Impact of Budget Allocation in Enhancing Agricultural R&D: Study in EU

Nikolche Jankulovski [1], Biljana Angelova [2], Klimentina Poposka [2], Meri Boshkoska [1]

[1]*University "St. Kliment Ohridski", Bitola, Republic of Macedonia*
[2]*University "Ss. Cyril and Methodius", Skopje, Republic of Macedonia*

Abstract **– The primary aim of this research is to explain the impact of budget allocation in enhancing and restructuring the research and development of agricultural sector. However, the research has been conducted in the European nations while the mixed choice of research design has been chosen. For the qualitative analysis, the researcher has used the data of the EURO STAT while for the quantitative survey, the researcher has used the SPSS tool to evaluate the correlation and regression. The results clearly evaluate that there is a significant impact and relationship among the high budget allocation and agricultural research and development department.**

Keywords **– Agricultural sector expenditures, rural development, direct payment.**

1. Introduction

The report generated by the United Nations has predicted that the population of the world in the year 2050 would reach the level of 9.7 billion [2]. However, the report clearly points out that the agricultural sector would be the most competitive challenge for the coming future especially with respect to the scarcity of resources and rapid climatic change. Moreover, it has been predicted that the stage would be declared as the creation of food crisis if the governmental bodies and policy makers would fail to take some corrective actions. The assurance of the food availability and supplies at that time will be given if there would be about 70% increase in food production and supplies for about next 30 years [3].With the changing contemporary world, the pace of agricultural activities has been upgraded from the last 10 to 15 years which is favorable for the economy of the EU nations. Moreover, the pace has taken a rise through undertaking major innovations and advancements and by upgrading the software, infrastructure and logistics in the agricultural departments or sectors. Furthermore, it has been noted that the public sector has been among the exceptional driving force in order to bring in the advancement especially in the research and development department. It has been noted that in the year 2011, there has been a major investment of $69 billion to increase the global capability of research and development department of the agricultural sector in the EU countries [8]. Presently, it has been also noted that the fiscal policies have been changing to make the research and development growth high in the European countries. The notable context has been provided to private sector which has been seen to overcome the problem. However, the private investment in the agricultural sector has resulted into exceptional innovation and has upgraded the productivity level simultaneously. [8]

Before the year 1970, the major indicators for the growth and development of agricultural sector in the global sector were the land expansion, labor intensification and capital. Time changes and meanwhile in the year 1990, it has been noted that the growth rate of the materials and labor capital in the agricultural sector has become steady. Moreover, the maximizing total factor productivity also measures the effectiveness and turns the minimum input into healthy amount of output that would result into agricultural growth and productivity. From the year 2001 to the year 2013, the total factor productivity has been accounted for about more than two third from the overall growth and productivity. [10]

Nevertheless, in the year 2016, the global productivity agricultural report clearly stated that the

DOI: 10.18421/TEM74-10
https://dx.doi.org/10.18421/TEM74-10

Corresponding author: Nikolche Jankulovski,
University "St. Kliment Ohridski", Bitola, Republic of Macedonia
Email: nikolce.jankulovski@uklo.edu.mk

Received: 06 July 2018.
Accepted: 02 October 2018.
Published: 26 November 2018.

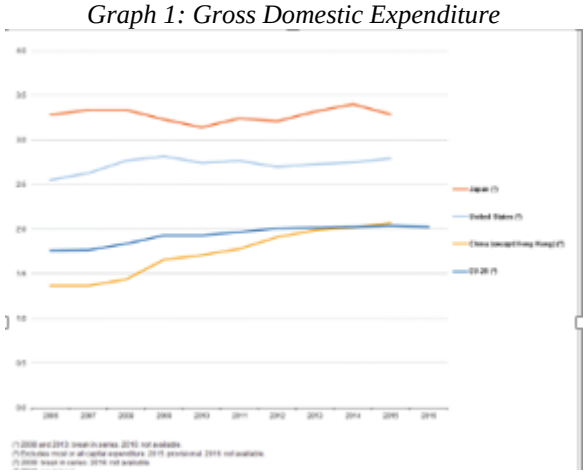
private sector has been contributing a lot in analyzing the agricultural growth in an efficient manner. However, the rapid and fast production of food supplies is sufficient to meet the demands of the year 2050 very effectively. The percentage of growth has been seen among most of the developed countries but the developing nations lag behind attaining the TFP growth and productivity due to low income and capital. In those countries, the majority of output productivity comes from the agricultural inputs that have been increased and the land which are still under cultivation process. [11]

The article has been provided in the Euro Stats which critically illustrates the data and expenditure which has been spent on the research and development department in the European Union nations. The data has been gathered through the insight in the statistical surveys which suggest that a healthy amount of investment and concentration in the R and D has improved the performance of the agricultural departments of private and public sectors. Moreover, during the last few days, the main objective of the EU was to motivate the research investment in the agricultural department. European Union has been following one of the key aims from the last several years however, the primary aim was to motivate investments in the research and development department that could upgrade the competitiveness of the EU nations. The strategy for the year 2020 has been adopted by Europe in order to increase their GDP at the level of 3% through obtaining the research and development department activities.

In the year 2016, it has been seen that the budget of research and development stood by 303 billion euros that seemed to be 40% increase from the preceding 10 years. Moreover, during these 10 years, it has been noted that there has been huge number of variations in the price and level of expenditures. By keeping aside the minimization in the research and development department expenditures in the year 2009, it could be clearly seen that the European nations have faced the lowest annual rate in comparison with all the years [4]. Furthermore, in the year 2015, it has been noted that the level of expenditure on the research and development department has almost reached to the equivalency to 2/3 which is recorded in the United States. On the other hand, China seems to have the highest level of expenditure which was 48.5% and that was double in Japan. While the expenditure level was five times higher in South Korea, the increases in the percentage and the values have been seen in Euro terms. Moreover, the depreciation rate in the Euro has been comprehended to be varied which could change the ratios by the passing time. [5]

Another figure illustrates the GRED that explains the figures in clear manner. However, the figures and relationship between budget allocation in R and D and enhancement in agricultural sector seem to be more comparable. Moreover, the ratio that has been declared for the GERD and the GDP is considered among the five keys and indicators of the European Union strategy 2020. The increase in the intensity level of research and development could make them successful to attain their aim of future development consequently. However, the ratio of the rising investment and future development has increased slowly and steadily. The increase in the ratio has been encountered from the year 2006 to 2012 from the percentage of 1.7 to the percentage of 2%. In addition, there has been more fluctuation within the year ranging from the year 2012 to the year 2016 within the European nations. Except for the increasing rate in the research and development expenditure level, the GDP level of the European countries seems to remain below especially in Japan and the United States. The percentage of the GDP in Japan has been recorded as 3.2% while the percentage of the US has been recorded as 2.79%. The graph illustrates that in China, the intensity of research and development has been surpassed in the year 2015 and reached to an equivalent level of 2.07%. [12]

Graph 1: Gross Domestic Expenditure

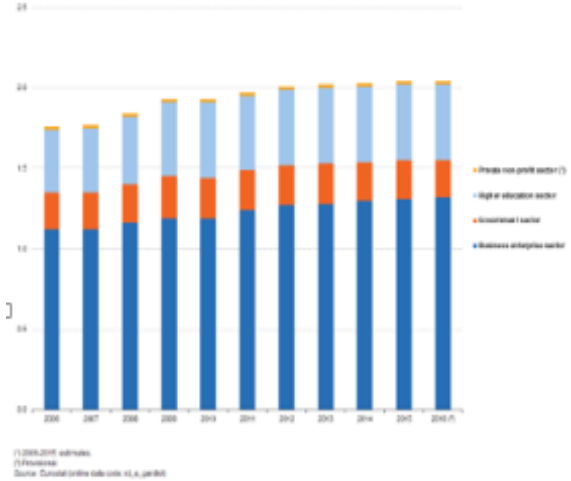


Source: (Eurostat, 2018[5])

The above figure illustrates how the European Union rate has encountered a rapid growth from the year 2006 to the year 2016. This is because the European countries have decided to invest the money in four important sectors in each state. However, the first sector was agricultural sector. During this period, the maximum number of percentage in the research and development expenditure has raised from 1.1% to 17.9%. Furthermore, the second foremost sector that has been chosen for the investment is the higher education sector. The R and D investment and pace in the educational sector have reached at the level of 3.2% in Japan, 2.58% in Switzerland and 2.4% in the United States of America. The comparison from

the year 2015 depicts that it was a significant increase in the intensity of research and development department. Concisely, there was a rapid increase and initial rise while it has been forecasted that the GDP level would also increase in the coming years. The intensity in the research and development department of all the private and non-private sectors within European nations has been considered to be increased by the coming years. [15]

Graph 2: GDE on R&D by EU



Source: (Eurostat, 2018[6])

There is a huge difference in the significance and importance of the expenditure of research and development between different countries listed in the European nations. However, the level of expenditure among the countries and their business sectors also seem to be really different. Moreover, the importance of the research and development expenditure in the agricultural sector has been relatively higher than the average in the coming years. [6]

2. Material and methodology data and descriptive statistics

The material and methodology defines the techniques and procedures that are used to identify the methods to accomplish the aim of the research. The research relies on both qualitative and quantitative survey and this is the reason that the researcher has used both primary and secondary data for the analysis. Every research relies on the philosophy, however, the philosophical viewpoint that has been used in the research is pragmatism. As the design of this research relies on both qualitative and quantitative analysis, the choice of the methods is mixed method. The research has critically focused on the strategies for the analysis of both qualitative and quantitative data. Moreover, the qualitative analysis has been done by analyzing the data of the EURO STAT and the F.A.D.N Farm accountancy data. Consequently, the quantitative survey has been analyzed through finding the regression, correlation in order to find out the relationship between the independent variable (budget allocation) and dependent variable (Research and development department of agricultural sector).

3. Classification methods used in research

The classification of research methods is very simple and it has been distributed into qualitative and quantitative data. However, the data analysis methods have been classified into two parts. For the qualitative analysis there has been the illustration of graphs and tables extracted from the EURO STAT and the agricultural from the F.A.D.N., Farm accountancy data network. Moreover, the quantitative data analysis has been conducted by using SPSS statistical analysis software. The linear regression and the bivariate correlation table have been used as fixed models to define the random effects of the variables on each other.

4. Data analysis and results

Qualitative data analysis expresses the results through the illustration of graphical representation and tables.

Table 1. Science, technology and digital society: R&D expenditure

Year	EU-28([4])	China (except Hong Kong) ([3])	Japan ([1])	United States ([2])
2006	1.76	1.37	3.28	2.55
2007	1.77	1.37	3.34	2.63
2008	1.84	1.44	3.34	2.77
2009	1.93	1.66	3.23	2.88
2010	1.93	1.71	3.14	2.74
2011	1.97	1.78	3.24	2.77
2012	2.01	1.91	3.21	2.70
2013	2.02	1.99	3.32	2.73
2014	2.03	2.02	3.40	2.75
2015	2.04	2.07	3.29	2.79
2016	2.03	/	/	/

Source: (Eurostat, 2018 [6])

The above table [6] illustrates the comparison between the European Union nations and other countries in making investments in the research and development of the agricultural sector. However, it clearly signifies that the EU nations have made significant efforts through the promotion of direct payments and rural development programs thus, their expense rate has increased from 1.76 to 2.03 which is a huge difference.

Table 2. Science, technology and digital society: R&D Expenditure (% relative to GDP)

	2006	2016
EU-28 (1)	1.76	2.03
Euro area (EA-19) (1)	1.80	2.13
Sweden (1)(2)	3.50	3.25
Austria (1)	2.36	3.09
Germany (1)(3)	2.46	2.94
Denmark (1)(3)(4)	2.40	2.87
Finland	3.34	2.75
Belgium (1)	1.81	2.49
France (1)(4)	2.05	2.25
Netherlands (1)(4)	1.76	2.03
Slovenia (1)(4)	1.53	2.00
United Kingdom (1)(4)	1.59	1.69
Czech Republic (1)	1.23	1.68
Italy (1)	1.09	1.29
Estonia	1.12	1.28
Portugal (1)(2)(4)	0.95	1.27
Luxembourg (1)(4)	1.67	1.24
Hungary	0.98	1.21
Spain	1.17	1.19
Ireland (3)	1.20	1.18
Greece (2)(4)	0.56	1.01
Poland (1)	0.55	0.97
Croatia (4)	0.74	0.85
Lithuania	0.79	0.85
Slovakia	0.48	0.79
Bulgaria	0.45	0.78
Malta (1)	0.58	0.61
Cyprus (1)	0.38	0.50
Romania (4)	0.45	0.48
Latvia	0.65	0.44
Iceland (4)	2.92	2.08
Switzerland (5)(6)	2.71	3.37
Norway	1.46	2.03
Serbia (7)	:	0.89
Turkey (5)	0.56	0.88
Former Yugoslav Republic of Macedonia (7)	:	0.43
Montenegro (5)(7)	:	0.37
Bosnia and Herzegovina (7)(8)	:	0.26
South Korea (4)(5)(9)	2.83	4.23
Japan (4)(5)	3.28	3.29
United States (5)(9)	2.55	2.79
China (except Hong Kong) (4)(5)	1.37	2.07
Russia (5)	1.01	1.10

Source: (Eurostat, 2018[6])

The above table clearly illustrates gross domestic expenditure on research and development department within the European Union nations in the year 2006-2016. It has been noted that the ratio of investment in the research and development department has been increased along with the increasing contemporary demands of the market and has reached from 1.8 to 2.1 which is a big change (Eurostat). Consequently, the table has been explained on the basis of each of the European nations in order to identify their extent of investment.

Moreover, South Korea has been among the most notable ones that have increased the pace of the agricultural sector by making frequent investments in the research and development sector. The table also justifies that the GDP and the economic productivity of any country rely on its agricultural sector. Moreover, the budget allocation in the agricultural sector as per the demand of the contemporary industry could be proved to be highly significant for the countries. Therefore, the governments of the European Union nations must implement the policy of investment and budget allocation to improve the research and development departments.

Table 3. Science technology and digital society R&D expenditure

	Business enterprise sector	Government agricultural sector	Higher education sector	Private non-profit sector	Abroad
2005	54.1	34.4	0.8	1.6	9.1
2006	55.0	33.6	1.0	1.7	8.8
2007	54.9	33.3	0.9	1.7	9.2
2008	54.8	33.8	1.0	1.6	8.8
2009	54.1	34.9	1.0	1.6	8.4
2010	53.8	34.8	0.9	1.6	8.9
2011	55.0	33.3	0.9	1.6	9.2
2012	55.1	32.8	0.8	1.6	9.7
2013	55.2	32.5	0.8	1.6	9.9
2014	55.5	31.9	0.9	1.6	10.1
2015	55.3	31.3	0.9	1.7	10.8

Source: (Eurostat, 2018 [6])

The above tables have been explaining the rate of expenditure in the EU nation agricultural department and other departments during the year 2005 to 2015. Moreover, the tables clearly elaborate that the EU nations have significantly adopted the trend of research and development sector. Furthermore, the funds from the enterprises and programs have become the source of the EU nations so that they might significantly adopt the research and development innovations to upgrade their agricultural sector in an effective manner. The analysis has been done on the research and development expenditure; however, funding has been among the most essential sources for the agricultural sector.

In the year 2015, about 55.3% of funding had been allocated by the private and governmental sectors within the European Union nations. From which about one third of the funding has been funded by the governmental sectors. The percentage

that has been attained and allocated by the non-governmental sectors was comparatively small at the percentage of 0.9 to 1.7 simultaneously. Moreover, the shares in the agricultural sector from the year 2006 to 2015 and onwards have been seen to be relatively stable. However, the above tables also explore that the funding for the R and D of the agricultural department has also been gathered abroad as well. Another analysis has also been done in the Asian economies especially in China and Japan. These countries have allocated larger amount of share for the research and development department expenditure in the year 2015 that proved to be very beneficial. Moreover, in the United States of America, about 64% of shares have been funded to the EU nations for the development of agricultural sector. [5]

Table 4: Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.268[a]	.072	.053	1.87263

a. Predictors: (Constant), Direct payment, Rural Development

The above table demonstrates the regression analysis that has been done to elaborate the quantitative analysis for this research. The researcher has chosen the relationship between the dependent and the independent variables; however, here the dependent variable is R and D development while the independent variables are direct payment and rural development. R and R^2 express the correlation between the variables. However, the results explain that the independent variables explain 26% of the dependent variables.

Table 5. ANOVA[a]

Num.	1		
Model	Regression	Residual	Total
Sum of Squares	26.286	340.154	366.440
Df	2	97	99
Mean Square	13.143	3.507	
F	3.748		
Sig.	.027[b]		

a. Dependent Variable: Research and Development
b. Predictors: (Constant), Direct payment, Rural Development

The above ANOVA table expresses and illustrates the significance of the regression model between the dependent variable "Research and development" and the independent variables or predictors which are Direct payment and Rural development. The significant value of the relationship is .027 which is less than 0.05. The sig value which is less than 0.05 clearly indicates that by enhancing the direct payments and upgrading the rural development programs, the agricultural sector could increase the research and development. Moreover, as mentioned in the above literature that directs payment and rural development programs could be an encouragement factor for the farmers and other operators to practically implement the R and D in the agricultural field. Thus, the statistical analyses have proved the same logic.

Table 6. Coefficients

Model		(Constant)	Rural Development	Direct payment
Unstandardized Coefficients	B	14.317	-.172	.342
	Std. Error	1.710	.122	.126
Standardized Coefficients	Beta		-.150	.286
T		8.373	-1.416	2.704
Sig.		.000	.160	.008

a. Dependent Variable: Research and Development

The above table demonstrates the coefficient analysis among the dependent and independent variables that illustrates the separate significance of the factors. However, the constant value signifies the dependent variable. While, the B and significance value of rural development is -.172 and .160 that demonstrates that the increase in the rural development factor will not make any impact in upgrading the research and development in the agricultural sector of the EU. Moreover, the sig value and Beta of direct payment is .008 and .342 that demonstrates that the increase in the direct payment would help the EU nations to upgrade the R and D in the agricultural department. The reason behind this is that for the motivation of the farmers and other operators to get indulged with the research and development department would be direct payment from the government. Moreover, direct payment would also help the farmers to get align with the business demands properly.

Table 7. Correlations

		Rural Development	Direct payment	Research and Development
Rural Development	Pearson Correlation	1	.378**	-.042
	Sig. (2-tailed)		.000	.680
	N	100	100	100
Direct payment	Pearson Correlation	.378**	1	.229*
	Sig. (2-tailed)	.000		.022
	N	100	100	100
Research and Development	Pearson Correlation	-.042	.229*	1
	Sig. (2-tailed)	.680	.022	
	N	100	100	100

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 7. illustrates the correlation between the independent and dependent variable, however, this table also demonstrates that the sig value of direct

payment is .000 and correlation is significant at the level of <0.05. In addition, the Pearson correlation of rural development program is 1, which illustrates positive linear relationship. On the other hand, the Pearson correlation for direct payment is 0.37 or 0.4 which illustrates moderate relationship between the variables.

The above table clearly demonstrates the quantitative survey that has been done by distributing the close ended questionnaires among operational departments, technical departments, and educated farmers in order to attain their viewpoint regarding the enhancement of research and development department. As per the results, the awareness of the importance and significance of research department is quite low among people. Due to this, the results show somehow unfavorable answers but through the evaluation of qualitative survey the thoughts of people could be changed any way regarding the results and approach of research and development department as well.

The variables that have been used to conduct the quantitative analysis are direct payments and rural development programmers.

5. Direct payments

Direct payments have been considered as the most essential source of funding for the agricultural departments. Moreover, in the direct payments, the farmers tend to receive the yearly return and profit that helps the farmers to stabilize their farms by the implementation of new and advance research and development department technologies.

Furthermore, it also helps the farmers face the unpredictable ups and downs of market prices and unpredictable weather conditions and all the input costs. The benefit that has been attained through the direct payments is that farmers use to follow all the rules and contemporary practices of new era to get aligned with the environmental standards [7]. There are some requirements for the agricultural sector in order to compete with the firms globally however, it is obligatory for the European Union nations to adopt all the requirements. This would also help the markets from destruction and distortions. Moreover, it also helps the farmers to allocate a systematic amount of input for the requirement output [9].

The researches declare that Europe and the United States have been emphasizing notably on encouraging the agricultural sector by compensating the farmers through environmental facilities [17]. Moreover, the programs have been focusing on sponsoring the environmental facilities by minimizing negative factors such as soil erosion and boost the positive externalities such as safe preservations [16].

6. Rural development programmes

The role of rural development has been very effective in the agricultural sector. The benefit of adopting rural development programmes is that it provides collaborative funding to the agricultural sector to attain the social objective and environmental objectives. The budget allocated by the rural development programme has been done through tailor-made plans that have been designed regionally and nationally in order to align with the challenges and the opportunities [14].The variable of spending has been strongly interlinked with the new targeted indicators of economics. After the budget allocation, the member states must deliver their actions in a clear manner in order to manage all the operations efficiently [13]. In addition, the public funding that has been attained by regional and national administration is also allocated to the development programs. These development programs also help to raise the important amount of the private investment that has been creating significant impact on the agricultural sector. [1]

7. Discussion and conclusion

The research has been significantly focusing on evaluating the impact of budget allocation on the research and development of agricultural sector in the European Union nations. The research has attained its aim through analyzing the data in both qualitative and quantitative manner. However, the discussion that has been elaborated states that the EU nations have been presently investing about 38% of budget in the agriculture research and development department. Moreover, the factors that have been discussed in the research are development programs and direct payments by government. These factors have encouraged the European Union nations to significantly invest in the research and development department to attain healthy future.

Concisely, the role of agricultural department has been always significant among all the countries to grow their economy. This is the reason that government and nation must make healthy investment to make their agricultural sector efficient and effective. This would directly enhance the economic condition of the European nations and make them stabilize. The future of agricultural sector seems to be very bright if the role of research and development department would become the focal point for the European countries.

The quantitative and qualitative survey and data analysis in the research has clearly indicated the effectiveness of budget allocation in enhancing and upgrading the agricultural research and development. Moreover, it would be significant for

the European Union countries to make healthy investment and efforts in creating the awareness and importance of R and D so that they might be able to enhance their economic system and GDP level.

References

[1].Chambers, R. (2014). *Rural development: Putting the last first*. Routledge.

[2]. Earlham Institute. (2017). *Double Fish Production while Preserving Biodiversity: Can It Be Done?*, EurekAlert!/AAAS. Available at: https://www.eurekalert.org/pub_releases/2017-01/ei-dfp011117.php.

[3]. ET Bureau. (2016). ET Startup Awards 2016: How AgroStar Is Making a Profit while Making a Difference. The Economic Times. Available at: https://economictimes.indiatimes.com/small-biz/startups/et-startup-awards-2016-how-agrostar-is-making-a-profit-while-making-a-difference/articleshow/53590267.cms.

[4]. EuroStat. (2018). R & D Expenditure - Statistics Explained. *Ec.europa.eu*. N.p., Web. [Accessed: 05 May 2018].

[5]. Eurostat (2018). [online] Available at: http://ec.europa.eu/eurostat/product?code=rd_e_gerdtot&language=en&mode=view [Accessed: 2 May 2018].

[6]. Eurostat (2018). *R & D expenditure - Statistics Explained*. [online] Ec.europa.eu. Available at: http://ec.europa.eu/eurostat/statisticsexplained/index.php/R_%26_D_expenditure [Accessed 2 May 2018].

[7]. Giannakis, E., & Bruggeman, A. (2015). The highly variable economic performance of European agriculture. *Land Use Policy*, *45*, 26-35.

[8]. Goldman Sachs. (2016). Precision Farming: Cheating Malthus with Digital Agriculture. Equity Research, Profiles in Innovation. Available at: http://docdrop.org/static/droppdf/GSR_agriculture-N1sH6.pdf.

[9]. Hodge, I., Hauck, J., & Bonn, A. (2015). The alignment of agricultural and nature conservation policies in the European Union. *Conservation Biology*, *29*(4), 996-10.

[10]. Jaruzelski, B., V. Staack, and A. Shinozaki. (2016). The Global Innovation 1000:Software-asa-Catalyst.'strategy+business. Available at: http://www.strategybusiness.com/feature/Software-as-aCatalyst?gko=7a1ae.

[11]. Kearnes, M. (2016). 7 Cutting-Edge Offshore Aquaculture Innovations and Designs. SeafoodSource. Available at: http://www.seafoodsource.com/news/aquaculture/7-cutting-edgeoffshore-aquaculture-innovations-anddesigns?limitstart=.

[12]. Pardey, P. G., Chan-Kang, C., Dehmer, S. P., & Beddow, J. M. (2016). Agricultural R&D is on the move. *Nature News*, *537*(7620), 301.

[13]. Ray, C. (2000). The EU LEADER programme: rural development laboratory. *Sociologia Ruralis*, *40*(2), 163-171.

[14]. Davies, M., Guenther, B., Leavy, J., Mitchell, T., & Tanner, T. (2009). Climate change adaptation, disaster risk reduction and social protection: complementary roles in agriculture and rural growth?. *IDS Working Papers*, *2009*(320), 01-37.

[15]. Russell, K. and L. Sandall. (2017). Corn Breeding: Lessons from the Past. Plant & Soil Sciences eLibrary. Available at: http://passel.unl.edu/pages/informationmodule.php?idinformationmodule=1075412493&topicorder=10&m axto=12.

[16]. Baylis, K., Peplow, S., Rausser, G., & Simon, L. (2008). Agri-environmental policies in the EU and United States: A comparison. *Ecological economics*, *65*(4), 753-764.

[17]. Ilbery, B., & Bowler, I. (1998). From agricultural productivism to post-productivism. AGRIS.