CONTRIBUTION OF ROMANIAN SOILS TO THE POLLUTION OF ATMOSPHERE WITH CO_2, THE DANGERS OF CLIMATE CHANGES AND MEASURES TO ATTENUATE OR ELIMINATE THEM

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Abstract
Romania has a surface of abt. 24 mil ha, and is almost entirely covered with soils. Over 9 millions hectars belong to the group of arable soils, cultivated with different field crops and permanently submitted to agricultural machine interventions. This led to the oxidation of organic matter and of the heteropolycondensed humus due to the lack of technical and scientific instruments to stabilize the soils. In the moment when soils in the Southern, Eastern and Western part of Romania were fallowed, these owned up to 15 % humus, either in a condensed form (huminic acids), either as humus-C, i.e. biomass residua in transformation.
By the taking in culture and the soil tillage within the conventional system practiced still in our days, the analysis of literature and simulation calculations made by us showed that beginning 1930 until nowadays, over 70% of the agricultural soil humus was lost and abt 29 billions tons of CO_2 and other dangerous gases were cast in the air. Recuperation of CO_2 from air can be done only by „greening" all the surfaces and reintroducing CO_2 in soil as humus. This can be done the speediest possible in a rate of maximum 0,1 % humus /year. There is no a viable solution for this, able to solve quickly the absorbtion.

Keywords: humus, carbon dioxide, soil recovery.

1. INTRODUCTION

Climate changes in our days became possible due to intensified anthropic activities which took place when industrialization began, they continued when it accelerated, and became critical when CO_2 accumulated massively in the air, situation generated by the combustion of fossil fuels and also by the humus combustion due to soil tillage in contradiction with ecological laws. [1]
Today's scientific world agrees with one voice that the istorical rates of climate variations which took place continuously during the last 400 millions years, namely exactely since on earth the factorial conditions necessary to human beings apparition appeared, do not manifest anymore today when the climate parameters exceeded a lot the rates variation interval, threatening by their new dimensions the planet existence itself (figure 1), Raggam (2009). [8]
If the climate evolution oscillated between glaciation and warmings in interval of 50-80.000 years, due to absorbtion and desorbtion of carbon in soil in a natural way, within the interval from 180 ppm = 400 billions tons C at 300 ppm = 700 billions tons carbon in athmosphere. Raggam and many other authors which were waiting after almost 100 millions years a recurrence on the warming top the same level, i.e. 300 ppm and 16^{o}C temperature, find out, especially at the beginning of the third millenium that all the limits are exceeded.
Thus it was determined that in 2004 there were in the atmosphere 400 ppm, i.e. 930 billions tons carbon and an average temperature of earth superior to 20^{o}C. The calculations indicate alarming scenarios so that in abt. 100 years 20.000 ppm could be reached, i.e. over 8500 billions tons C in atmosphere and a temperature over 35^{o}C.
Such a scenario would lead to the disappearance of ecosystems and mankind. The optimist scenarios, based on human intelligence show us that if at global level would be taken measures to bring back in the soil as humus the CO_2, both the air carbon content and the atmosphere temperature would come back within the parameters of historical ecological rates.
Intensive agriculture participate in a large degree, larger than the combustion of fossil energy to the starting of climate aberrations

through: CO_2 - obtained throungh humus combustion and other farm activities; N_2O - nitrogen monoxide, following the nitrogen fertilizer surplus applied during the last 40 years if past century; CH_4 - methane generated especially by animal breeding (94% was and is eliminated by cows).

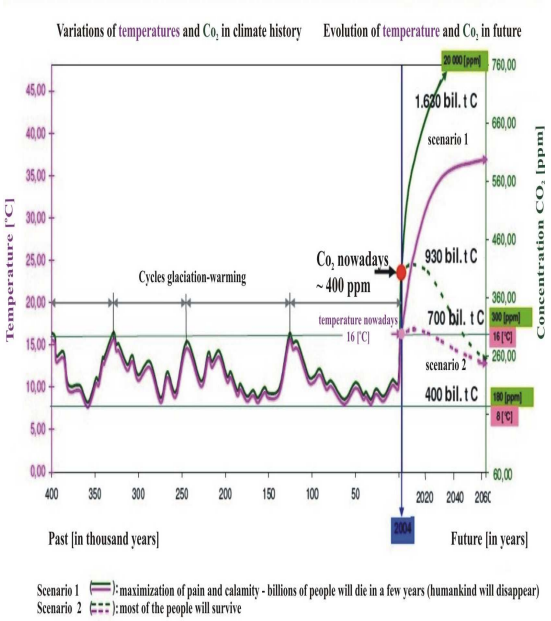


Figure 1 Variations of temperatures and CO_2 in the climate history (processed after Raggam, 2009) [8]

The coeficients of transformation into potential dangerous gases after Haas (2005) [4] are the following:

1 unit CO_2 = 1 unit CO_2
1 unit CH_4 = 23 units CO_2
1 unit N_2O = 300 unis CO_2

Decrease of CO_2 emissions is a problem which proved to be a very complex one at the planet level, and none of the conferences until now could come to concrete solutions regarding settlement of this serious problem. The last conference in Copenhagen fully showed its limits, and the interministerial conference held in Berlin the 18th of January 2010 brought back to discussion what was not discussed in Copenhagen, i.e. agriculture.

Because the absorbtion of CO_2 from atmosphere and its return into the soil can be done only by ecosystems reconstruction, by doubling the biomass quantity and its recovnersion in humus. In this equation the soil biomass has not to be missing, as it too was reduced during the last 80 years from 30 tons/ha to 3 tons/ha, i.e. 10 times (Raggam, 2009) [8].

2. MATERIAL AND METHOD

We investigated the archives and the maps with vegetation of Romania since the first world war until present time. As in the Southern part of Romania over 90% were surfaces with forests and steppes we could determine the organic matter content in form of humus before the fallowings and cuttings. Then, by simulation, depending on the soil tillage technique we could assess humuss losses on little historical periods until our days. [3]

Starting from our own experiences and of other researchers (Dumitru M. and colab., 2008), we made models of ecological reconstruction of soil and of CO_2 absorbtion in humus. We used the probability theory, the analysis of functions in 2D and 3D and numerous simulations.

3. RESULTS AND DISCUSSIONS

What is certain is the fact that beginning forests and steppe clearing the humus quantity began to slowly decrease. We must not forget that during 1930-1950 the Romanian agriculture did not receive fertilizers and only small quantities of manure.

During the first 20 years 2,5% humus-C were lost. After the cooperativization began, between 1950-1980, due to the introduction in agriculture of heavy equipment and fertilizers, the soil humus decreased from d 12,5 to 5%. This decrease was relatively reduced during 1980-1990, as the technological processes in agriculture were being reduced and scarification was compulsory introduced. Humus decrease intensified during 2000-2010, due to reintroduction of heavy, massive and very productive ploughs a (figure 2). Per total within the interval 1930-2010 12,5% humus C were lost.

This means that Romania practically lost the compative advantages she had in the XXth century (see figure 3). According to the

calculations in figure 2, Romania lost 8 billions tons humus = 4,6 billions tons carbon, i.e. over 1% of the atmosphere CO_2 content, which was provided to this.

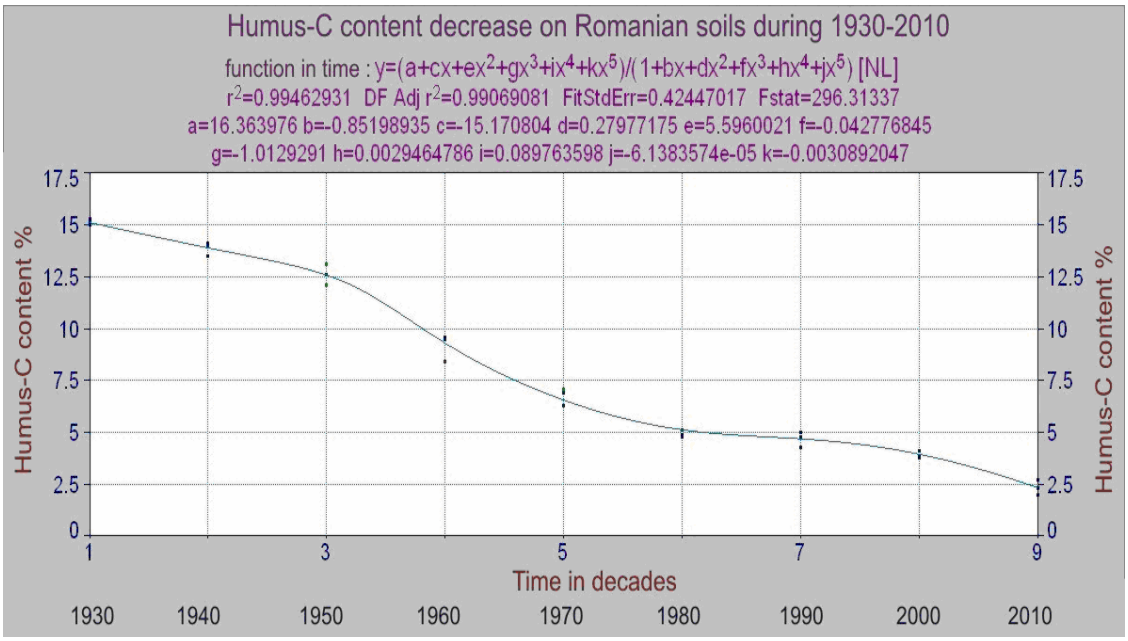


Figure 2 - Decrease of humus-C content in the soils of Romania during 1930-2010.

The recuperation of this huge quantity of CO_2 from the atmosphere and humus reserve recovery can be done only by changing the mentality of our farmers and bringing back technologies to natural models according to the universal valuable principle: *„Nature is the best engineer because during millions of years it created its best systems and laws for a good functioning"*. Reconstruction of humus by incorporating CO_2 is done by the means of biomass in the following stages:

1) If we consider the average quantity of humus as being today 17,5 kg/m^2 = 175.000 kg/ha = 175 to/ha (figure 3) this is a small quantity, placing us within dangerous areas. That's why we propose for a minimum comfort of our soils to increase three times the humus quantity, i.e. to come to 7,5% humus-C (525 to/ha), which is about the European average. In order to reach this goal, we think the following steps:

Step I: To give up plough, so much used in Romania. This should become a museum exposé. (By replacing the ploughing a quantity of 70 kg to/ha is saved from oxidation in abt. 20 years). Ploughing tillage is to be replaced with a 60-65 cm deep scarification tillage. By scarification we get remaking of fluxes on profile. Soil broken up in depth without being horizontally displaced. It remains in its natural condition. Water, roots, micro-organisms penetrate in depth and the whole activity of soil begins again. At surface the soil is not too much broken up in order to avoid oxygen surplus and to limit to the absolutely necessary the oxidation processes. [5]

Step II. Because soils are lacking organic matter or this is found in small amounts, dead biomass contribution is necessary (plants residua - straw, cobs, sunflower and rape stalks etc.) as well as green biomass obtained from green mulch (intermediary crops). In this moment it is necessary to do humus balance in soil. In order to achieve it is necessary to know both the consumption and the biomass contribution in soil.

Starting from this equation it was determined afterwords how can we bring humus-C in soil in order to compensate both the plants and micro-organisms consumption and to secure an

accumulated reserve. For this we will work havig as surface unit the hectar (ha) taking in consideration data obtained by research for inputs and outputs.

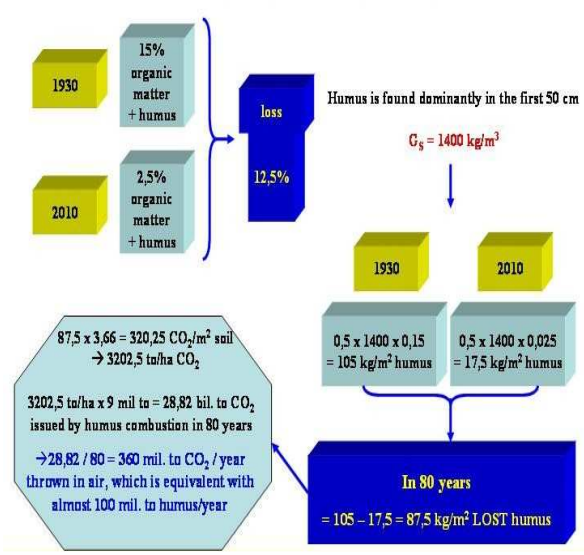
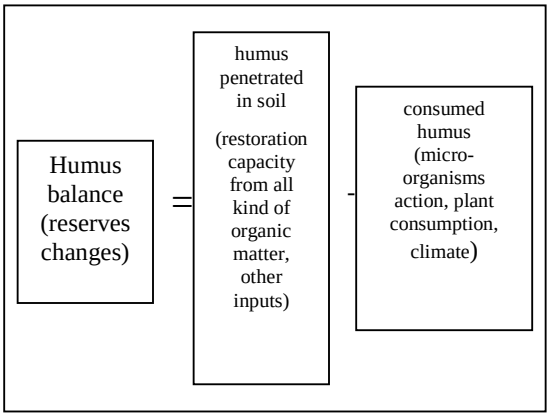


Figure 3 - Rate of humuss loss in Romania.



A. Rape = - 280
Cereals = - 280
Maize = - 560
Flax = - 280
Peas = + 160

Annual average = - 350 kg/ha according to Liz program, without peas in crop rotation.

Balance: - 248 kg/ha, according to Liz program, with peas in 5 years crop rotation, which can be easily corrected.
What should be done? We have to intervene on the soils covnered by plants with organic matter, i.e.:
Straw, cobs, sunflower and rape stalks: 1 to = 70 kg humus-C
Green mass: 1 to = 16 kg humus-C

Table 1 Dynamics of humus in soil depending on cultivated plantes (Data at European level in similar conditions) [7], [6]

Crops	Changes in humus balance (VOLUFA method)		
	minimum	maximum	average
a) Principal crops			
Cereals, including oleaginous plants for fiber (group III)	- 280	- 400	- 340
Beet and other root crops	- 760	- 1300	- 1030
Potato group I	- 760	- 1000	- 880
Annual legumes	160	240	- 200
Maize kernels and for silo group II	- 560	- 800	- 680
Perennial ameliorating crops., including gramineae			
Alfa-alfa, clover, basic year	600	800	700
During the sowing year	400	500	450
Hidden crop	200	300	250
Summer vetch	300	400	350
Summer gramineae	100	150	125
b) Intermediary crops			
After barley and wheat	120	160	140
On the stubble field	80	120	100
Hidden crop	200	300	250

By using the Liz program we come to the conclusion that crop rotation of more than 5 years of 1 hectar can be corrected with 5 to/ha straw and 7 to cobs, and brought in limits accepted by the European Union.
The quantity of carbon dioxide fixed in this way is 249 x 3,66 = 907 kg/ha (almost 1 to). As we do need a restoration of humus from 2,5% to 7,5% = 5% = 350 to/ha, then the procedure becomes very difficult. If, for example, we would introduce in the crop rotation alfaalfa as an ameliorating plant, in the best case we would obtain 1 to humus/ha. For recosntruction at the required level we would need 350 years.

In this case we would capture 1000 kg x 3,66 = 3660 kg/ha CO_2 which we would include in the humus. If 1/5 of the agricultural surface of Romania would be cultivted with alfalfa, this would mean 9 mil x 0,2 = 1,8 mil ha = 1,8 mil to humus/year = 3,66 mil CO_2 fixed in humus. Recuperation of CO_2 issued by the humus combustion in 80 years would be done by the means of alfalfa in 7900 years.
It's too much in order to be able to save the planet. To this model many others could be added, not studied by us.

4. CONCLUSIONS

1.The CO_2 emissions in the Romanian agriculture during the last 20 years are due to soil tillage and are evaluated to almost 29 billions tons, i.e. 1% of the emissions generated at world level.
2.When using alfalfa in 20% of the country cultivated surface (hypothetically) only 1,8 millions humus could be recuperated at national level, i.e. 3,66 millions tons CO_2/year.
3.New ecological systems are necessary in order to increase the CO_2 absortion. The permanent greening of fields and reforestation of abt. 1 million hectars could accelerate the process of CO_2 reconversion in humus by the means of biomass.

5. ACKNOWLEDGMENTS

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6. REFERENCES

[1] Berca M., 2008, Probleme de ecologia solului, Editura Ceres.

[2] Dergaeva Maria, 2003, Pedohumic method in paleoenvironmental reconstruction: an Example for Middle Siberia. Quarternary International. Vol. 106-107, pag. 73-78. [3] Dumitru M., şi colab., 2000 Monitorul stării de calitate a solurilor din România, Editura GNP.

[3] Dumitru M., şi colab., 2000 Monitorul stării de calitate a solurilor din România, Editura GNP.

[4] Haas Guido, 2005, Relevance of Organic Farming for Climate Change in Germany - Wishful thinking. Agraringenieurbüro. Dr. Guido Haas. www.agroexpertise.de

[5] Haider K., Martin P., 2007, Abbau und Umvandlung von Pflanzenruckständen and Ihre inhaltstoffen durch die Mikroflora des Boden. Zeitschrift für Pflanzenernärung und Bodenkunde volum 142 (3), pag. 456-475.

[6] Kolbe, Hartmut (2008) *Einfache Verfahren zur Berechnung der Humusbilanz für konventionelle und ökologische Anbaubedingungen.* Working paper, FB Pflanzliche Erzeugung, Sächsische Landesanstalt für Landwirtschaft, Leipzig.

[7] LFZ, 2007, Humusbilanz. Methode für Beratung in Bayern Bleistift Version. www.Liz-online.de.

[8] Raggam A., 2009, Klimaveränderung durch Humus_abbau www.bio-austria.at