Researches on the management of economy dematerialization in the agriculture of Dambovita county, Romania

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Abstract: Starting from the need to feed an increasing population in the world and also in Romania, as well as to totally protect the environment according to the principles of sustainable agriculture, the authors aimed at finding through research working models able to reduce in agriculture the utilization of costly inputs as fertilizers and pesticides and their substitution with natural resources got by valorization of natural models use. The managerial projects wich we suggest for Dambovita county aim at replacing in the agrarian economy 30 – 150 kg synthetic N/ha with nitrogen obtained from the natural systems and circuits, already studied by us in the area, and replacing most of synthetic plant protection means with alternative models, where those enhancing the plant imune system (Systemic Aquired Resistance/SAR) play the main role. The economic effects of this kind of dematerialization are up to 310 euro/ha in the first stage, plus the benefits not yet evaluated of sustainable soil, biodiversity and water conservation, and of using in energetic aims the residual biomass on the agricultural lands.

Key words: dematerialization, agrarian economy, sustainable agriculture, cost decrease

1 Introduction
The next fifty years will bring the world population at the level of about 10 billion inhabitants, thus increasing by 60% the effort of the international community to get food and energy. Bartmer C.A. [1] pointed out at DLG conferences in Berlin (2008 and 2009) that the Green Revolution set in motion by the use of synthetic nitrogen obtained by industrial fixation (Haber-Bosch procedure) led, undoubtedly, to the yield increase and its quality improvement, but also the the unlimited pollution of soil and phreatic waters with nitrates and heavy metals, always accompanying the industrial fixation. Year 2008 brought with him an increase much too big of the industrial nitrogen price (exceeding even 3 Euro/kg a.s.) making it hardly accessible to the farmers and agricultural productions. In these conditions, said Bartmer [1], it is necessary a re-thinking of nutrition and agricultural crop protection. The new models wich we also propose in our studies take into account the slogan „Re-greening of the green revolution,” and intend to tackle a new type of management leading to the utilization of the least nitrogen fertilizers from soil and their replacement with nitrogen biologically, associatively or symbiotically fixed [3], and also with the nitrogen resulted from the recycling of the residual matters from farms, by the means of intelligent composting methods. We also add that the agricultural technologies process itself, wich is taking place, can lead directly to dematerialization within the agrarian economy. Thus, the agricultural technologies develop in such a manner that soil basic works, maintenance and harvesting are being done in full respect towards the environment components (soil, water, biodiversity, air). The main principle of dematerialization with full respect for the environment suggests that the anthropic interventions on soil are to be done in such a way that this can remain in a condition as close as possible to its natural model [4].

Soil movement by plough utilization is considered by most authors as an out-of-fashion method leading to decisive disturbances in its biological and water conservation systems. In order to achieve the economic principle of dematerialization, the anthropic interventions in the agroecosystem should be minimum and very intelligently elaborated [4]. It was essential for us to elaborate in Dambovita area „state” models of natural and anthropic ecosystems and intervene only when necessary, if necessary, and with accessible technologies, without inducing damages to the above mentioned soil components [6].

In our researches in the area [6] we started from a careful study of the natural ecosystems and especially of
the forests, and we noticed that these are producing each year in some areals 15 – 30 to biomass, consuming up to 150 kg N, over 60 kg P_2O_5, and over 40 kg K_2O, without any anthropic intervention. Elucidation of the mysteries of this model, its mathematical and graphic description and setting up of similar models for the agricultural area allowed us to hope that there are big chances for success of the economic dematerialization process within Dambovita county. The aim of the work, starting from the objective above mentioned, consists in its transfer and implementation in agroecosystems. What comes out is a TRANSFORMED AGRICULTURE.

2 Research methodology

In order to elaborate the „state models” and those of „substitution” we used the method of itinerary research, of tracing out the niches with optimum biological and agrobiological activity. We took samples and according to the test results we set up „state” parameters of the agroecosystems, especially for soil and biodiversity. The factor water was considered for agroecosystems only related to the soil. The restrictions caused by water deficit was taken into account in the evaluation of the ecosystems. According to this, irrigation recommendations were made, if necessary. Further on, in order to elaborate the indicators of the economic dematerialization state we used the mathematical statistics, and especially the „factors substitution method”, the analysis of correlation and variant. In order to elaborate charts we used the tree method. It was also used the processing of the static indicators calculated by us, or of those obtained from the local authorities (agricultural directorates or statistics offices) by the means of comparative method. These data are presented as tables and diagrams.

3 Results

At the level of Dambovita county the surface occupied with ecosystems is 249.001 ha. The main agrarian systems in the country, starting from north to south, along both sides of Dambovita river, are the following:

1. Agroecosystems made of pastures and hay-fields.
3. Tree agroecosystems.
4. Agroecosystems made of subsistence agricultural crops, with high biodiversity, but small lots.
5. Agroecosistems made especially of big crops: wheat, corn, potato, sun-flower, rape – situated mainly in the southern part of the county.

Table 1

<table>
<thead>
<tr>
<th>No.</th>
<th>Agroecosystem</th>
<th>Biomass (dry)</th>
<th>Surface (ha)</th>
<th>Interval variation</th>
<th>Total biomass (state indicators)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>pastures + hay-fields</td>
<td>0.5 – 4.2</td>
<td>43.8-29</td>
<td>77.5</td>
<td>30.543</td>
</tr>
<tr>
<td>2</td>
<td>pastures + hay-fields + trees</td>
<td>0.8 – 3.1</td>
<td>20.362</td>
<td>97.5</td>
<td>30.240</td>
</tr>
<tr>
<td>3</td>
<td>trees + vineyards</td>
<td>0.9 – 5.2</td>
<td>97.5</td>
<td>30.543</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>agroecosystems small agriculture</td>
<td>0.9 – 4.4</td>
<td>79.060</td>
<td>30.543</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>big agriculture</td>
<td>2.9 – 10.2</td>
<td>96.055</td>
<td>30.543</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>2.77</td>
<td>30.543</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total quantity of dry substance biomass got at the county level is 689.768 to; our calculations show that 35% of this is useful biomass, destined directly for people food, and the rest of 65% is made up of residual biomass (straw, stalks of sunflower and rape, branches of trees, potato stems, leaves, radicular mass of plants and others) which sustained the useful biomass but which at the moment of harvest most of the times cannot find its usefulness. In a very wrong way this biomass is burnt. A part of it, as straws and stalks, are used especially in the north of the county to feed the animals.

Depending on the biomass formed in the ecosystems, each hectar from the listed agroecosystems need the following inputs:
Table 2
Consumption of main nutrition inputs per hectare in Dambovita county

<table>
<thead>
<tr>
<th>Agroecosystems</th>
<th>N, kg/ha</th>
<th>P₂O₅, kg/ha</th>
<th>K₂O, kg/ha</th>
<th>N/P/K ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. pasture + hay = fields</td>
<td>34</td>
<td>48</td>
<td>92</td>
<td>1:1:1.7</td>
</tr>
<tr>
<td>2. pasture + hay = trees</td>
<td>34</td>
<td>48</td>
<td>92</td>
<td>1:1:1.7</td>
</tr>
<tr>
<td>3. trees + vineyards</td>
<td>34</td>
<td>48</td>
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</tr>
<tr>
<td>4. agroecosystems small agriculture</td>
<td>34</td>
<td>48</td>
<td>92</td>
<td>1:1:1.7</td>
</tr>
<tr>
<td>5. big agriculture + average ha</td>
<td>72</td>
<td>120</td>
<td>240</td>
<td>1:1:1.7</td>
</tr>
<tr>
<td>Total country</td>
<td>12,804</td>
<td>10,916</td>
<td>9,955</td>
<td>1:1:1.7</td>
</tr>
</tbody>
</table>

N₁ = State indicator – what is consumed now.
P₁ = Potential indicator – what is necessary for an optimum yield in given conditions.
Nᵣ = Necessity indicator – how much is still necessary to get to the potential indicator.

From table 2 comes out that at the present level of yields the crop on those 249,001 ha consume: 33,675 to fertilizers, as follows: 12,804 to N₁, 10,916 to P₁O₅ and 9,955 K₂O. With this nutrition system we got those 689,768 to biomass of which: 35 % food biomass.

Taking into account the necessity to increase the biomass production, for the utilization of the potential of the other vegetation factors, the total quantity of nutrients (N, P, K) should be 78,277 to (Iᵣ) with which we could obtain 1,603,113 to total dry biomass, and about 561,080 to dry substance useful biomass (food + fodder). For this 30,000 to nitrogen would be necessary.

This nitrogen, as the whole quantity of fertilizers, is expensive and polluting. Only those 30,000 to N a.s., at the level of prices in 2008 cost 90,000,000 Euro, money which the county farmers do not possess, and also it is not advisable to make such a waste. In figure 1 we present the concept of dematerialization in agriculture which we will exemplify by the means of nitrogen, as we experienced it in Dambovita county.

According to figure 1, the agricultural systems use intensively different the inputs (nitrogen in our case) and at the county level, according to the state indicator S₁ they do not cover but 2 tons of wheat equivalent, and 2,2 tons straw (1 ton wheat in Dambovita area consumes 25,1 kg N). The small and uncompetitive yields are got in majority in subsistence systems (60%), classical systems (semisubzistence + market) (23%) which are big nitrogen consumers, but unscientifical (2 in figure 1), intensive system (3) – classical, which is practiced on about 3% of the surface and which also is a very big consumer (wasting and polluting), biological systems (4) and which occupies at the most 1%. The rest of 13% from the agrarian surfaces are, at the level of 2009, abandoned and out of the agricultural circuit. All the four systems with partial exception of the biological one, consumes the natural resources in a bigger percentage as necessary in order to achieve these small yields. It is about an unscientific, wasteful consumption, which cannot give back to the environment what is taken from it, creating those imbalances generating destructive phenomena within the agricultural space and also within the natural one, such as: erosion, soil pollution, physical and biological soil degradation (compaction, lack of structure, lack of microorganisms and biological activity) with consequences on soil and population depletion. A big part of the results of photosynthetic synthesis (allorganical rests are abandoned creating pollution, and are burnt). In both cases we are in the situation to acknowledge a big waste.

By the dematerialization phenomenon presented in column 5 figure 1, and especially in the model in figure 2, the phenomena and inputs which act on the plants are seen in balance on the necessary background of soil ecologization, presented as a „TRANSFORMATION” PHENOMENON of the agricultural model presented in figure 2. It is about activities made on soil and technological system of agriculture. Our aim is to develop a new way of thinking leading to an agriculture transformed in a modern one, by valorizing and making the most of the natural resources, already known, but not enough studied in detail. It is mainly about achieving within the soil that microbiological and ecological
constellation which could allow the maximum of free, associative and symbiotic fixation. This implies, by one side, the least interventions on soil, and in the other side the use by the farmers of ameliorating plants such as annual legumes (peas, horse bean, vetchling) or perennial (alfalfa and red clover) within agricultural areas, or white clover + specific grasses within the areas with pastures + hay-fields and other cultivated fodder areas in the northern part. There are already niches within the natural areas of the region which we have carefully studied, and they led us to this conclusion.

If we think at prognosis, at superior valorization of water and light factors of the county on the agricultural surface, we could get hypothetically an yield of 1,250,000 to wheat equivalent which consuming the 30,000 to necessary nitrogen to all the cultures, would position the production to about 5 to wheat/ha, and about 6 to straw/ha (figure 3).

At the level of year 2008: if this nitrogen would be taken only from industrial synthesis, it would have cost 90,000,000 Euro; at the level of year 2009 it would cost about 60,000,000 Euro. All this money indicate a cost of 72 Euro/ha in the first case, and 48 Euro/ha in the second case. And this only for nitrogen.

The economic calculations done only for nitrogen show that 83% from the quantity of nitrogen necessary to the county crops could be got only by natural models of fixation (free, associative, symbiotic). The other 15% could be got by recycling (composts, manure, etc.), and thus the pollution generated by nitrogen would disappear.

From figure 3 it comes out, according to our calculations, that through the phenomenon of agricultural transformation towards the natural models can still be mobilized from soil 50-60 kg P₂O₅ and 30-40 kg K₂O, meaning at the level of the county other billions of Euro.

But transformation implies giving up plough, special technics of soil working without furrowing, bacteriological and mycorrhiza inoculations in case these are lacking from the soil, and long term crop rotation (vetch, vetchling, peas), unknown yet in Dambovita county.

4 Conclusions
1. The necessity to transform the classical and subsistence agricultural systems in a performing one using the attributes of dematerialization becomes a target for the future of Dambovita county agriculture too.
2. The ecological niches optimum found in the space of the county demonstrated that by the ecological transformation of soils and technological processes in agriculture the quantity of nitrogen in the agroecosystem can be covered up to an equivalent of almost 5 to wheat/ha. The nitrogen fixed by synthesis (nitrogen from bag) could complete the lacking necessary. But it should be applied by a special management, on the consumption curve of the crops, and not fortuitously. The same thing is valid also for other inputs and technologies.
3. If soil ecologization is done, interventions in agricultural fields are reduced at a minimum, the yields increase on the account of natural inputs brought in soil by natural models of fixation, as well as by the mobilization of others, by reducing the production costs up to 50%.
4. The final benefit is brought by the system sustainability which would lead to the increasing of soil fertility, to the beautifying of the areals, and welfare and health of the population in the county.
5. Other sources of dematerialization in the county’s agriculture are also possible. They are connected especially to the energetical and industrial valorization of the residual biomass of the county, estimated at more than 1 million tons after the implementation of transformation phenomenon.
1. A potential yield of Dambovita county in wheat equivalent:

\[ 30,000 \text{ to } N \times \frac{24 \text{ kg/to}}{} = 1,250,000 \text{ to wheat equivalent } \text{approx. } 5 \text{ t/ha} \]

Costs until now: 90,000,000 Euro\(^*\) = 72 Euro/ha = 3 to wheat

\[ 249,000 \text{ ha } \times 0.1 \text{ to nitrogen naturally caught } = 25,000 \text{ to } 83\% \]

- Still to be covered from other sources 5000 to 1.7%. They can be covered up to 100% from other sources (composts, manure)

Dematerialization - Costs are reduced with 72 Euro/ha (50%) and the yield is guaranteed for equivalent 3 to wheat/ha, at these are added other 2 tons of wheat generated by the recycled nitrogen and nitrogen from manure and crop rotation.

Aim accomplished: big productivity, food security, sustainable environment and its resources.

Other possible sources of dematerialization in agriculture

Use of secondary biological resources as an energy source.

Value of the same resources in other industrial branches.

Beneficial general effects guaranteed by sustainability and a healthy environment.

* Note: if prices decrease at synthetic (industrial) nitrogen, use correction can be done, but the balance keeps staying positive and favorable to dematerialization.
References: