what competence is. According to the European Qualifications System[76], competence is a confirmed ability to use knowledge, skills, personal, social and / or methodological abilities in work or training situations, in professional, and personal development.

The term "competence" is quite broad and generally refers to the ability of a person who is faced with new situations and unforeseen difficulties to use and apply knowledge and skills independently.

But let's go back to the agricultural sector. Whether it is a large agro-industrial enterprise or a small farm, at the heart of agricultural production there are professionals who are responsible for everything that happens. We call them farmers.

Their professional and business qualities, responsibility, and daily decisions drive and guide the development of the entire agricultural industry.

The role of farmers is unlikely to change (if at all). But to stay on the crest of the technological wave that is about to overwhelm the entire industry, they need new knowledge, skills, and abilities...

The future will require them to be leaders with well-developed communication skills.

A farmer must become a professional who can create and maintain all the important relationships during the technological cycle and beyond, and be able to motivate, engage and develop other people. Let's take a closer look at what a farmer should know and do in the future.

[76] *https://ec.europa.eu/esco/portal/escopedia/Competence*

TECHNICAL COMPETENCIES:

- A professional has knowledge in several areas: soil, biology, plants, animals, ecology, and any other fundamental area.
- A professional has analytical skills related to data and information.
- A professional actively introduces new technologies "here and now." At the same time, he can connect technological innovations with the existing infrastructure on the farm, eliminating the gap between the new technology and the field/farm / equipment/production data[77].

MANAGERIAL COMPETENCES:

1. A professional is a leader of changes based on their entrepreneurial thinking, digital technologies, data processing, technical equipment of the entire production, knowledge of the soil, plants, and animals to achieve not only financial but also environmental goals.
2. A professional has a strategic mindset, and risk assessment is one of the key priorities of their work[78].
3. A professional understands that the industry is moving to a model of "market attraction" ("the market requires a certain type of product, and manufacturers respond, produce and supply this product[79]"). The entire food and product distribution system moves from a supply chain mentality to a differentiated demand-based system. Therefore, the key skill for a farmer is the ability to produce for today's consumers. Farmers must have the skills to work in an interdependent system that focuses on relationships and cooperation.

[77] *https://cahrc-ccrha.ca/sites/default/files/StuartCULLUM_en_0.pdf*
[78] *https://www.farmprogress.com/technology/3-skills-tomorrow-s-farmer-will-need*
[79] *Jon C. Dixon The "Market Pull" versus "Technology Push" Continuum of Engineering Education. University of St. Thomas BFGoodrich Aerospace*

COGNITIVE COMPETENCIES:

- A professional builds communication effectively. They listen to understand and can clearly and convincingly present ideas and complex concepts to a wide range of listeners.
- A professional has emotional maturity. They understand and control emotions while simultaneously showing empathy for others and using these skills to lead others.
- A professional knows how to make difficult decisions. They think analytically, conceptually, and adaptively. They can understand new information at various detail levels.

LEADERSHIP COMPETENCES:

- A professional welcomes and supports versatile thinking. They use the power of diversity to capitalize on cultural differences, gender differences, different experiences, and generational differences.
- A professional builds relations of cooperation with clients, employees, global knowledge networks to achieve business goals.
- A professional uses an engagement tool to achieve their goals: encourages teamwork, aligns differences, and uses different talents of people.
- A professional takes over the mentor's role, consistently trains, and mentors employees to help them achieve personal and team success and grow the next generation of professionals.
- A professional builds trust in the broadest sense of the word. They manage human resources and processes so that people in a stressful situation could confidently rely on themselves and their competency.

7.2.
THE COMPETENCE OF THE FUTURE UNIVERSAL FOR ALL INDUSTRY PROFESSIONALS

The agricultural industry has a lot of specialists and workers involved in the process of creating a product at different stages. Let's look at the universal competencies for everyone who will work in agriculture in the near future.

The Atlas has identified the key competencies that specialists will need in the agricultural industry in the future.

All key competencies were divided into four categories:

1. social and personal competencies,
2. intellectual skills,
3. technological skills,
4. functional competencies in the field of corporate governance.

1 SOCIAL SKILLS

It is not enough for a specialist of the future to work with machines (machinery, equipment). They need to manage their personalities and interact with other people.

In the context of technology development, a requirement to build a trusted communication network to meet emotional needs will increase. Social networks, new production communities, and temporary project teams will require specialists to negotiate, cooperate, present, moderate, and facilitate the work of groups.

These skills will become a separate vector of training and self -improvement of future specialists.

2 INTELLECTUAL SKILLS

Experts agree that robots and AI will perform an increasing number of processes and functions soon. By 2030-2040, however, a person will lose to a machine in performing routine tasks. How do we win the competition? Thinking is one of the few areas where machines have not yet penetrated. Critical, creative, systemic, and other thinking styles are available only to humans and will remain their monopoly for the foreseeable future. Even today, specialists of the future should purposefully develop their thinking styles and techniques. Only in this case will we gain a foothold in the future with machines and make them assistants that collect data for us and perform simple functions for us and those that are easy to algorithmize.

3 TECHNOLOGICAL SKILLS

In the middle of the last century, computer experts believed that computer literacy would be as necessary for a person as the ability to read and write by the beginning of the 21st century. We see that their forecasts have come true. Digitalization gives a person a volume of information thousand times larger than it was at the beginning of the century. A large amount of loosely structured data is called Big data. This data contains information based on which a manager will make more informed and more objective decisions. The volume of information is growing every day. But without processing, this information is useless.

Therefore, the industry will need such specialists who can identify data collection points and tools, structure and analyze them, and provide structured information to the Manager for deci-

4 CORPORATE SKILLS

At the core of industrial companies of the 20th century were factories and corporations. These are large organizations that can bring together a large number of specialists and organize mass production. According to experts, the core of business in the XXI century will be digital platforms. On the horizon of 10-15 years, we will synthesize organizational models of the 20th and 21st centuries.

Modern corporations are clumsy and overly hierarchical. If an employee wants to propose, he/she will spend a long time going through all the stages of approval, change the current regulations, overcome inertia and resistance to changes. The lower the employee's position in the corporate hierarchy, the more difficult it is to complete these procedures.

The key to success in competition is fast decision-making and implementation. In the future, the demand for this speed will only increase.

To overcome this disadvantage, modern corporations are changing their management style. Organizations of the future provide all dedicated employees who have an innovative idea of improvement with the opportunity to express themselves, regardless of their position in the hierarchy. To take advantage of this opportunity, an employee needs to master some skills, e.g., management, agile planning.

Employees who have ideas for improvements and can self-organize to implement them will be the driving force for future companies.

During the survey, leading experts of the Kazakhstani agricultural industry identified several competencies in the group of ***social and personal competencies*** that a professional should have in the near future. First of all, to be sought-after and successful in the agricultural industry in the future, specialists at all levels ***need to learn quickly, retrain, and adapt to new situations throughout their working life.***

Figure 7.1.

SOCIO-PERSONAL competencies in demand in the agricultural industry in 10-15 years

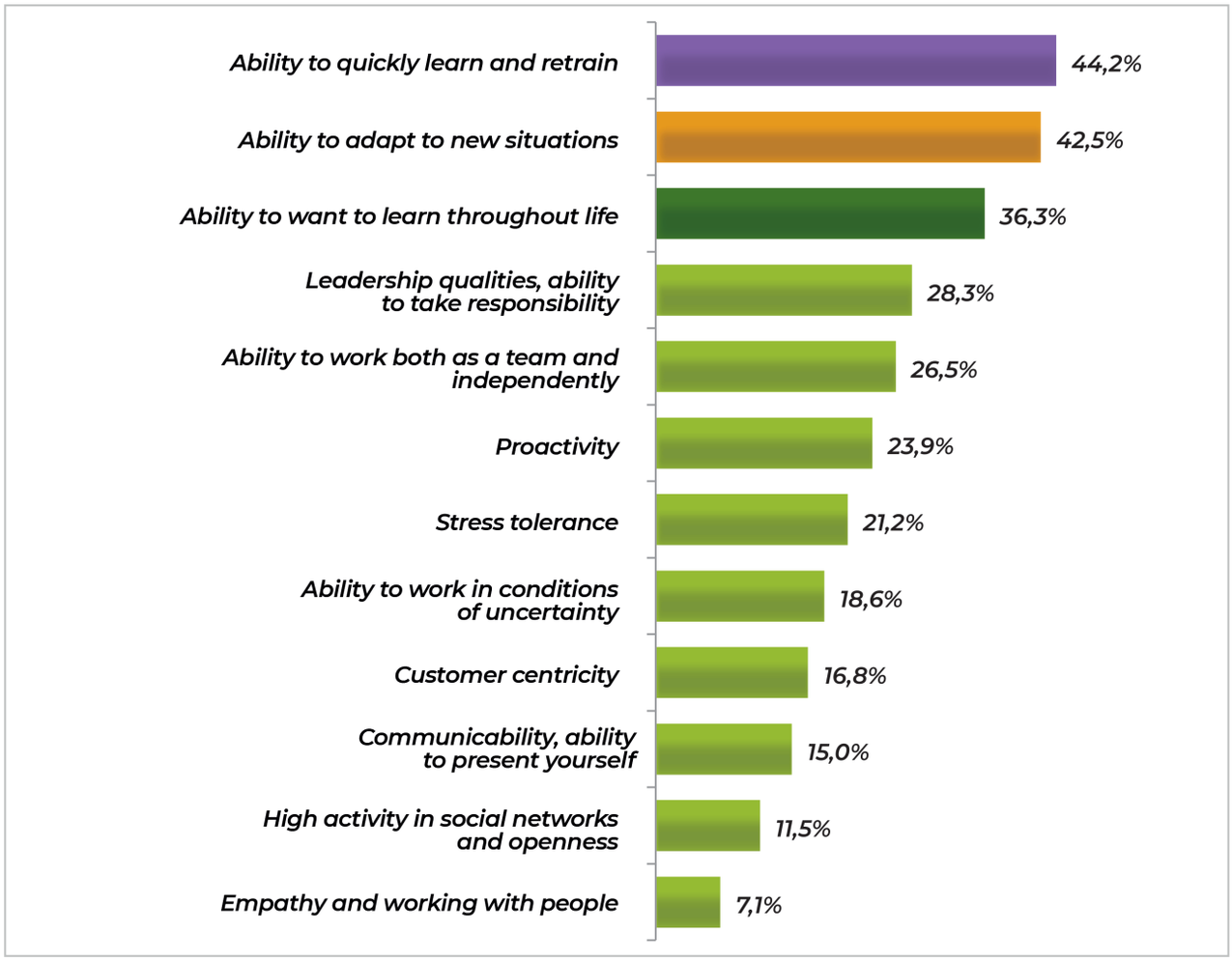
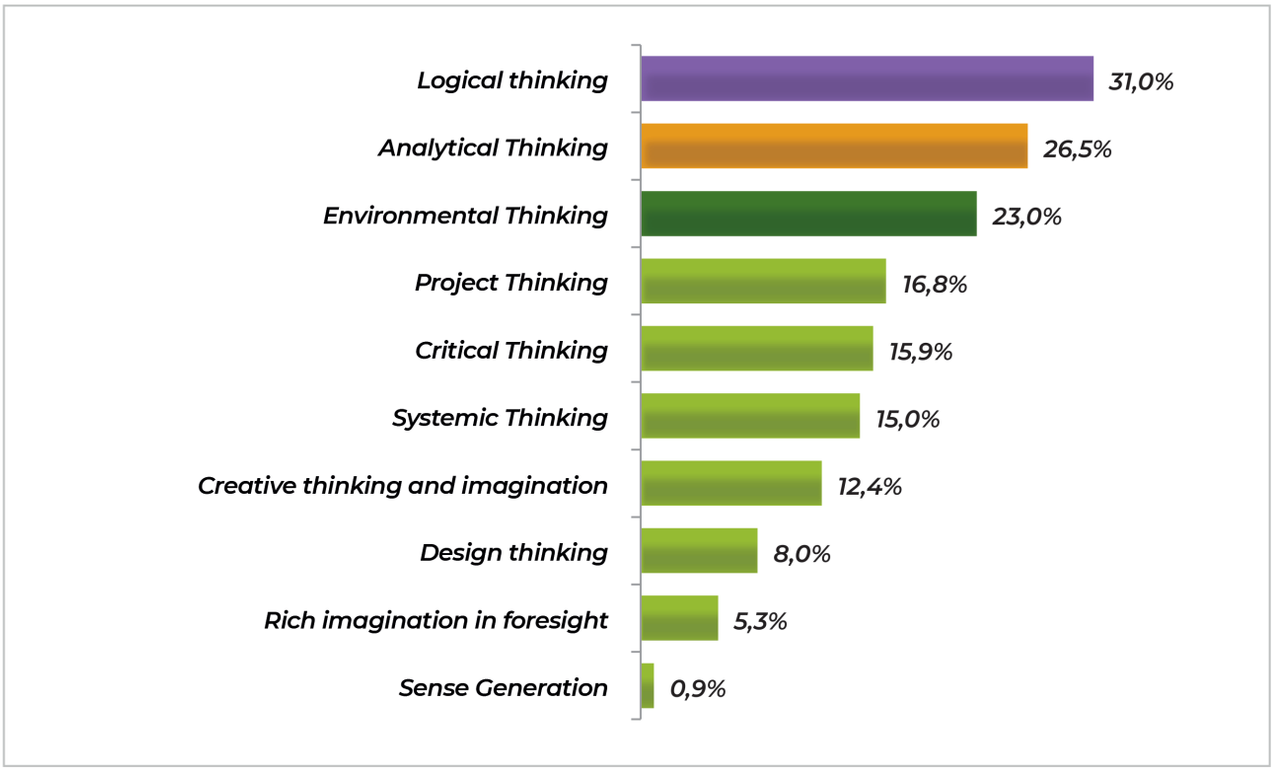


Figure 7.2.

Employee THINKING STYLES that are in demand in the agricultural industry in 10-15 years



To find solutions quickly in a changing world filled with different people and the latest technologies, one needs to use different thinking styles.

The experts emphasized three of them: logical thinking, analytical thinking, and environmental thinking.

Working in an environment that is filled with the latest scientific and technological progress fully requires logical thinking from a specialist. These people are not guided by assumptions or biases or what seems right. Logically minded people, experts observe and analyze and then draw conclusions based on the data obtained. They can justify their strategies, actions, and decisions based on the facts they have gathered.

On the other hand, some problems and tasks may require a creative approach, while others may require only a clear, methodical approach. Both ways of solving the problem need an analytical style of thinking.

Agriculture, in many ways, will continue to depend directly on nature, on its condition. In the face of rapid climate change, loss of biodiversity, and water scarcity, it has become clear that the world's agriculture economy must move quickly and decisively to sustainable development. To make the required transition, it is necessary to replace non-renewable resources with

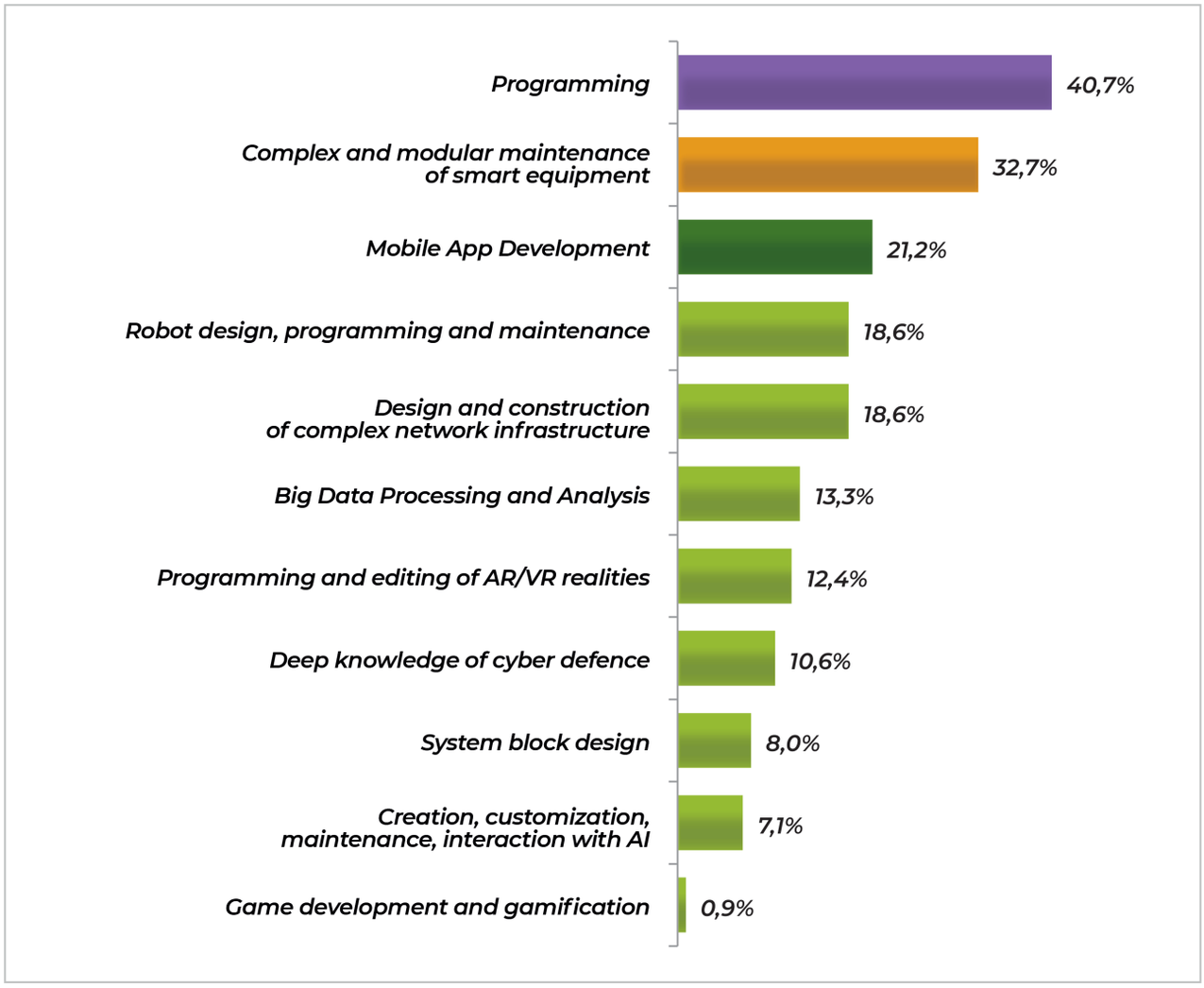
qualified personnel with environmental thinking, so the importance of ecological thinking among agricultural specialists is quite natural.

The whole idea of the current changes in the world and the industry is based on an indisputable fact – this is the impending wave of digital technologies. Therefore, as expected, the experts have identified the ability to program and develop mobile applications as the most important competencies for specialists soon.

Following the digital competencies[80], experts consider it important to perform complex and modular maintenance of smart equipment.

Figure 7.3.

Competencies demanded in the agricultural industry in 10-15 years for working with NEW TECHNOLOGIES

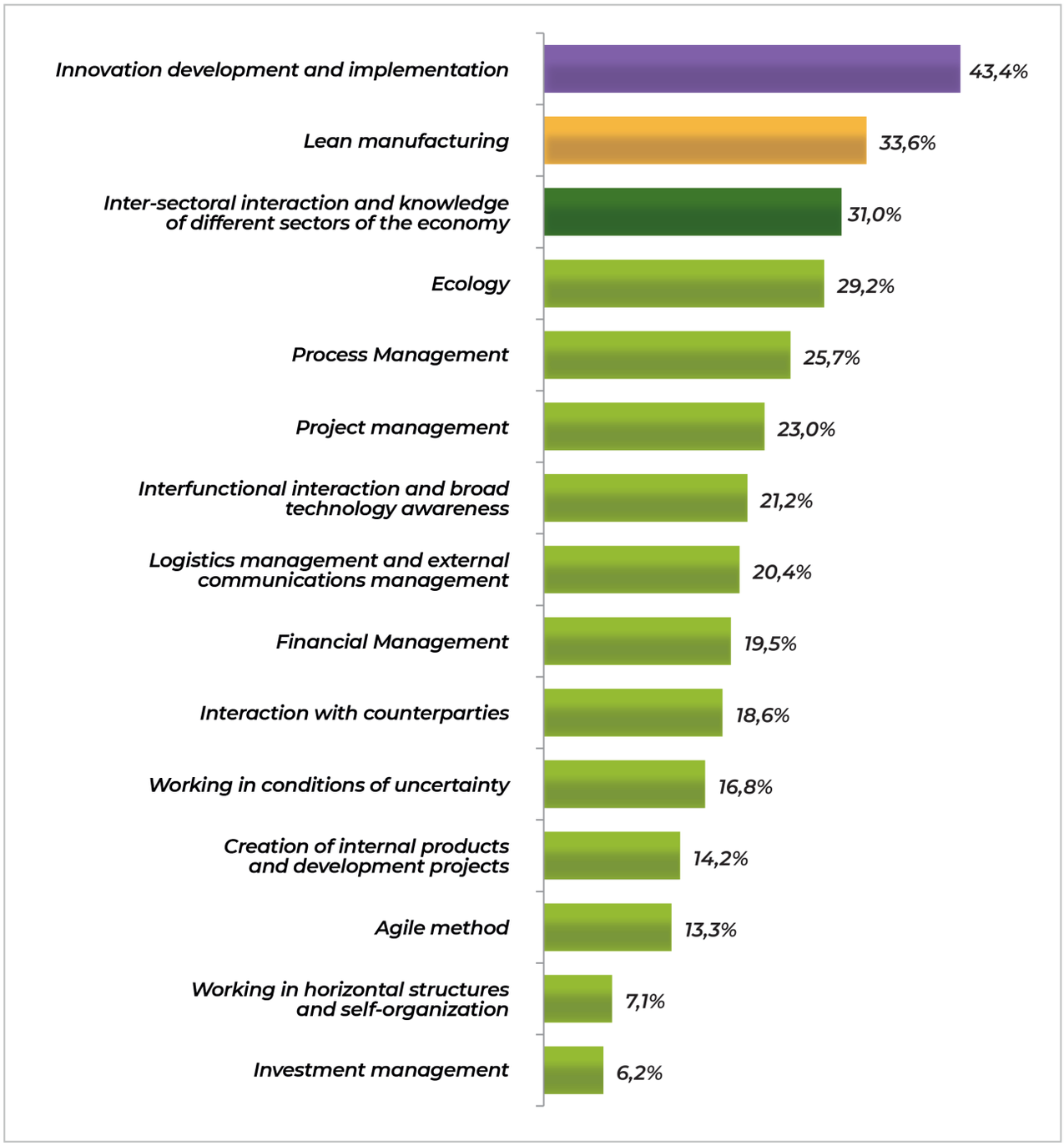


[80] *http://obzory.hr-media.ru/cifrovye_navyki_sotrudnika*

The Fourth Industrial Revolution forces us to reconsider the foundations on which companies and corporations' work is based. We have already said that global business leaders have a new understanding of how their companies work. Now business works in the interests of customers, employees, suppliers, and communities, not just their shareholders. This movement corrects the principles of ***corporate governance***.

Figure 7.4.

Competencies demanded in the agricultural industry in 10-15 years, in the field of CORPORATE GOVERNANCE.



Most of the experts noted that developing and implementing innovations is the key to success farms and large agricultural enterprises in modern, rapidly changing conditions

Lean manufacturing is becoming relevant not only in industrial production but also in agriculture. Reducing losses in the production of products, reducing associated costs should become new sources of increasing production in the agricultural sector.

Intersectoral interaction, such as trade, agriculture, and small industrial enterprises, is designed to reduce transaction costs for agricultural producers. It is one of the ways to expand production. The ideas of the new time that came with the Fourth Industrial Revolution were also reflected in new methods of production management in agriculture:

- Lean production(LEAN);
- Event modeling(ECM);
- Methods of PRISM.

The use of LEAN production in agriculture can reduce energy consumption, eliminate chemical fertilizers and pesticides, and significantly reduce losses by avoiding overproduction and reducing waste[81].

To achieve these results, it is necessary, first of all, to radically change the thinking of farmers[82].

Agricultural production is seasonal. The time period of operation does not coincide with the production period. The dependence on weather conditions is extremely high, and the long production period does not allow a quick response to changes in the market situation.

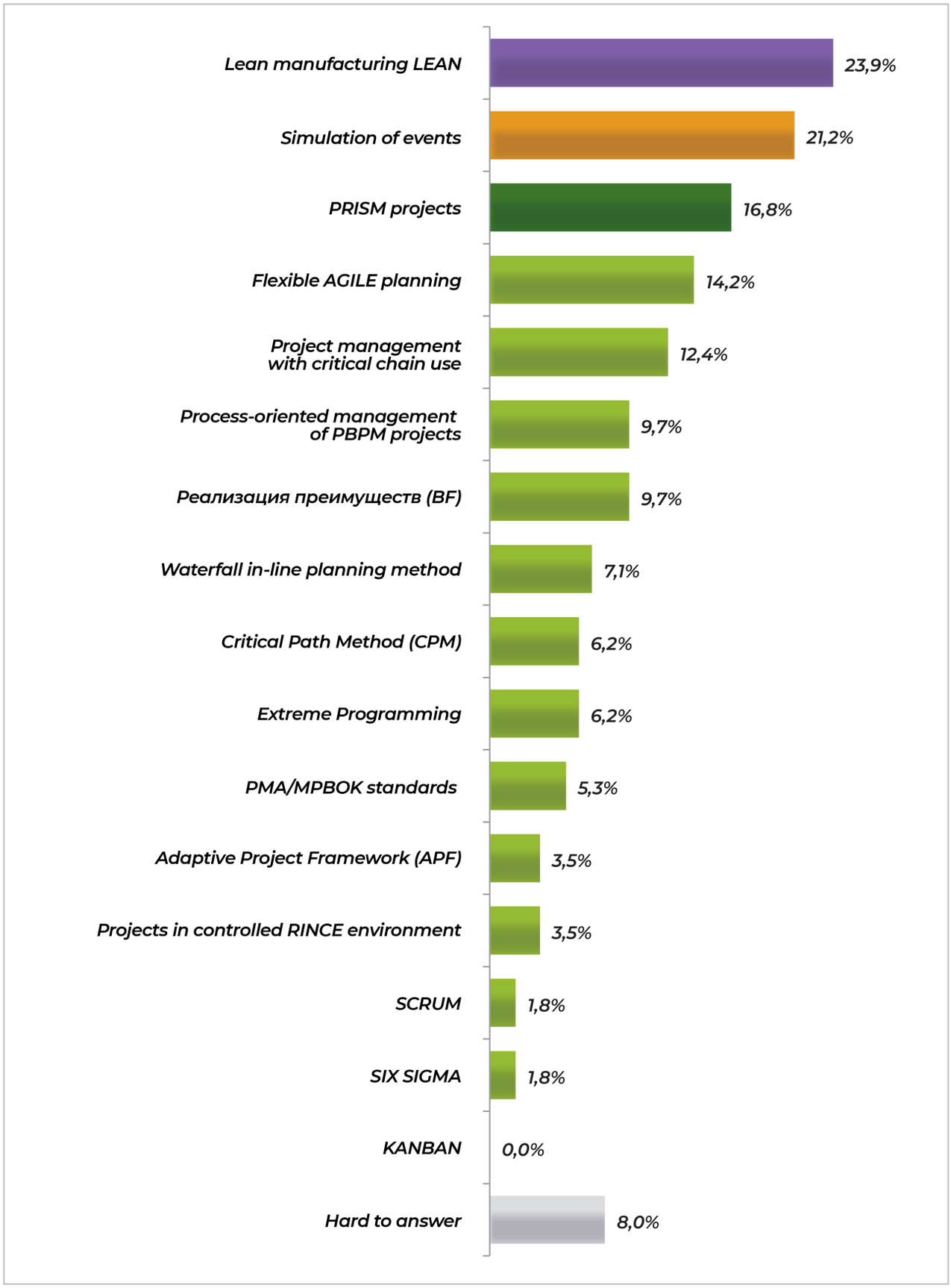
The answer to all these challenges is the project management method of event Modeling (ECM). During the production cycle or the implementation of a project, events almost always occur to "break" the entire schedule and deadlines. To manage this risk, you must try to identify these events in advance.

Modern companies understand that the use of best practices in one area of business cannot compensate for the damage caused in another area of business. Therefore, the company that uses PRISM bears its part of the responsibility for the observance of human rights, compliance with the labor code, respect for nature, and the fight against corruption[83].

[81] *Source: https://planet-lean.com/jim-womack-lean-farming/*
[82] *Source: http://www.fareasternagriculture.com/crops/agriculture/lean-farming-can-make-agricultural-operations-more-effective-says-experts.*
[83] *Source: https://greenprojectmanagement.org/prism-methodology*

Figure 7.5.

PROJECT MANAGEMENT competencies demanded in the agricultural industry in 10-15 years.



WHERE TO STUDY FOR NEW PROFESSIONS IN KAZAKHSTAN

8.


KAZAKH NATIONAL A
VETERINARY SCIENCE

LOCALIZATION OF NEW PROFESSIONS IN THE AGRICULTURAL SECTOR IN THE HIGHER EDUCATION INSTITUTIONS OF KAZAKHSTAN

The next stage in the development and implementation of the Atlas of New Professions in Kazakhstan is the localization of new professions. As part of the process, the experts suggested 14 universities from Table 8.1. These universities already have an Agronomy as a basic specialization, have a high rating of NCE "Atameken" 2019, and additional facilities that allow to organize training in related specialties.

Table 8.1.

Ranking of universities for localization of new professions in the agricultural sector of the Republic of Kazakhstan*.

	Universities	Rating	Number of new professions
1	Sh. Ualikhanov Kokshetau University	3.80	7
2	Shakarim State University of Semey	3.572	14
3	North Kazakhstan State University named after M. Kozybayev	3.571	7
4	M. Kh. Dulati Taraz State University	3.48	16
5	Zhangir Khan West-Kazakhstan Agrarian-Technical University	3.45	10
6	S.Seifullin Kazakh Agro Technical University	3.31	7
7	Toraighyrov University	3.22	12
8	Kazakh National Agrarian University	3.04	16
9	Kostanay State University named after Akhmet Baitursynov	3.01	7
10	Kostanay engineering and economics university named after M. Dulatov	2.87	5
11	M.Auezov South Kazakhstan university	2.82	16
12	Kyzylorda State University named after Korkyt Ata	2.33	6
13	Kh. Dosmukhamedov Atyrau State University	1.57	2
14	Shymkent University*	1.22	1

**Source of the University rating*[84]

[84] *https://atameken.kz/uploads/content/files/%D0%90%D0%B3%D1%80%D0%BE%D0%BD%D0%BE%D0%BC%D0%B8%D1%8F(3).pdf*


One more for good measure.
FEDOR

Table 8.2 shows 18 new professions in the agricultural sector, as well as educational specializations, on the basis of which it is possible to expand the localization of new professions. Localization of new professions is an activity aimed at developing teaching materials and special training practices to teach knowledge, skills and competencies for new industry challenges.

Table 8.2.

The list of faculties required for the localization of new professions in the engineering industry of the Republic of Kazakhstan.

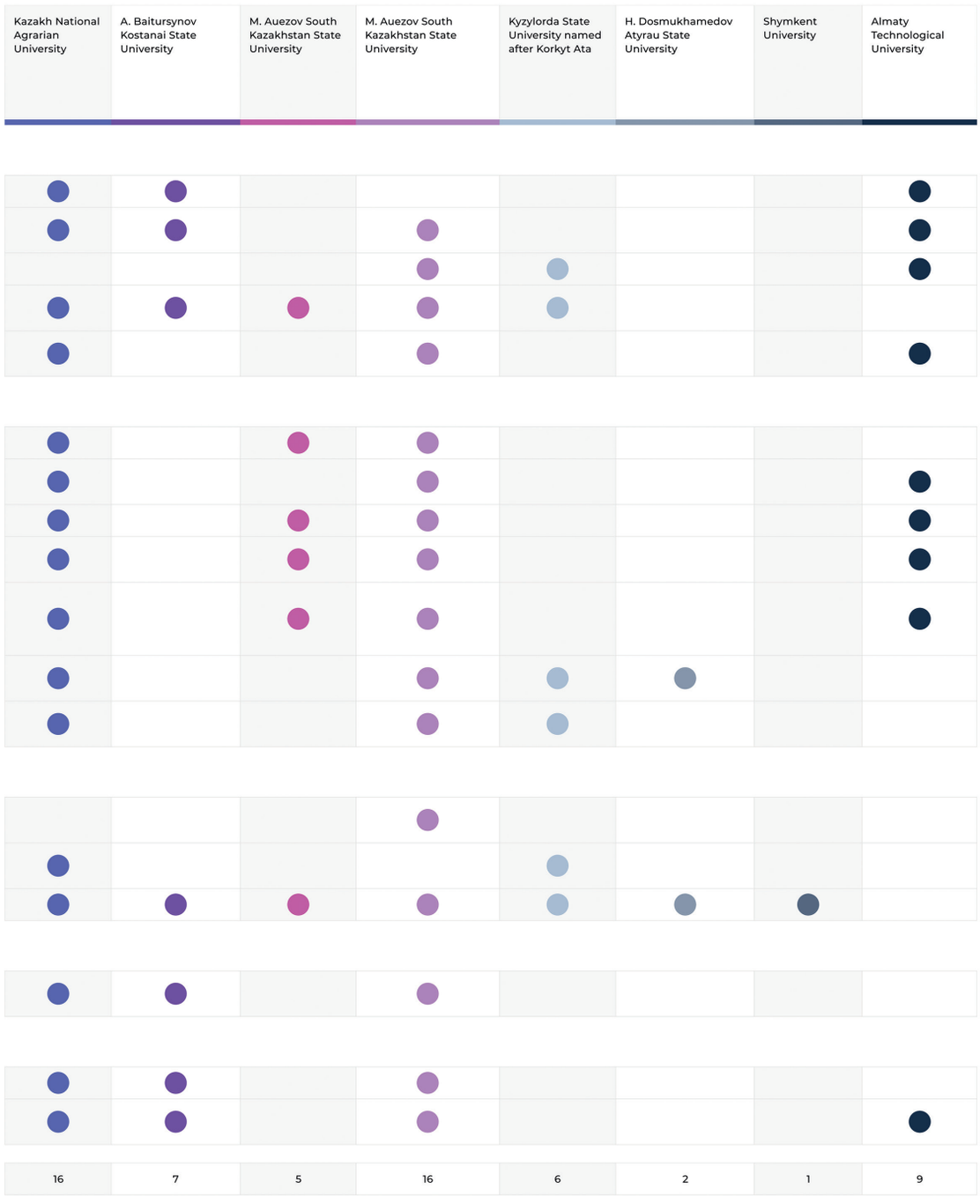
	Profession	List of faculties and departments required to localize new professions in the industry
1	**"ENVIRONMENTAL" PROFESSIONS**	
1.1	Ecotechnologist	▶ 5B072800-Technology of processing industries (by industry), ▶ 5B060800-Ecology ▶ 5B070100-Biotechnology
1.2	Biotechnologist-microbiologist of aquasystems	▶ 5B060800-Ecology ▶ 5B070100-Biotechnology
1.3	Eco-packaging specialist	▶ 5B060800-Ecology ▶ 5B072000-Chemical technology of inorganic substances, ▶ 5B072100-Chemical technology of organic substances
1.4	Ecosystem management technologist	▶ 5B060800-Ecology ▶ 5B073100-Life safety and environmental protection
1.5	Technologist of innovative biological products	▶ 5B060800-Ecology ▶ 5B070100-Biotechnology
2	**«DIGIT» and «ROBOTS»**	
2.1	Digital agronomist	▶ 5B080100-Agronomy ▶ 5B070200 - Automation and management

	Profession	List of faculties and departments required to localize new professions in the industry
2.2	Robotic livestock breeder on dairy farms	▶ 5B080200-Technology of production of animal products ▶ 5B070200 - Automation and management
2.3	Robotics operator	▶ 5B070400-Computer engineering and software ▶ 5B070200 - Automation and management
2.4	Product Tracking Engineer	▶ 5B070200 - Automation and management ▶ 5B070300-Information systems
2.5	Automation and robotization engineer for agricultural production (Agroinformatics)	▶ 5B070200 - Automation and management ▶ 5B070400-Computer engineering and software
2.6	IT engineer for Water Resources Management	▶ 6D080500-Water resources and water use ▶ 5B070300-Information systems
2.7	IT Engineer Land Management	▶ 5B090300-Land management ▶ 5B070300-Information systems
3	**«SALES INSIDE THE COUNTRY. EXPORT. DIGIT»**	

	Profession	List of faculties and departments required to localize new professions in the industry
3.1	Agricultural export specialist	▶ 6M073200-Standardization and certification ▶ 5B020200-International relations
3.2	Business continuity manager	▶ 5B090900- Logistics (by industry). ▶ 5B070300-Information systems ▶ 5B050900–Finance
3.3	Agronomist-economist	▶ 5B080100-Agronomy ▶ 5B050900–Finance ▶ 5B070400-Computer engineering and software
4	**«INNOVATIONS»**	
4.1	Specialist in new technologies in agriculture	▶ 5B070100-Biotechnology ▶ 5B080100-Agronomy
5	**«GENETICS»**	
5.1	Agrogenetic	▶ 5B070100-Biotechnology ▶ 5B080100-Agronomy
5.2	Biotechnologist in synthetic biology	▶ 5B070100-Biotechnology ▶ 6M072100-Chemical technology of organic substances

TABLE 8.3.
LOCALIZATION MAP OF NEW PROFESSIONS IN UNIVERSITIES OF KAZAKHSTAN

№	Name of the profession	Kokshetau State University Sh. Ualikhanov	Shakarim State University, Semey	North-Kazakhstan State University named after M.Kozybayev	Taraz State University n.a. M.H. Dulati	West-Kazakhstan agrarian-technical university named after Zhangir khan	Seifulin Kazakh Agricultural Technical University	Pavlodar State University named after S.Toraigyrov
Direction "Ecological" professions								
01	Ecotechnologist	●	●		●	●	●	
02	Aquasystems biotechnology microbiologist	●	●	●	●	●	●	●
03	Specialist in eco-tare		●	●	●	●		●
04	Technologist for ecosystem management	●	●	●	●	●	●	●
05	Technologist of innovative biological products	●	●		●	●		●
Direction "Numbers" and "Robots"								
01	Digital agronomist		●		●			●
02	Robot technician-animal breeder on dairy farms		●					●
03	Operator of robotics		●		●			
04	Product Tracking System Engineer		●		●			●
05	Agricultural Automation and Robotization Engineer (Agroinformatik)		●		●			●
06	IT Engineer for Water Resources Management				●			
07	IT-engineer for land management				●	●	●	
Direction "Domestic Sales. Export. Number"								
01	Specialist in export of agricultural products				●			
02	Business Process Continuity Manager							
03	Economist agronomist	●	●	●	●	●	●	●
"Innovations" Direction								
01	Specialist in new technologies in agriculture	●	●	●	●	●	●	●
Direction "Genetics"								
01	Agrogenetic	●	●	●	●	●	●	●
02	Biotechnologist in synthetic biology		●	●	●	●		●
	Total:	7	14	7	16	10	7	12


Kazakh National Agrarian University
A. Baitursynov Kostanai State University
M. Auezov South Kazakhstan State University
M. Auezov South Kazakhstan State University
Kyzylorda State University named after Korkyt Ata
H. Dosmukhamedov Atyrau State University
Shymkent University
Almaty Technological University
16
7
5
16
6
2
1
9

CONCLUSION

9.

CONCLUSION

The agro-industrial sector of Kazakhstan is to become one of the most important drivers of the country's economic growth in the near future.

In fact, the agro-industrial complex should become a "new oil" for the country. Now the industry is a workplace for more than a million Kazakhstanis. The success of the agro-industrial complex– this is the food independence of the Republic. The development of agriculture in the next 10-15 years will show whether Kazakhstan's economy will be able to overcome the risky dependence on the extractive sector and move to a diversified development model.

Expert surveys and discussions in foresight sessions clearly showed that the industry has a clear understanding of the forces that are changing agricultural production now and will soon reshape it. First of all, the current state of agriculture is determined by two of the most influential trends – the need to increase economic returns and reduce the number of people employed. The industry is also affected by the need for green production and the depletion of natural resources (water problem).

In response to the destructive pressure of trends, it unfolds the other is digitalization and the growing demand for the industry's technological renewal.

Speaking about the industry's digitalization, first of all, we mean the use of precision farming technologies and specialized robotics in farms (so far, only large ones). Precision farming and robotics, with large initial investments, can increase production profitability, reduce to a minimum the loss of materials (seeds, fertilizers, water, etc.), and reduce the labor intensity of production.

Of course, the industry's digitalization and robotization will be based on two pillars: digitization and automation of production in crop and livestock production. However, digital technologies will bring a lot of other, sometimes unexpected, and useful changes to the industry. For example, consumers will track the entire production process of a product from the field to the

counter using cloud solutions. Production will become transparent, and only those who accept this innovation will win the competition for the buyer. Manufacturers will be able to consciously plan and make decisions "what to produce, for whom to produce and what are the chances of successful sales" using monitoring technologies, AI, big data, and proactive logistics. Digitalization will help Kazakh producers "cut through Windows" to the markets of other countries. Products will initially be "cut" in compliance with the regulations and standards of the importing markets. Consumers in these markets will be fully informed about the production process, about the compliance of products with all necessary standards. Such digital transparency will be an indispensable help in promoting Kazakhstan's products on foreign markets.

The problem of increasing economic returns will not remain in the focus of attention of Kazakhstani producers forever. The industry will either cope or go into final decline (but this is unlikely to happen). Sooner or later, the issue of increasing the greening of agricultural production will become acute.

Organic farming is already actively developing in Kazakhstan. Although the share of "organic" is still small and all this is produced for export to the EU, positive experience and increased environmental awareness among consumers, especially among young people of generations Y and Z, will inevitably lead to the fact that ordinary farms will take some elements of organic farming.

Therefore, production methods, the pressure of the economy on the ecosystem, and the expenditure of resources - the choice of specific solutions at each technological stage will be environmentally friendly.

Over time, the experience of successful Kazakh agricultural producers will finally become the norm for the industry. What do we mean by that? No new technologies will make life in the village more attractive if social, and household problems are not solved. Living conditions are just as important as working conditions. It will become undeniable when qualified specialists are needed to work on new technologies. Attracting and retaining these people is possible only if life in villages becomes comfortable.

The final expert community’s task was to list new professions that will appear in 10-15 years in domestic agriculture and worldwide. Eighteen new professions will be at the heart of the industry's changes. Everything will, as expected, line up around "numbers", "ecology", "sales", "innovations" and "genetics".

All the accumulated information will serve as a guide for people who will work in agriculture or are already part of the industry, to clearly understand what is waiting for everyone behind the inevitable technological turn, which will help meet the future fully prepared.

RESEARCH PRJOECT TEAM

10.

RESEARCH PROJECT TEAM

**** Members of the research team that performed work within the framework of the project "Atlas of new professions and competencies of the agricultural industry of the Republic of Kazakhstan»***

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8. Abdykaparov Baurzhan	National expert
9. Syzdykov Teleutay Usenovich	National expert
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- ALE "Union of Food Enterprises of Kazakhstan"
- ALE Association "Fat and Oil Union of Kazakhstan"
- ALE&I "Union of Poultry Farmers of Kazakhstan"
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- Fund for saving the Aral Sea in the Republic of Kazakhstan
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- Kazakh National Agrarian University
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- NCE RK "Atameken"
- North Kazakhstan University named after M.Kozybaev
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- ROO "Union of Farmers of Kazakhstan"
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- Toraighyrov University
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