The impact of the applying of fertilizers on growth production at the national level

Pop, Ruxandra-Eugenia

ICEADR Bucuresti

16 November 2017

THE IMPACT OF THE APPLYING OF FERTILIZERS ON GROWTH PRODUCTION AT THE NATIONAL LEVEL

RUXANDRA – EUGENIA POP[1]

Abstract: *This paper aims to highlight the importance of applying and administering fertilizers to wheat production at national level. As far as the territory of our country is concerned, the regions on which the most important wheat production has been registered, along with the amount of fertilizers administered in the respective areas, as well as their type (nitrogenous, phosphatic, potassium, natural) fertilizers. Thus, using statistical models such as the Pearson correlation coefficient, Spearman's correlation coefficient, we can see concretely the link between the two variables analyzed (the production obtained and the quantity of applied fertilizer) and the nature of its intensity (low, medium, high). It is also desirable to know the most efficient types of fertilizer in order to increase wheat yield per hectare at national level in the context of the other key factors, components of the farm's macroeconomics.*

Key words: *fertilizer, wheat production, Pearson coefficient, Spearman coefficient, yield*

***JEL Classification**: C 30, L11, Q13*

INTRODUCTION

Although agriculture is an important economic branch both at the European Union level and at national level, its share in GDP has decreased fourfold in the past twenty years, reaching 20% in only 4,4% in 2015, a minimum at historical level. At european level, France and Germany occupy leading positions in agriculture, especially if we refer to grain crops, technical plants, but also to livestock and viticulture.

It is known that one of the most important factors in increasing productivity in agriculture is the administration of fertilizers. As a synthesis, it can be said that the administration of fertilizers is the addition of mineral substances, thus supporting the needs of plant development. Depending on the particularities of the soil and the plants concerned, the timing and optimal amount of fertilizer is determined. Proper fertilizer management can provide productivity gains of up to 50%, and there are cases where this percentage can reach up to 80% in some crops.

Carbon, oxygen and hydrogen are indispensable elements for the normal growth and development of plants that they take from air and water. Also, plants need 13 essential minerals, nutrients or fertilizers, which plants normally take from the soil.

With the passage of time, depending on the continuous use of the soil, it loses its nourishing properties, requiring human intervention by applying specific chemical fertilizers, taking into account soil deficiencies.

On the territory of our country, the following fertilizer categories apply: chemical, nitrogenous, phosphatic, potashic and natural. We can outline a brief classification of these between:

- Nitrogen fertilizers: ammonium nitrate; urea; ammonium nitrate; calcium nitrate;
- Phosphate fertilizers: triple superphosphate; super phosphate;
- Potassium fertilizer: potassium chloride; potassium salt;
- Natural fertilizers.

MATERIALS AND METHODS

In the present paper, we want to analyze the impact of the quantity of fertilizers applied on the territory of our country on the production of wheat, processing the existing data on the National Institute of Statistics website, using - the following statistical variables are interpreted:

[1] ASC Pop Ruxandra – Eugenia, ICEADR, Bucureşti, pop.ruxandra@iceadr.ro

• ***Pearson correlation coefficient***: the statistical technique that measures and describes the degree of linear association between two normally distributed quantitative variables; this coefficient is calculated according to the formula (in the present paper it will be calculated to determine the relationship between the variables: the amount of fertilizer applied and the yield obtained):

$$R = \sum (X-\ddot{X})\,(Y-\ddot{Y}) \,/\, \sqrt{\sum (X-\ddot{X})^2 \sum (Y-\ddot{Y})^2}$$

- ***Spearman ranges correlation coefficient***: the statistical technique that can be applied to any type of variables does not require the assumption of the bivariate normal distribution of those two variables of interest (in the present case, the amount of fertilizer applied and the production obtained); it is calculated according to the formula:

$$r_s = 1 - 6\sum_{i=1}^{n} D_i^2 \,/\, n(n^2 - 1)$$

Interpretation result: The interpretation of the Pearson coefficient obtained is done according to the empirical rules of interpretation as follows: Let R be the notation for the Pearson coefficient calculated, if:

- R ⊂ [-0.25 up to +0.25] → there is no relation
- R ⊂ (0.25 up to +0.50] ∪ (-0.25 până la -0.50] → weak relation
- R ⊂ (0.50 up to a +0.75] ∪ (-0.50 până la -0.75] → moderate relation
- R ⊂ (0.75 up to +1) ∪ (-0.75 până la -1) → strong relation

The sign obtained from the Spearman coefficient calculation shows the direction of the relationship between the two variables studied. Thus, the + sign shows a directly proportional link, and the sign - shows an inversely proportional link.

- ***The average production value*** obtained and the average amount of fertilizer applied at country level;

RESULTS AND DISCUSSIONS

In order to analyze the link between the amount of fertilizer applied and the production of wheat obtained, we will define these two variables, taking into account the timeframe 2007-2015, depending on the county to which reference is made. Thus, in Table 1, we present the values of wheat production recorded in Romania between 2007-2015:

Table 1

WHEAT PRODUCTION (TONS) 2007 – 2016 ACORDING TO COUNTY										
County	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
AB	50501	59527	40918	53902	67293	35078	58744	69786	66879	68362
AR	166651	221205	156820	224704	238710	218149	279840	318475	323487	407658
AG	69026	138555	119467	121863	178059	209675	145712	127911	125995	136381
BC	27684	53492	30371	42673	55738	39599	48959	43672	44756	54851
BH	134076	230427	117869	161948	230421	171839	243403	246371	332807	240400
BN	15770	16127	11218	8886	17160	9714	6874	8206	9612	9725
BT	42041	79165	59582	90678	79534	55913	72570	83156	74825	83140
BR	135388	271486	206557	275530	271431	227812	340669	269348	297203	362188
BV	42206	49763	53404	39130	55865	40860	49384	52907	37183	39412
BZ	56793	292228	201877	255550	182609	113057	292645	337849	342516	229241
CL	148760	626547	340226	364767	548869	395796	556005	504459	618397	613625
CS	28080	38236	44996	38014	33938	33182	37906	46977	36640	58609
CJ	37823	35196	31083	43387	35997	26988	31878	38414	39342	44024
CT	187405	697368	371216	474087	617393	544984	513406	584832	670293	743847
CV	51773	81507	73875	45868	90548	44498	60231	65135	62464	69768

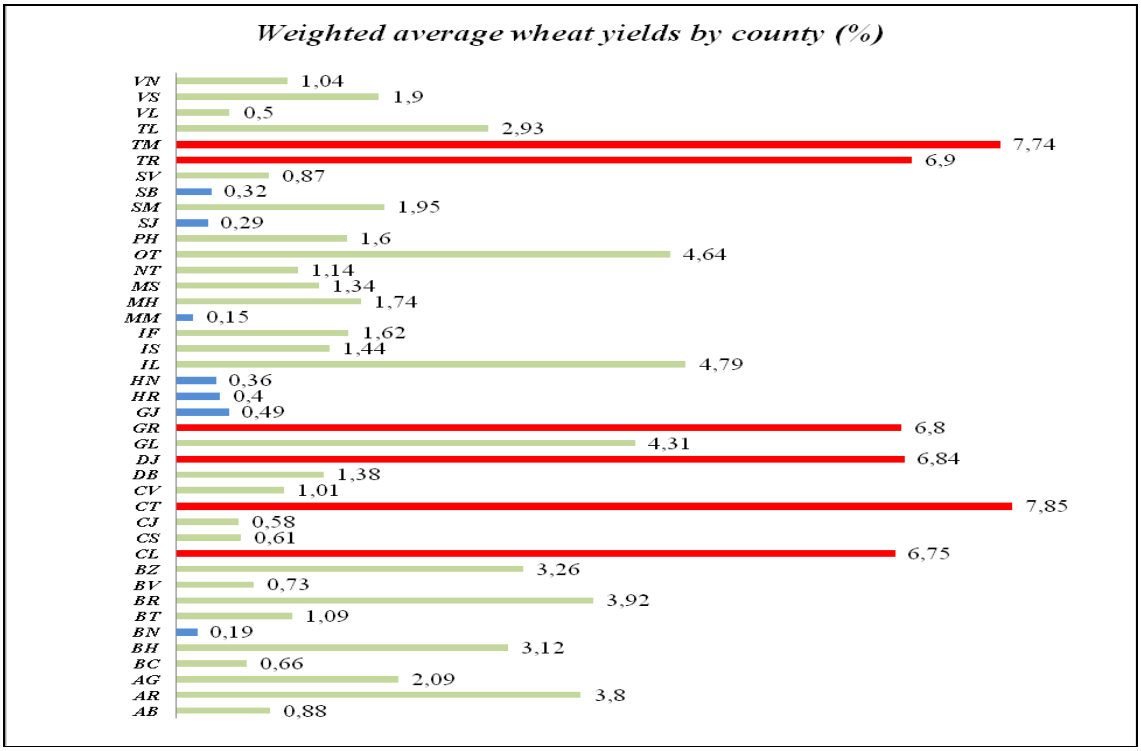
WHEAT PRODUCTION (TONS) 2007 – 2016 ACORDING TO COUNTY										
County	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
DB	45929	97589	83961	104687	129774	67776	104168	101491	90724	99573
DJ	122933	520404	428198	481311	539463	380004	496057	552481	569306	663827
GL	67346	201579	127618	176070	204172	55196	157947	1988941	164967	235961
GR	98531	278518	225124	262589	289213	224889	3337822	330597	344170	289733
GJ	25917	38156	37267	33963	41387	19685	26402	27835	27668	29680
HR	19217	26703	24967	21222	36156	17497	21849	27083	31169	33941
HN	19086	27347	19448	20055	26870	15180	20685	23541	26946	31272
IL	111323	395985	229969	296191	417805	288589	454811	47223	526357	539688
IS	54216	107117	66604	108243	90352	70965	98154	122360	113838	139265
IF	19001	51022	32229	52100	58209	520426	80805	74025	78412	76387
MM	12432	16070	7093	5962	9894	6935	7508	8733	9781	9858
MH	29526	147682	136355	134670	161174	53814	121479	132742	128366	161045
MS	64262	93675	88936	77566	92086	48940	86699	99394	115422	111646
NT	39612	74879	64743	71524	83299	77902	78854	81372	85585	102081
OT	113160	426101	360474	306631	344439	267039	414747	467279	45445	440377
PH	39918	109625	104098	90780	125413	81867	131315	133173	136743	157447
SJ	20934	30907	12023	10889	17462	13816	18125	18291	19455	21505
SM	100153	100043	98275	108336	123983	121603	147736	152407	159479	163376
SB	17722	24369	21230	17552	20287	15115	21286	23471	21354	21022
SV	63045	67493	66097	46370	58364	31308	38646	49709	46051	58732
TR	188602	520412	398141	406998	604381	432909	524536	542536	522410	580409
TM	405200	424849	382332	373583	521072	457997	627736	582080	657714	660891
TL	48947	256859	104417	180134	214508	112178	263296	296435	294902	359148
VL	19356	25653	32818	43757	40434	25317	37505	41170	30212	30122
VS	68748	154286	136054	61533	94773	148100	147416	148776	143977	167527
VN	35353	72832	54576	78021	83055	43880	92527	80113	80569	85497
TOTAL	***3044446***	***7180984***	***5202526***	***5811724***	***7131590***	***5766071***	***10296337***	***8950756***	***7553421***	***8431241***

Source: www.insse.ro

In order to have a profound picture of the evolution of the wheat production recorded in the period 2007 - 2016, according to the county, we present in Figure 1 their weights of the total production registered at national level, according to the year:

Thus, the rows marked in red represent the counties where the highest wheat yields have been recorded on our territory (Timiş, Constanţa, Teleorman, Dolj, Giurgiu, Călăraşi), and the rows marked with blue represent the counties on the territory of which the highest recorded the lowest wheat yields (Maramures, Bistrita Nasaud, Salaj, Sibiu, Hunedoara, Harghita, Gorj).

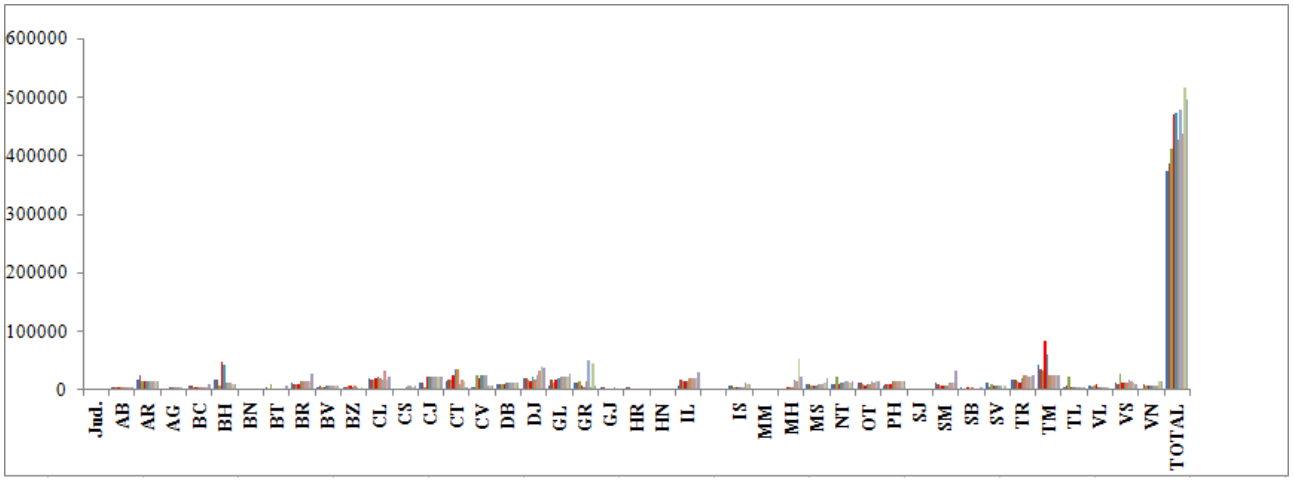
Figure 1 – Average production of wheat by county



Source: www.insse.ro

In order to have the other variable defined in order to continue the analysis proposed by the present paper, we present in the following figures the amount of fertilizers (chemical, nitrogenous, phosphatic, potashic and natural) applied by county in 2007 - 2016:

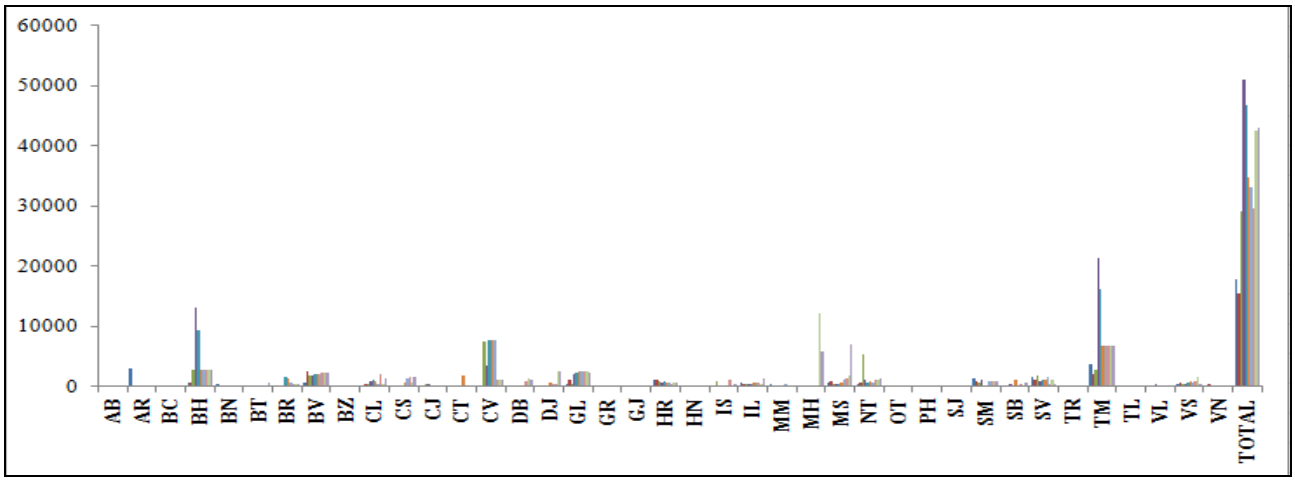
Figure 2: Amount of chemical fertilizer applied in 2007 - 2016 by county (tons of active substance)



Source: www.insse.ro, own calculations

It is noticed that the largest amount of chemical fertilizers was applied on the territory of Timis, Teleorman, Dolj, Cluj, Constanta, Giurgiu and Bihor. At the opposite pole, with the lowest amount of chemical fertilizers applied, there are counties such as Bistrita Nasaud, Hunedoara, Maramures, Salaj, Gorj, Harghita and Sibiu.

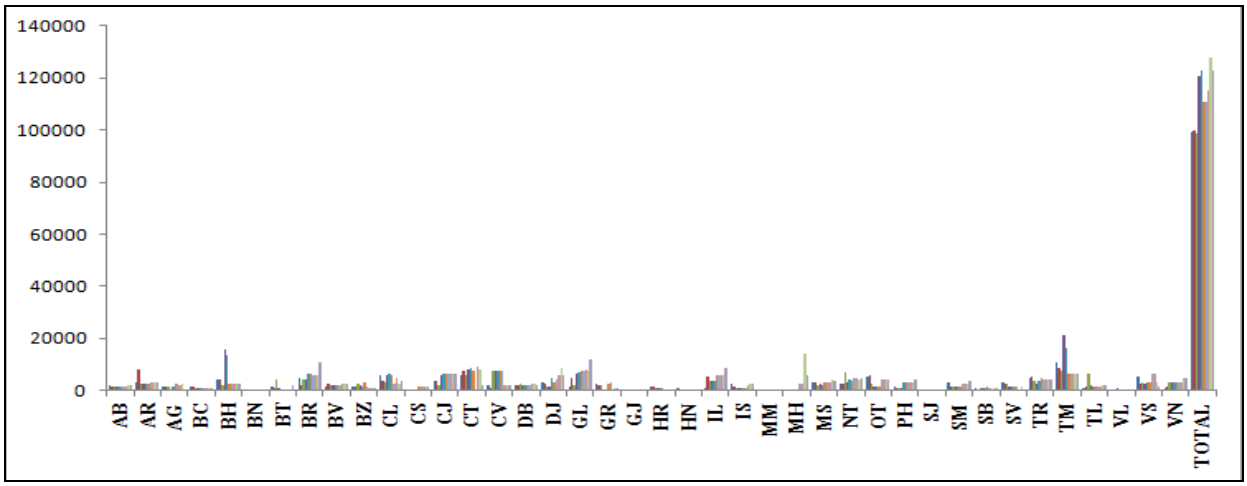
Figure 3: Amount of potassic fertilizer applied in 2007 - 2016 by county (tons of active substance)



Source: www.insse.ro, own calculations

In Figure 3 we observe the counties on which the highest quantity of potash fertilizers was applied during the analyzed period 2007 - 2016: Timiş, Bihor, Covasna, Braşov, Giurgiu and Mureş. In Mehedinţi County, only in the last 2 years was applied a higher quantity of potash fertilizers than that applied in other counties throughout the analyzed period. The counties on which the least amount of potash was applied were: Gorj, Giurgiu, Olt, Prahova, Sălaj, Hunedoara, Tulcea, Bacau and Botosani.

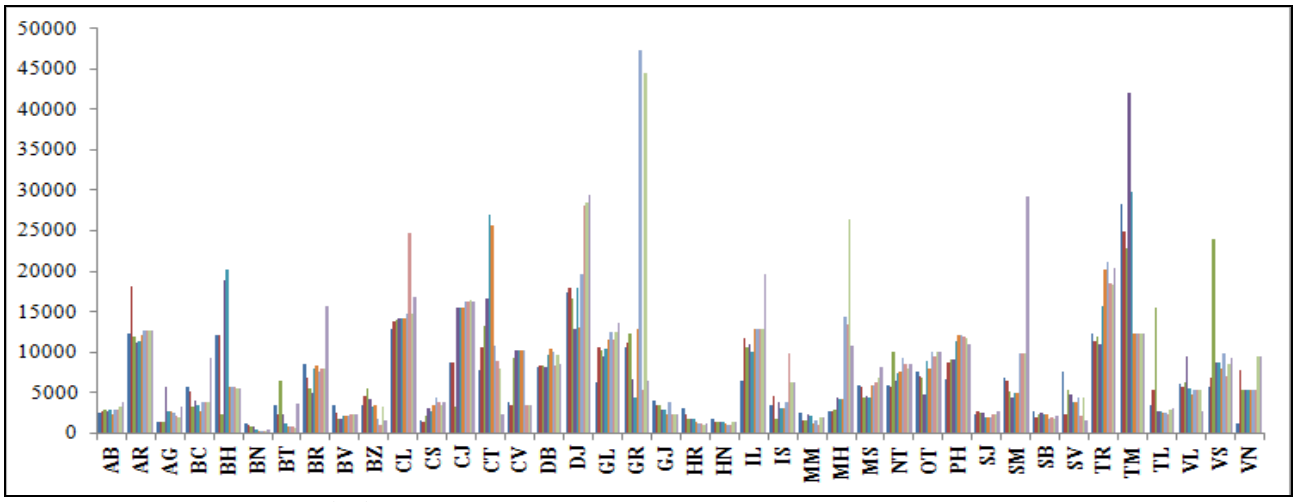
Figure 4: Amount of phosphatic fertilizer applied in 2007 - 2016 by county (tons of active substance)



Source: www.insse.ro, own calculations

Figure 4 shows the counties with the highest amount of phosphatic fertilizer applied during the analyzed period: Timis, Galaţi, Constanţa, Braşov, Bihor, Cluj and Ialomiţa. From processing the data taken from the National Institute of Statistics website, we mention the counties with the lowest amount of applied phosphatic fertilizers: Gorj, Valcea, Bistrita Nasaud, Hunedoara, Maramures, Salaj and Caras Severin.

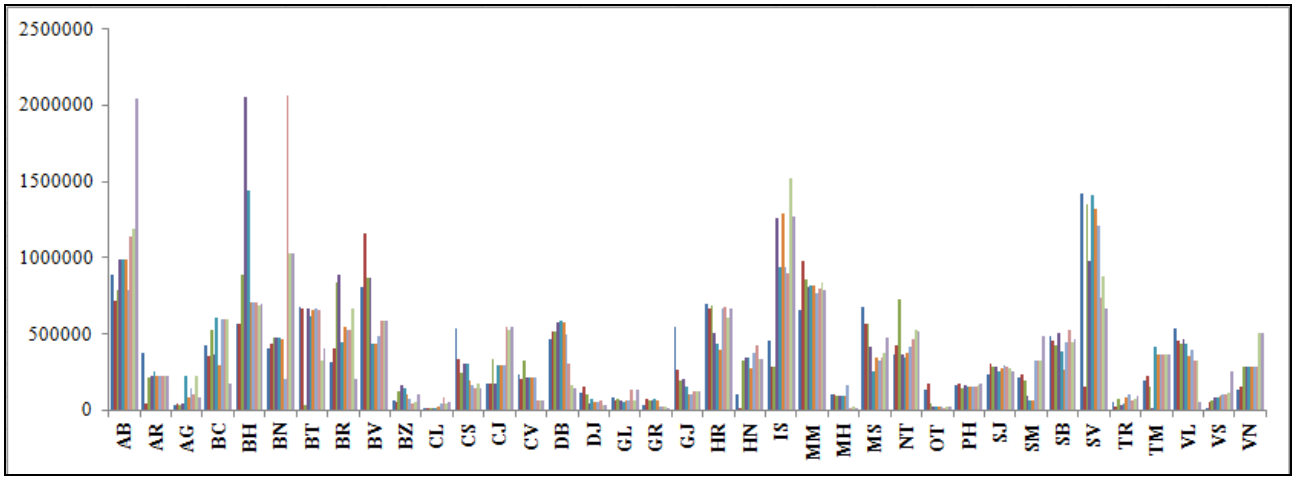
Figure 5: Amount of nitrogen fertilizer applied in 2007 - 2016 by county (tons of active substance)



Source: www.insse.ro, own calculations

Figure 5 shows the counties according to the amount of nitrogen fertilizer applied. The counties on which the highest amount of nitrogenous fertilizers has been applied are Timiş, Giurgiu, Dolj, Teleorman, Călăraşi and Cluj. At the opposite pole there are the counties: Bistrita Nasaud, Hunedoara, Harghita, Maramures, Sibiu, Botosani.

Figure 6: Amount of naturals fertilizer applied in 2007 - 2016 by county (tons of active substance)



Source: www.insse.ro, own calculations

It is noticed that the largest quantity of natural fertilizers was applied on the territory of the Alba, Suceava, Iasi, Bihor, Maramures and Bistritza Nasaud counties. On the opposite side, with the smallest quantity of natural fertilizers applied, there are counties such as Călăraşi, Giurgiu, Olt, Teleorman, Dolj and Mehedinţi.

Thus, taking into account the average yield of wheat obtained, on the one hand, and the average fertilizer amount, on the other hand, in the interval 2007-2016, we will calculate the interdependence of these variables using the Spearman and Pearson correlation coefficient, according to the formulas outlined in the ***Materials and Methods*** section using the Excel calculation program. In Table 2 we present the Pearson correlation and the Spearman ranks, in the range studied 2007 - 2016, of the variables studied, the production of wheat obtained on the one hand and the amount of fertilizer applied on the other, as well as its interpretation:

Table 2

PEARSON COEFFICIENT VALUES AND SPEARMAN RANGES CALCULATED FOR WHEAT YIELD VARIABLES / APPLIED FERTILIZER				
Studied correlation	**Pearson value**	**INTERPRETATION**	**Spearman value**	**INTERPRETATION**
Variables: wheat production / quantity of chemical fertilizer applied	***0,76***	Strong positive, linear relation	***0,77***	Direct, proportional relation
Variables: wheat production / quantity of potassic fertilizer applied	***0,22***	No defined link	***0,14***	No defined link
Variables: wheat production / quantity of phosphatic fertilizer applied	***0,64***	Strong positive, linear relation	***0,71***	Direct, proportional relation
Variables: wheat production / quantity of nitrogen fertilizer applied	***0,82***	Strong positive, linear relation	***0,79***	Direct, proportional relation
Variables: wheat production / quantity of naturals fertilizer applied	***-0,48***	Weak, negative, nonlinear relatin	***-0,57***	Inversely proportional relation

In Table 2, we observe the links between the variables studied, both in terms of their power and in terms of direction. The direction of the link between variables is given by the coefficient sign, a positive sign indicates direct proportionality, while the negative sign shows an inverse proportionality. Looking at the table, we note that in most cases the hypothesis is confirmed that in the counties over which larger quantities of fertilizers have been applied, a higher wheat production was obtained, especially in the case of chemical, potassium, phosphate and nitrogen fertilizers, and in the case of natural fertilizers, which are not necessarily vital for the production of wheat. Exceptions to this general rule are most likely due to the erroneous fertilization of wheat crops, which can only harm the production of wheat.

CONCLUSIONS

In this paper we have analyzed how the wheat yields produced on the territory of our country, depending on the county (variable 1), are influenced by the quantities of fertilizers (variable 2) applied in these regions.

Analyzing the data on the National Institute of Statistics website, and processing them, I noticed the high wheat yields registered in the counties: Timiş, Giurgiu, Constanţa, Teleorman, Dolj and Calarasi. Besides the advantages offered by the pedoclimatic conditions held by the regions from which the counties are part, we have observed a parallel with the quantity of fertilizers applied on the territory of these counties. We list the counties with the highest quantity of fertilizers applied, depending on their type:

- Chemical fertilizers: Timiş, Bihor, Covasna, Brasov, Giurgiu, Bihor;
- Potassium fertilizers: Timis, Bihor, Covasna, Brasov, Giurgiu, Mures;
- Phosphatic fertilizers: Timis, Galati, Constanta, Brasov, Bihor, Cluj, Ialomita;
- Nitrogen fertilizers: Timis, Giurgiu, Dolj, Teleorman, Calarasi, Cluj;
- Natural fertilizers: Alba, Suceava, Iasi, Bihor, Maramures, Bistrita Nasaud.

At the opposite end, both in terms of production and in terms of the quantity of chemical fertilizers, phosphatic potassium, applied nitrogen, there are counties such as: Maramures, Bistrita Nasaud, Salaj, Gorj, Harghita, Sibiu, Hunedoara.

In order to confirm the premise that the amount of fertilizer applied directly influences the production of wheat obtained, we used the two statistically appropriate calculation methods to study the correlation between two variables: pearson coefficient and Spearman rank coefficient, using the Excel calculation program.

The values obtained showed, in most cases, that between the two variables studied there are strong, definite, linear and directly proportional links. The only case where we have obtained a weak, negative and nonlinear inverse link is that of the interdependence between wheat production and the amount of natural fertilizer applied.

Of course, the application of a considerable amount of fertilizer of whatever type is not sufficient; moreover, it can even destroy wheat production if it is not applied in the way and when it is needed. It is known that a fertilizer of wheat crops can pollute the groundwater, only harming this type of production.

In order to prevent these things, as a recommendation, it is preferable to resort to the assistance of a specialist or consultant in the field prior to the administration of fertilizers, whatever their type, or other innovative treatments for wheat cultivation. Thus, beneficial wheat yields can be made in an efficient, economical and environmentally friendly way.

BIBLIOGRAPHY

1. Voineagu V., Țițan E., Ghiță S., Boboc C., Todose D.; *Statistică. Baze teoretice și aplicații*; Ed. Economică, București 2007;
2. Pop, I., Tehnologia Grâului, Editura Printech Bucureşti 2016;
3.Bolboacă S., *Curs statistic: Corelația și regresia liniară*, disponibil la http://sorana.academicdirect.ro/pages/doc/MV2012/MVRom06.pdf;
4. www.madr.ro;
5. www.insse.ro;
6. http://ec.europa.eu/eurostat .