себептері айқындалған. Қазақстанда сүтті өндіруге және өңдеуге кедергі келтіретін проблемаларды шешу үшін бірқатар ұсыныстар әзірленді.

SUMMARY

In this article, the author has studied the importance of milk production and processing to ensure the food security of the country. The main factors affecting the level of productivity of dairy herds were identified. The article identifies the reasons for the low quality of raw milk that impede the development of the dairy industry in Kazakhstan. Series of proposals on addressing the problems hindering the development of milk production and processing in Kazakhstan were developed.

UDC 338.43

INNOVATIONS AND PRODUCTIVENESS IN AGRICULTURE: HOW FAR COULD THEY TAKE US?

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ABSTRACT

This research paper is *aiming* to explain the role of innovation in agriculture sector in terms of in increasing its productivity.
Methodological parts of the research paper consist of several methods such as comparison of socio – economic data, regression, correlation and trend analysis.
Originality/value – The value of the research is that the interdependence of innovation and productivity is proved that depends on time interval whether is happens in short run or long run, because of fluctuation in agriculture sector development.
Finding – Results of the research are based on multiplicative effect of considering combination of innovation in agriculture and its impact on productivity of agriculture that leads to develop strong agricultural cooperation in Kazakhstan, as well as increasing funding for innovation in sector of economy, significantly emphasize productivity of farmers in livestock production.
Key words – innovation, productivity, gross agricultural output, crop and livestock production.

INTRODUCTION

The research topic innovation in agriculture is ample scope for empirical studies. It is known, that innovation issues in agriculture have long history depending on economic background of the country. Nevertheless, it needs further deep research particularly in case of Kazakhstan. Innovation in agriculture incorporates several elements as entire system of variety of sectors, including research.

Organization for Economic Co-operation and Development (OECD) defines (2005) innovation in agriculture as a combination of product, process, marketing and organizational innovations (Figure 4). Innovation implementation varies depending on who implements – entrepreneurs, organizations and institutions, as well as government. The government's role is huge and strong in terms of innovation in agriculture. First, it can foster innovation in this particular area through effective policy that means providing with resources, especially, finances, service and knowledge. These three crucial elements build support system. Second, removing obstacles in regulatory frameworks such as legal, trade, and investment barriers. Third, strengthening human resources through a sound educational system that includes all levels of schooling and vocational training. Fourth, promoting research policy that encourages greater investment in research and development, seizing opportunities and creating effective linkages among all participants. Taking into account these mentioned details would be fundamentals for agricultural innovation systems. The key actors of this system are research and technological development organizations and farmers and farmer organizations. Latter providers of inputs or technical and financial services that promote the development of new knowledge. That we consider as innovation in agriculture if they are appropriately managed.

LITERATURE REVIEW

There are many studies devoted for research question – innovation in agriculture. Majority part explore innovation through technical change, knowledge transfer in order to improve its efficiency. Philip G. Pardey et al (2010) in their research mention the strong role of institutions in innovation implementation.

World Bank has conducted research 'How innovative іт your agriculture', which consider innovation system encompassing knowledge–education domain, business domain, and bridging institutions between of two domains.

Christine Greenhalgh and Mark Rogers study innovation on economic activity in variety sectors from the measurable indicators' point of view that is using appropriate quantitative indicators.

Fundamental research has been conducting for long time by the International Bank for Reconstruction and Development. The main outcome of the research is to increase complex agriculture markets, competitive advantage which connected with knowledge. It is possible taking into consideration only via interaction of institutions, coordination and emphasized link between them.

David J. Spielman considers innovation in agriculture through complex relationship between different actors (research partnerships, knowledge networks, industry clusters, state and non-state' such as public research organizations, private firms, and producer organizations demonstrating entire innovation process as knowledge applied by heterogeneous agents in order to solve social and economic problems.

Innovation in agriculture emerges in response to scarcity land, labour and economic opportunities of the enterprises. This point is discussed in research of David Sunding, David Zilberman. The authors reviews the generation and adoption of new technologies in the agricultural sector. Research describes models of induced innovation and experimentation. In this case, innovation process is tackled government in order to adopt.

Research conducted by Lawrence Klerkx et al 'Strengthening Agricultural Innovation Capacity: Are Innovation Brokers the Answer?' focus on multifunctional agricultural sector which is embedded in a fast-changing global context of market, technology, policy and regulatory settings that present both challenges and opportunities. These challenges can be tackled by government getting through combination of economic, social and environmental goals of the country.

All in all above mentioned and other researches the innovation defined as a key instrument for agriculture. However, lack of research studies connection between innovation and productivity in agriculture sector in Kazakhstani situation led us devote our research on this issue.

GENERAL ANALYSIS AND CONTEMPORARY TRENDS IN AGRICULTURAL DEVELOPMENT

It is true technological change has been a major factor shaping agriculture in all over the world, which refers to Kazakhstan as well. Last twenty five years harvested cropland has declined (from 35182.1 in 1990 to 21839.9 thousand hectares in 2018), the share of the agricultural labor force has decreased (from 1341 thousand people in 1998 to 1234.8 thousand people in 2018). However, Kazakhstani agriculture policy is targeted to solve these situations. Nevertheless, Kazakhstan has big potential to overcome them. Numbers show positive trend that are illustrated in figure 1.

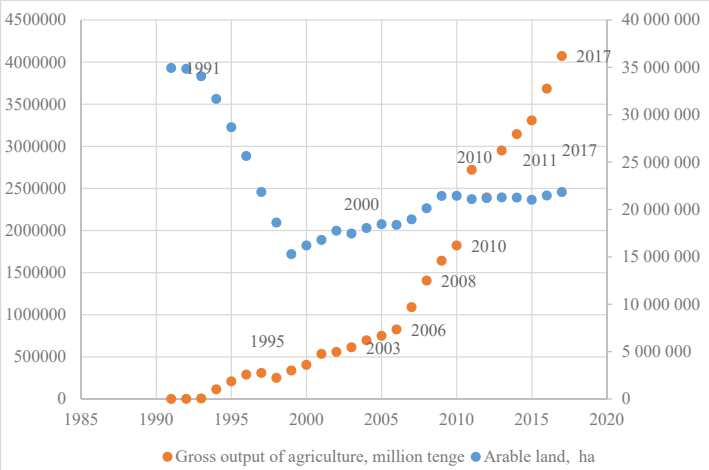

Figure 1 - Dynamic of arable land and gross output of agriculture in Kazakhstan, 1991- 2017

Table 1 – The growth rate of two main indicators of agriculture in Kazakhstan

period	Arable land, ha	Percentage change of arable land, %	Gross output of agriculture, million tenge	Percentage change of gross output, %
1991	34 935 450		77.8	
1995	28 679 600	90.58	208 919.2	183.89
1999	15 285 300	82	337 253.8	134.71
2000	16 195 300	106	404 145.9	119.83
2003	17 454 200	98	613 306.9	109.77
2005	18 445 200	102	749 077.8	107.66
2010	21 438 700	100.06	1 822 074.1	111.01
2011	21 083 000	98	2 720 453.4	149.31
2015	21022 900	99	3 307 009.6	105.20
2017	21839900	102	4 070 916.8	110.49

As far as the arable land territory decreased 43% from 3493 50 ha in 1991 to 15285 300 ha in 1999. That was period of dramatically decreasing agriculture sector entirely over the country. However, Government policy coped with the task, so from 2000 arable land territory started to increase and that means to produce. The table data shows the both indicators have the same direction of development in agriculture, that is gradually increasing and both are under fluctuation. However, level of growth rate is different; for example, arable land growth rate is 3% in 2017, whereas gross output growth rate is 110.49%. Growth rate of gross output is sharply

increased by 149.31% in 2011. Last 10 years the level of arable land is steady in Kazakhstani vast territory, whereas Almaty oblast's indicators stay the same.

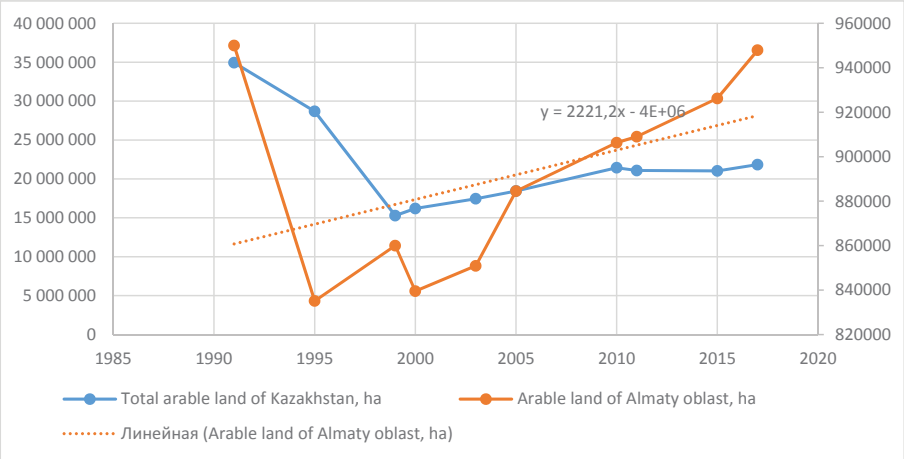

Figure 2 – Dynamic arable land territory in 1990- 2017, ha

The line graph clearly shows that total arable land of Kazakhstan slumped in the first decade of independence. Only from 2001 it started to go up and from 2010 it to maintains at the same level. Regarding Almaty oblast the territory of the arable land has moderate growth from 839500 ha in 2000 to 947900 ha in 2017 (112% growth rate).

Next interesting indicators that are for compare are agriculture gross output, measured by million tenge per year and total arable land of the oblast, in thousand ha. We graphed agriculture gross output in vertical axis (Y), it is dependent factor, and total arable land is in horizontal axis (X), it is independent factor. By calculating its slope, it is noticeable positive relationship having the same development direction. For slop calculation, we have taken data of last two years (2016 and 2017):

$$Slope = \frac{\Delta Y}{\Delta X} = \frac{Y2 - Y1}{X2 - X1} = \frac{630931.6 - 597308.2}{947.900 - 932.200} = \frac{33623.3\ thousand\ tg}{15700\ ha}.$$

The meaning of the slope depicts increasing of arable land by 15.7 thousand ha led expanding of gross output of agriculture by 33623.3 million tenge.

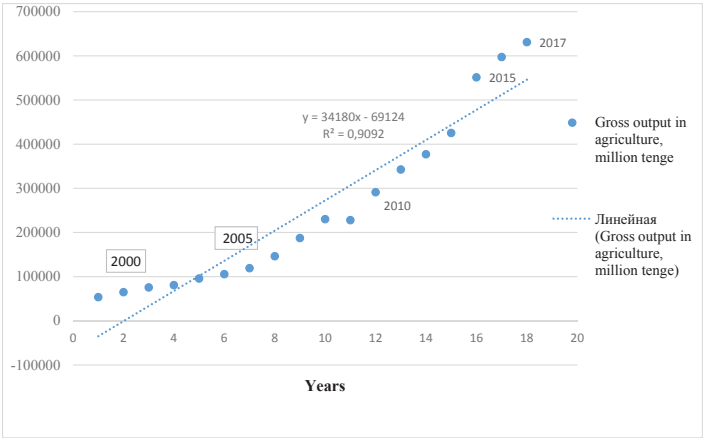

Figure 3 - Times series graph of gross output of agriculture in million tenge in Almaty oblast during 2000-2017

Using times series graph we shows growth rate of agricultural gross output in Almaty oblast within last two decades. The time interval in horizontal line shows between 2000 till 2020.

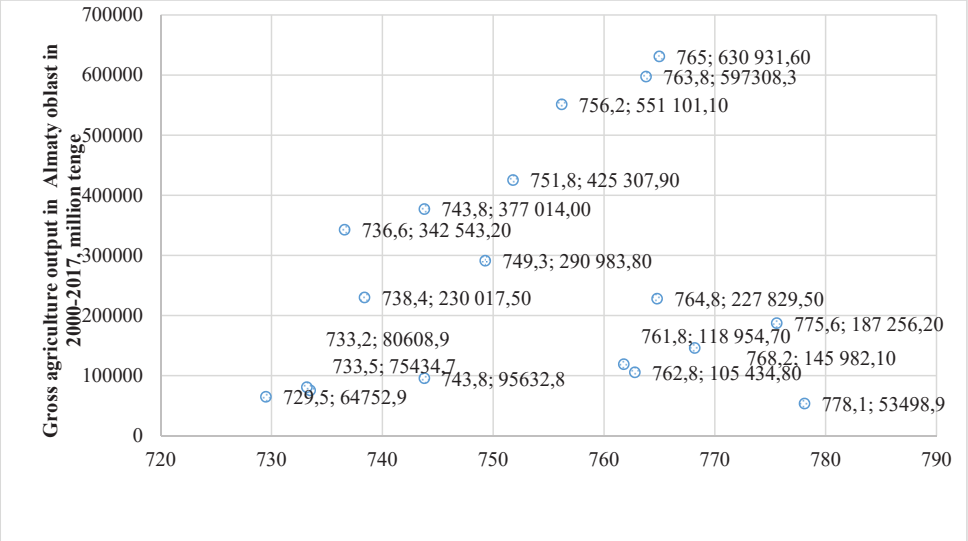

Figure 4 - Arable land of 4 agricultural products in 2000- 2017, thousand ha

Innovation in agricultural and its linkage to productiveness

Research results depicts that there is direct relation between innovation and productivity in terms of agriculture sector (we exclude disruptive innovation).

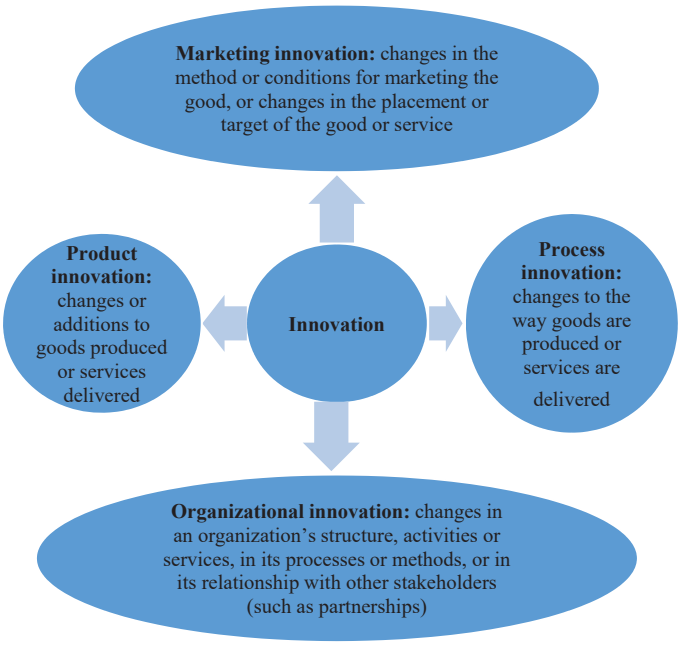

Figure 5 – Innovation in agriculture

By innovation there, we mean several components such as funding agriculture science, which has considerable impact on its productivity. Kazakhstani Government has been increasing expenses for science about decade. There is a new aim pointed to increase funding up to one percent of the gross output of agriculture. The aim has already achieved, funding agriculture science was 6528.0 million tenge in 2017, and gross output

volume was equal 630931.6 million tenge. In turn, we would like to demonstrate some indicators that we consider as contribution to innovation

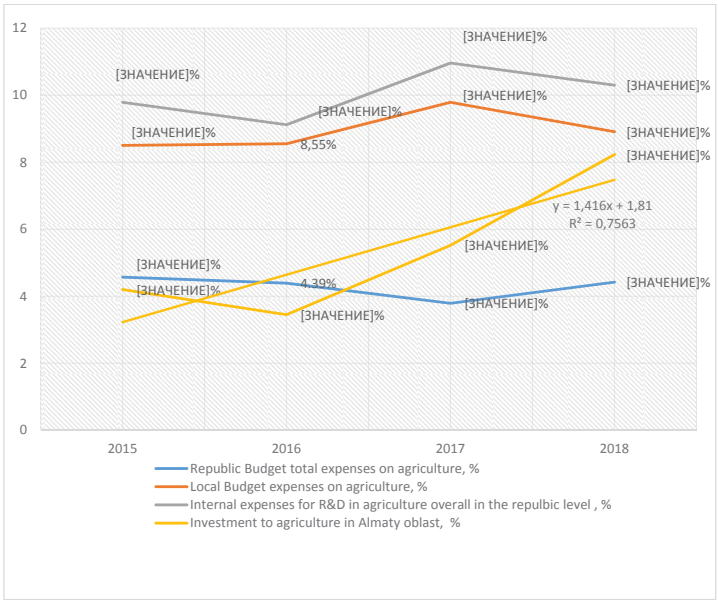

Figure 6 - Expenses for agriculture development in Almaty oblast, 2015-2018 years

Analysis shows government allocated 68 884,2 million tenge in 2017 for research and development (R&D) for various sectors. 10% of the mentioned amount of funding refers to agriculture, that is 6528.0 million tenge. Positive news is that business and entrepreneurship environment are interested in developing and funding money to agriculture particularly for R&D. For example, in 2017 business's contribution was 2185.6 million (33.4%), government – 2577.1 million tenge, 792.2 non–commercial sectors and universities' funding – 2577.1 million tenge. This moment we consider innovation into research in agriculture. This is financial support of agriculture in order to transfer it into innovation–driven sector of economy. Unfortunately, among 234 agricultural enterprises, only 18 of them have innovation, their innovation activity 7,7%. and only 3% of the 234 mentioned enterprises have collaboration with other innovative enterprises of other sectors. Currently, the results are poor; however, policymakers and producers are receiving priceless experience.

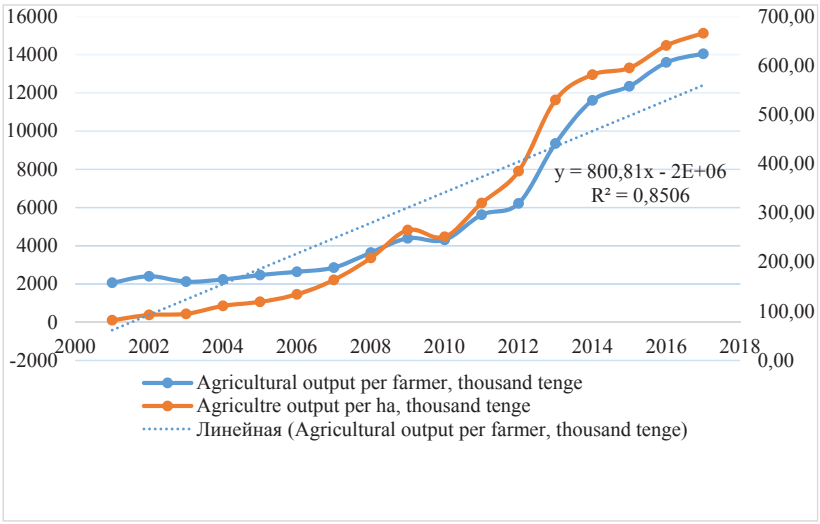

Figure 7 - Arable Land and Labor Productivity, tenge

Usually, productivity concerns labor productivity, which defined as real economic output per labor hour. Thus, it is a ratio between working time and output.

$$Labour\ Productivity = \frac{Gross\ Output\ of\ Agriculture}{Labor\ time}$$

Though this general formula is well known, we tried to modify it by adding some elements. In 2018, Kazakhstani government fixed norm of working time at forty-hours per week. It is 1984 hours annual. We would like to demonstrate real situation from Almaty region. Thus, overall population in Almaty region was 2000371 people in 2017. The rural population labeled in 1530786 people in 2017, which is 76.5% of total population. This is only one region in our country where rural population's percent is high. Economic active part of the rural population is 789200 people that is 51.5%. Economic active population of the oblast was 988 400 people, among them only 242200 people of the oblast work in agriculture (24,50%).

By demonstrating these data, we are aiming to calculate productivity in agriculture. We used usual formula of productivity and changed its indicators by agriculture indicators.

$$\text{Gross agricultural output per capita} = \frac{\text{GAO, measured in million tenge}}{\text{Rural population}}$$

$$= \left[\frac{\text{GAO}}{\text{working h per year}} * \frac{\text{working h per year}}{\text{number of agricultural workers}}\right] * \frac{\text{number of agricultural workers}}{\text{economic active part of rural population}}.$$

GAO – Gross agricultural output.

$$GAO\ per\ capita = \frac{630931.6}{1530786} = \left[\left[\frac{630931.6}{1984} * \frac{1984}{242200}\right]\right] * \frac{242200}{789200}.$$

The altered formula depicts how gross output of agriculture per capita depends on three components.

$$GAO\ per\ capita = \frac{630931600000}{1530786} = 412161.8\ tenge.$$

This part of the formula shows 412161.8 tenge per capita, per rural population.

$$\frac{630931600000\ tenge}{1984\ hours\ per\ year} = 318\ 009\ 879\ tenge\ per\ hour.$$

By taking into account number of agricultural workers, we see that hourly output is 1313.5 tenge (318009879/242200), which is approximately $3,5 per hour that much more less than workers in comparison with developed countries. However, it can be tackled by contribution of both government and business sides. The output of the gross agricultural product points out that it is achievable.

This part shows hourly output measured in tenge.

$$\frac{1984}{242200} = 0.8\ h$$

This part of formula - hours per workers, simply informs us how much, on average, workers are at work that is 8 hour per day (six working days). As far as we concerned the force of working time to productivity in entire economy, we show working time of various countries (Figure 7). The longest working time is in Kazakhstan, it is 1984 hours annually.

$\frac{242200}{789200}$=0.307= 30.7%.

The third part is the ratio of workers to population – the activity ratio or employment participation ratio, in this case, this is 0.307 (30.77%).

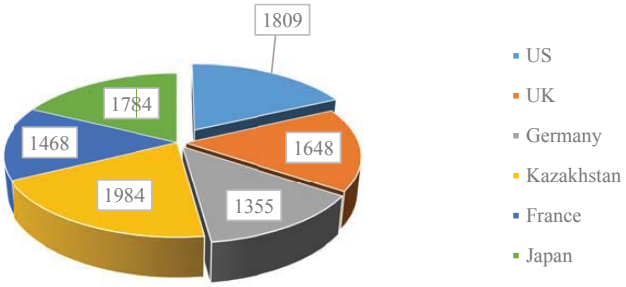

Figure 9 - Working hours per year, h

Figure 8 - Working hours per year, h

CORRELATION OF DATA WITH REALITY

What says numbers in agriculture sector of Almaty oblast? Our analysis of current situation is aiming to find out and determine perspectives of growth and forecasting production growth in agriculture. For data analysis in Excel applied program was used, namely correlation–regression model was used as a mathematical model. Dependent factor is gross agricultural output that is calculated for crop production. It consists of data 2000–2017 and for gross output of animal husbandry is for livestock production the same period as well.

Crop production consists of following independent factors

X1 – arable land, thousand ha;
X2 – gross output of grain (including rice) and legume (in weight after processing), thousand tons;
X3 – potato yield, thousand tons;
X4 – vegetable yield of open ground, thousand tons;
X5 – grain yield (including rice) and legume, center per ha;
X6 – potato yield, centner per ha;
X7 – vegetable yield of open ground, centner per ha;
X8 – Fertilized area with minerals by agricultural enterprises, thousand ha;
X9 – Application of mineral fertilizers in thousand centners', recalculated for 100% nutrients;
X10 – Investment in agriculture, million tenge;
X11 – Number of agricultural entities, units.

Livestock production also consists of data for the same period (from 2000 to 2017).

Factors we have taken for analysis are next:

X1 – Number of cattle, thousand heads;
X2 – Number of sheep and goats, thousand heads;
X3– Number of pork, thousand heads;
X4– Number of horses, thousand heads;
X5– Number of camels, thousand heads;
X6– Number of poultry, thousand heads;
X7–Average live weight of one head of cattle, kg;
X8– Average live weight of one sheep and goat, kg;
X9– Average live weight of poultry, kg;
X10–Average milk yield per cow, kg;

X11–Average egg yield of hen, pieces;
X12– The average cut wool from one sheep, kg;
X13–Investment into fixed assets of agriculture, million KZT;
X14–number of agricultural entities, numbers.

INTERPRETATION OF THE DATA

The arable land data (in hundred ha) based on four types of products such as grain (including rice and legume), potatoes, open ground vegetables and feed. The reason is they are main part of the total arable land of the oblast, its portion was 96.7% (out of 1512.2 thousand ha) in 1992 and still these arable lands cover overwhelming part of the total arable land, that is 81.6% in 2017 respectively.

There are some models were defined by using regression and correlation analysis; two model based on information of crop production and three models based on data of livestock production. First, we start explanation for crop production. The model are

$$y=-297147.5+20552.4*x5+1109.8*x7 \quad (1)$$

$$y= - 1131628.476+8144.877*X6+789.799*X7 \quad (2)$$

We will show only first model's interpretation. Further, in our research we will combine other models as well.

Table 2 shows crop production indicators of Almaty oblast, in 2000 – 2017 and table 3 Correlation matrix of indicators gross agricultural output in Almaty oblast for 2000-2017 (in last pages).

The first model is statistically significant and adequate. Fisher coefficient is F-26.77 and coefficient t-test correlation coefficient is t_{X5}=2.69; t_{X7}=4.09 and R^2=78.1% shows reliability of the model. This model is interrelation of gross agricultural output (Y) of Almaty oblast with grain yield (including rice) and legume (X5), center per ha and vegetable yield of open ground, centner per ha (X7). Grain production (including rice, legumes) takes the highest portion of arable land among all types of agricultural products. Its share is around 48%. Although Almaty region is not the leader in producing grain, however, its productivity is 26.1 centner per ha in 2015, that more for two times in comparison with republic level.

Harvest of vegetables of open ground has significant growth rate from 10.7 centner per ha in 1992 and 24.5 centner per ha in 2014. Interesting fact is vegetable harvest had a sharply increased from 24.5 centner per ha in 2014 till 291.9 centner per ha in 2015. All agriculture entities had good harvest in 2016, for example, agricultural enterprises' output 367.5 centner per ha, farmers' gain was 293.1 centner per ha and households' output was equal 271.9 centner per ha. Forecasting of vegetables of open ground abruptly changed and its R^2 shows only 33% its reliability because of this high difference.

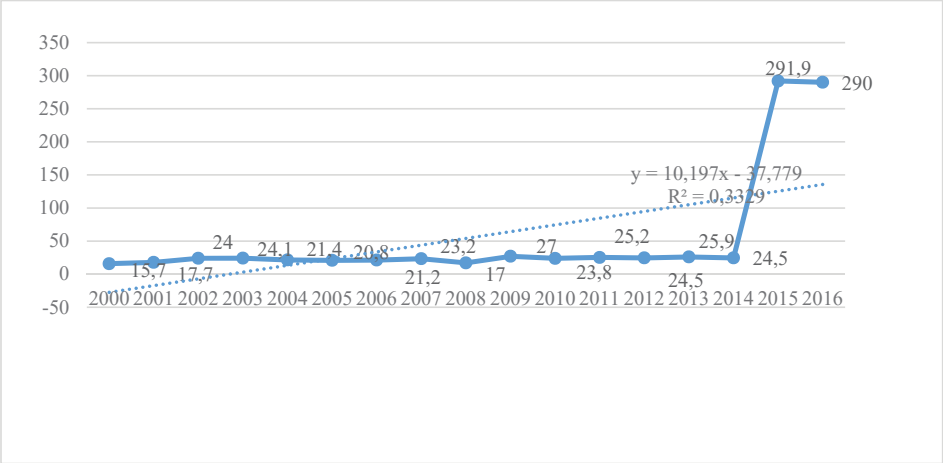

Figure 9 - Vegetable harvest of open ground in Almaty region, centners per ha, during 2001-2016

Based on the model we did regression forecasting, which is figure 9. In this graph the x-axis depicts interval between 0-20 that is 20 years (2000-2019). Further interval between 20 till 25 (5 years) done by program automatically. Whereas y-axis demonstrates agricultural output in Almaty region in million tenge.

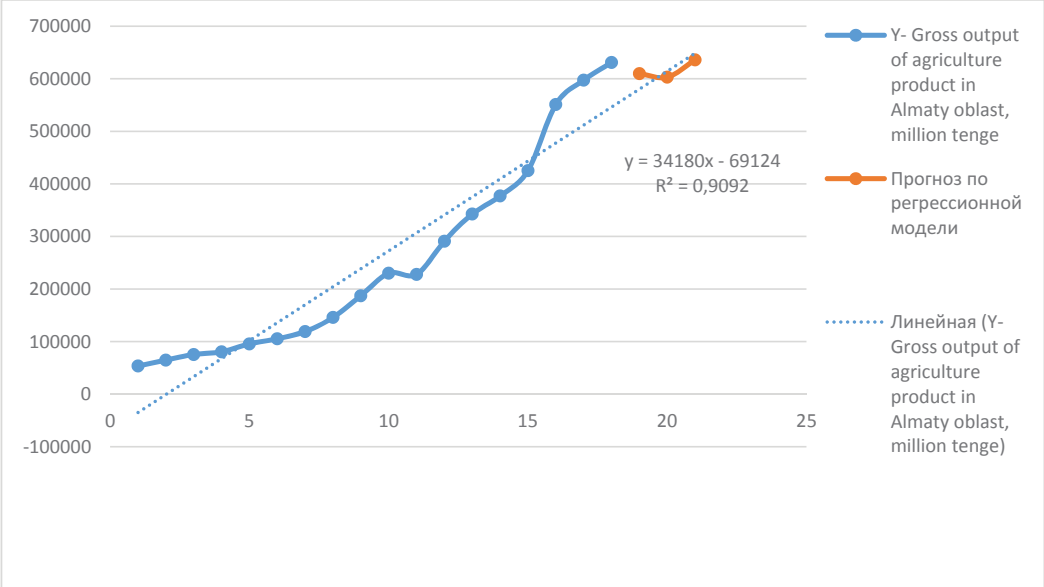

Figure 10 - Regression and trend forecasting of agricutural output in Almaty oblast in 2017-2019

Based on the regression model we provided forecasting for 2018, 2019 and 2020. Also by using trend model forecasting of total agricultural output shows next data.

Table 2 – Forecasted indicators based on regression analysis for period 208-2020

	2018	2019	2020
X5 forecasting	28.2	27,7	29.2
X7 forecasting	295	298	300
Y forecasting based on regression analysis	609846.1039	602899.561	602899.561
Y forecasting based on trend model	520544	552541	584538

Regarding livestock production there are three models. First model is

$$y= –231582.0057+404.19*X1+2.694*X14 \quad (1)$$

This model shows relation between (Y) gross output of livestock production in Almaty oblast, number of cattle, thousand heads (X1), number of agricultural entities, numbers (X14).

The first model is statistically significant and adequate. First model's Fisher coefficient is F=42. 7 and coefficient t-test correlation coefficient is t_{X1}=6,8; t_{X14}=5,47 and R^2=86,4% shows reliability of the model.

$$y= –76222.0005+17.853*X6+5.8164*X13 \quad (2)$$

This model shows relation between (Y) gross output of livestock production in Almaty oblast, number of poultry, thousand heads (X6), investment into fixed assets of agriculture, million tenge (X13).

The second model is statistically significant and adequate. First model's Fisher coefficient is F=70, 8 and coefficient t-test correlation coefficient is t_{X6}=3,7; t_{X13}=7,6 and R^2=90,4% shows reliability of the model.

$$y= -1392060.1932+27.853*X6+2.17334*X14 \quad (3)$$

This model shows relation between (Y) gross output of livestock production in Almaty oblast, number of poultry, thousand heads (X6), number of agricultural entities, numbers (X14).

The third model is also statistically significant and adequate. First model's Fisher coefficient is F=16,1 and coefficient t-test correlation coefficient is t_{X6}=3,4; t_{X14}=2,66 and R^2=68,2% shows reliability of the model.

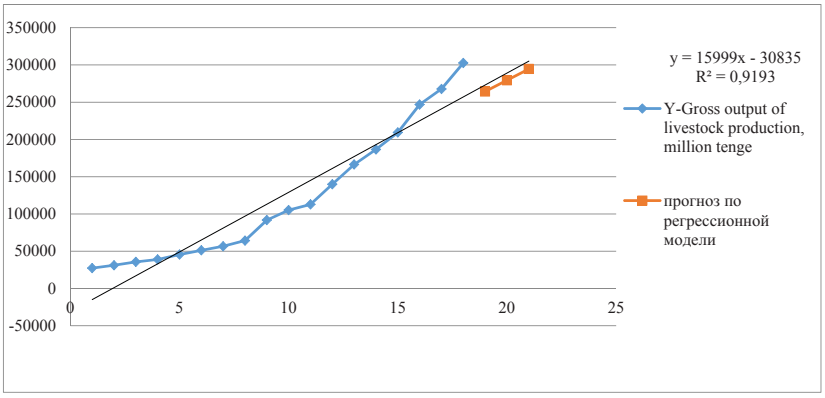

Figure 11 - Gross output of livestock production in Almaty oblast, million tenge

Based on the model we did regression forecasting for livestock production, which is figure 10. In this graph the x-axis depicts interval between 0-20 that is 20 years (2000-2019). Further interval between 20 till 25 (5 years) done by program automatically. Whereas y-axis demonstrates livestock production output in Almaty oblast in million tenge.

Also those mentioned indicators (Y, X1, X6, X13 and X14) were forecasting based on regression and trend analysis.

Table 3 – Forecasted indicators based on regression analysis for period 208-2020

	2018	**2019**	**2020**
First model data			
X1 forecasting	954.84	978.07	1001.31
X14 forecasting	40845.75	4256.82	45067.90
У forecasting based on regression analysis	264392.87	279470.511	294548.14
Second model data			
X 6 forecasting	10446.66	10733.82	11020.98
X 13 forecasting	26103.34	27772.98	29442.63
У forecasting based on regression analysis	262119.5802	276957.9238	291796.2673
Third model data			
X 6 forecasting	10446.66	10733.82	11020.98
X 13 forecasting	40845.75	42956.82	45067.90
У forecasting based on regression analysis	240811.9894	253407.4287	266002.8679

CONCLUSION

We encountered plenty of research papers and monographs devoted to study innovation in agriculture. However, we found out a research gap between innovation and its output (result), which led us to search it deeper in terms of finding innovation result. After that, we realized that innovation's result might be productivity as one of the outcome among variety of them. It is not define appropriate data to measure, therefore, we modified labor productivity formula rely on the given idea in textbook (Christine Greenhalgh, Mark Rogers. Innovation, Intellectual Property, and Economic Growth). That was just first simple steps, further it needs to conduct a separate research.

Collected data enables us to find out several models which were basis for analysis. Furthermore, according to the annually report of the local government body (Agricultural Committee of the Almaty oblast) points out

that increasing number of agricultural entities are main aims in this sector. The same results were shown in three models. This connection shows the value of the research.

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Table – 4 Crop production indicators of Almaty oblast, in 2000 - 2017

	Y- Gross output of agriculture product in Almaty oblast, million tenge	X1 - Arable land are based on 4 types of products, thousand ha	X2- Gross output of grain (including rice)and legume (after processing), thousand tons	X3-Gross output of potatoes, thousand tons	X4-Gross output of vegetables, thousand tons	X5-Harvest of grain (including rice) and legume, centners per ha	X6-Yield of potatoes, centners per ha	X7- Yield of vegetables, centners per ha	X8-Fertilized area with minerals by agricultural enterprises, thousand ha	X9-Mineral Fertilizing thousand tons, 100% in terms of nutrients	X10- investment to agriculture, million tenge	X11-Number of agricultural entities, units
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
2000	53498,9	778,1	675,3	418	356,4	15,7	129,5	15,7	12	22,8	570	25434
2001	64752,9	729,5	751	468,8	436,8	17,7	141,4	17,7	23	31,2	1217	31387
2002	75434,7	733,5	1072,3	490	459,6	24	149,6	24	30	45,4	2497	31387
2003	80608,9	733,2	1058,8	511,1	467,7	24,1	157,5	24,1	32	55,5	3345	37999
2004	95632,8	743,8	977,2	526,8	497,3	21,4	154,8	21,4	27	96,3	7211	42740
2005	105 434,80	762,8	979,8	535,4	513,4	20,8	156	20,8	26	20,1	5369	42740
2006	118 954,70	761,8	967,2	546	524,1	21,2	158,4	21,2	30	39,7	4043	45092
2007	145 982,10	768,2	1059,5	551,9	589	23,2	159,2	23,2	28	63,1	5151	51085
2008	187 256,20	775,6	659,7	555,2	617,4	17	160,4	17	10	11,4	3830	51449
2009	230 017,50	738,4	1191,6	572,1	708,7	27	165,6	27	27	45	5411	52377
2010	227 829,50	764,8	1066	583,9	656,7	23,8	167	23,8	12	11	6901	52900
2011	290 983,80	749,3	1119,8	599,7	708,2	25,2	169,5	25,2	20,7	21	5194	51760
2012	342 543,20	736,6	1021,7	636,6	842,7	24,5	175	24,5	16,4	22	12044	55105
2013	377 014,00	743,8	1104	654	895,6	25,9	176	25,9	24,2	33	13163	51626
2014	425 307,90	751,8	1046,5	682,8	932,4	24,5	178,2	24,5	33,2	37	19064	46140
2015	551 101,10	756,2	1172,1	706,7	947,9	26,1	181,5	291,9	16,4	31	16952	44654
2016	597308.3	763.8	1265.5	718.8	944.2	27.9	183.5	290	21896.1	34954.5	29243	43947
2017	630 931.60	765	1288.3	722	951.3	28.7	185.2	293	27862.1	40858.1	43146	44943

Table 5 – Correlation matrix of indicators gross agricultural output in Almaty oblast for 2000-2017

	Y- Gross output of agriculture product in Almaty oblast, million tenge	X1 - Arable land are based on 4 types of products, thousand ha	X2- Gross output of grain (including rice) and legume (after processing), thousand tons	X3-Gross output of potatoes, thousand tons	X4-Gross output of vegetables, thousand tons
Y- Gross output of agriculture product in Almaty oblast, million tenge	1				
X1 - Arable land are based on 4 types of products, thousand ha	0.167158353	1			
X2- Gross output of grain (including rice)and legume (after processing), thousand tons	0.670074595	-0.194356104	1		
X3-Gross output of potatoes, thousand tons	0.959817011	0.104018867	0.719952537	1	
X4-Gross output of vegetables, thousand tons	0.95523464	0.060748016	0.665833758	0.979331353	1
X5-Harvest of grain (including rice) and legume, centers per ha	0.732346172	-0.246614066	0.978268512	0.781663915	0.755199597
X6-Yield of potatoes, centers per ha	0.901607009	0.021299641	0.765169082	0.979452568	0.951849692
X7-Yield of vegetables, centers per ha	0.821532586	0.243752453	0.581352995	0.706813118	0.642691628
X8-Fertilized area with minerals by agricultural enterprises, thousand ha	-0.070139557	-0.442170935	0.414699361	0.035729777	-0.028804836
X9-Mineral Fertilizing thousand tons, 100% in terms of nutrients	-0.185833911	-0.321562433	0.223725988	-0.126444345	-0.188381977
X10-Investment to agriculture, million tenge	0.899601209	0.198022982	0.642366174	0.839637411	0.796220249
X11-Number of agricultural entities, units	0.40379659	0.087671183	0.399963412	0.582317868	0.585853809

Continuation

	X5-Harvest of grain (including rice) and legume, centners per ha	X6-Yield of potatoes, centners per ha	X7-Yield of vegetables, centners per ha	X8-Fertilized area with minerals by agricultural enterprises, thousand ha	X9-Mineral Fertilizing thousand tons, 100% in terms of nutrients	X10-investment to agriculture, million tenge	X11-Number of agricultural entities, units
Y- Gross output of agriculture product in Almaty oblast, million tenge							
X1 - Arable land are based on 4 types of products, thousand ha							
X2- Gross output of grain (including rice)and legume (after processing), thousand tons							
X3-Gross output of potatoes, thousand tons							
X4-Gross output of vegetables, thousand tons							
X5-Harvest of grain (including rice) and legume, centers per ha	1						
X6-Yield of potatoes, centers per ha	0.832141684	1					
X7-Yield of vegetables, centers per ha	0.563731845	0.620288414	1				
X8-Fertilized area with minerals by agricultural enterprises, thousand ha	0.35868697	0.081509135	-0.069046173	1			
X9-Mineral Fertilizing thousand tons, 100% in terms of nutrients	0.154118671	-0.099960692	-0.024384212	0.620219818	1		
X10-investment to agriculture, million tenge	0.669143846	0.772277141	0.823767032	0.127311718	0.009992329	1	
X11-Number of agricultural entities, units	0.470206619	0.683124057	0.012347422	-0.120780492	-0.140159684	0.215086554	1

РЕЗЮМЕ

В статье рассматривается взаимосвязь инноваций в сельском хозяйстве и их влияние на производительность. Проведен анализ текущей ситуации инноваций. Обоснована необходимость учета производительности после применения инноваций. Анализирована возрастающая роль инноваций и финансирование сельского хозяйства страны. На основе регрессионного анализа прогнозирован рост валового сельского хозяйственного продукта и других соответствующих показателей на будущий период.

ТҮЙІН

Мақалада ауыл шаруашылығындағы инновациялар мен оның өнімділігіне әсері талқыланған. Инновацияның қазіргі жағдайы талданған. Инновацияны қолданудан кейінгі өнімділікті есепке алу қажеттілігін анықталған. Ауыл шаруашылығына инновациялар тарту мен қаржыландырудың өсуі талқыланған. Регрессиялық және корреляциялық талдау негізінде жалпы ауылшаруашылық өнімі мен тиісті көрсеткіштер болжанған.

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ABSTRACT

Purpose – is to analyze the state of the higher education sector, summarize and study the world experience of the process of transition of universities to a new type - an entrepreneurial university.
Methodology – the study was conducted using such methods as: abstract - logical and comparative analysis, the method of description and generalization. The sources of research were theoretical and analytical articles, works of Kazakhstan and foreign authors, which deal with issues of higher education and the concept of TRIPLE HELIX (hereinafter referred to as the «triple helix»).