

## ECONOMICAL AND ENVIRONMENTAL ASPECTS OF THE PRODUCTION OF PELLETS

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Subsistence part of harvest of the crops – straw makes the most part of it compared to the merchandise. It is used for feed purposes and litter, in greenhouses, for soil mulching in construction, heating and so on. Now in Ukraine greater emphasis is made on usage of straw as a source of energy for space heating. Because using their own energy resources, as reduced coal, oil, gas and electricity is less than in 1989 [1, 2].

However, the straw is important in regulating the balance of organic matter in the soil in agricultural enterprises of different organizational forms with the absence of livestock industry [3]. By the rate of growth in prices for mineral fertilizers significantly outpaced the price of locally grown agricultural products on the one hand and on the other – the prices of fertilizers in the domestic market is sometimes higher than the world prices.

Average annual loss of the humus due to unbalanced introduction and removal of organic matter and erosion is 41.77 million tons [4]. Losses calculated only on the nitrogen equivalent of almost 10 billion m<sup>3</sup> of gas.

Depletion of soil significantly aggravates the environmental problem, which went beyond agriculture production and became nationwide [5, 6].

This is why the loss of organic matter should be included in the cost of each grown culture [7].

It is important to establish and justify inappropriate use of straw for the production of fuel pellets due to long-term negative impact that causes a decrease in the effective potential and soil fertility during its alienation from the fields, to mention further features and advanced expedient ways to overcome the energy crisis in Ukraine.

**Research Methodology.** The research was conducted on the basis of the following methods: monographic, analysis, synthesis and balance-calculated. With the help of the last one were determined monetary costs on the basis of alienation of straw and NPK consumption for replenishment of humus as an example of the main food crops of winter wheat.

**The results of research.** As the findings of the UN FAO, ukrainian producers actively increase export of straw of various kinds, including crushed and granulated (table 1.).

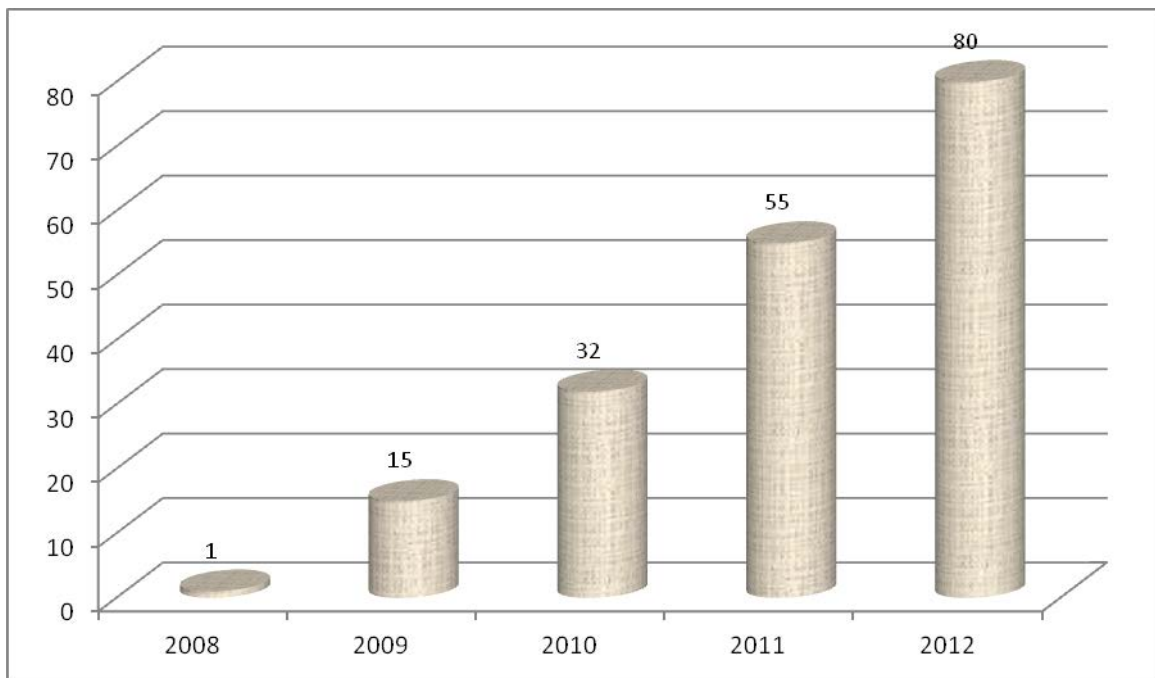
The number of manufacturers of fuel pellets from straw in Ukraine is actively growing (Fig. 1). The vast majority of Ukrainian manufacturers of pellets has a clear export orientation. The same situation is on other types of pellets. However, the evaluation of the process is not so simple. Hiding behind the thesis of renewable

energy sources in the pursuit of profit, do not forget about the fertility of the soil. Let's consider this example of winter wheat.

### 1. Dynamics of straw exports from Ukraine \*

Indicators	2005	2006	2007	2008	2009	2010
Weight, t	25	29	44	578	3437	4608
To the amount of thousands of dollars USA	7	6	7	97	366	437

\* constructed according to data [11]



**Figure 1. Changes in the number of manufacturers of straw pellets in Ukraine \***

\* constructed according to data [12]

Winter wheat among cereals food crops is the largest area both in Ukraine and in the Forest Steppe. It provides a yield of 50 t / ha of straw under 55 kg / ha. Straw contains up to 85% solids and more than 80% organic matter (cellulose, pentozyne, hemicellulose and lignine), which serve as energy material for soil microorganisms and synthesis of humus – an integrated indicator of fertility.

At different soil types it is important to have minimum optimal humus content by which you can get high yield. For sod-podzolic soils this value amounted 1,6-2,0% for grey forest soils — 2.5-3 for black soils — 3 – 4% [3].

During adding straw into the soil, microorganisms decompose simple carbohydrates, hemicellulose, protein compounds, then cellulose and lignin. The last decomposes mainly fungi as both basidial and marsupials, as long as the source is readily available in the form of cellulose. Rate of decomposition of cellulose and especially lignin depends on the ratio of C: N.

M.F. Fedorov stated that the ratio of carbon to nitrogen 20-30: 1 the most intense decomposition of organic matter is conducted, and in the straw it is considerably wider. We now know that decomposition occurs much faster with the

introduction of nitrogen fertilizer at the rate of 10-12 kg per each ton of straw (without their inclusion, micro-organisms that reproduce use nitrate nitrogen from the soil).

The intensity of straw decomposition depends on soil and climate conditions. Thus, on the sandy soils mineralization occurs more rapidly under equal moisture conditions, compared to more bound by the granulometric content.

As O.Ye. Avrov and Z.M. Moroz [8] established, wheat straw with soil moisture of 60% and temperature 5-17°C for at least two months, decomposed less intensive (0,9-1,3% and therefore 6,5-33,7%) compared with increase of temperature from 20 to 27 ° C (17,6-33,0% and 47,9-48,5% respectively).

So straw decomposition occurs most rapidly at optimum temperature and humidity because cellulose destructive microorganisms use humidity as environment necessary for dissolving nutrients, as it supports on the certain level osmotic pressure in the cells of microorganisms, which provides their vital processes – division and growth of cells, respiration and so on. Therefore, these factors should be used creatively to enhance the processes of decomposition of straw in the soil.

Straw to the fertilizer should be applied in granulated state with length of 5-10 cm with the help of combine harvesters and devices for spreading it evenly across the field. After harvesting wheat nitrogen fertilizers should be added at the rate of 10-12 kg per each ton of straw and the field is cultivated with heavy disk harrow.

The next plowing is made by plow without skim. At the same time on heavy loamy soils, plows should be equipped with helical shelves, and on the average granulometric content – with half helical shelves.

Incorporation of straw into the soil causes the increase of humus content on the 0,4-0,13% compared with the case without the application of organic fertilizers.

In the process of decomposition in soil of 1 ton of straw, in three months up to 50 kg of humus is produced, and after two years its formation completes reaching maximum value – 90-100 kg. So, from straw weighing 5.5 tons will form 495-550 kg/ha of humus. If we assume that one ton of manure contains 54 kg, then it will be 9.10 t/ha of manure, and in monetary terms it will be 1400 USD/ha in 6,4-5,1 times less than the revenue from the sale of straw at a price of 40-50 USD/t. Costs to cover the value of humus minus the value of straw will amount 1080-1025 USD/ha.

Next steps in the calculation will be the cost of fertilizers and their application. 1 ton of straw contains 35-40 kg of carbon, 5 kg of nitrogen, 2.5 kg of phosphorus and 8 kg of potassium, which will amount in accordance with the area of 1 ha of N – 27,5, P – 13.75 and K – 44.0 kg.

To return alienated nutrients we need to purchase fertilizers per hectare to the amount of: nitrogen – 243 UAH, potassium – 339 UAH, and phosphorus – 206 UAH, which generally amount 788 USD. But the actual cost will be even greater, as it should be added to this amount transportation costs and fertilizing costs.

Also with straw alienate potassium, calcium, magnesium, sulfur, boron, copper, manganese, molybdenum, zinc, cobalt, renovation of which in soil is also expensive. So there is no need to trouble the text by digital data, as the farm costs only through the loss of humus and main nutrients exceed the value of the revenues for straw in 9,9-8,0 times.

Using straw after fertilizer is polyhedral, as it improves physical and physico-chemical properties of the soil. Yes, B.O. Dosphehov noted that the systematic use of straw in grain-tilled crop rotation ensured the growth of impermeable units at an average of 2.7%.

Thus, there are experimental data showing that during adding straw increases permeability of the soil for 5 -7%, decreases its density and increases its not capillary porosity [8].

So introduction of straw contributes increasing of humus content, improves soil structure and its water permeability, water, air and nutrient regimes and absorbing ability, which leads to the growth of both the potential and the effective soil fertility.

By systematically introducing straw in the rotation increases the output of marketable products from 0.1 t/ ha to 0.2-0.3 t / ha in terms of grain units of each ton of straw. [3] In our case, the average value of 0.2 t / ha is equivalent to 1.1 ton of wheat, which is equivalent to nearly 2,000 USD per hectare. Difference of proceeds from the sale of additional products relatively realization of straw 220-270 UAH / ha will be 1780 -1725 UAH / ha.

Thus, the total loss for the economy will be: with the cost of humus 1080-1025, fertilizer – 788 UAH and possible increase from the receipts by realization of additional grain production 1700-1725 UAH, which will amount 3568-3538 UAH/ha, equivalent to 468-442 dollars/ha, with the help of which can be purchased 1114-1052 meters of natural gas in Russia.

From 1 t of straw produce 1 ton of pellets which equivalent to heat transfer of 450 m of gas and the cost of their realization is 100 euro. That is, in the modern prices for straw, farms sell it only by 4-5% of the price of pellets. And by 5.5 t/ha of straw, equivalent of heat transfer will be 2475 m<sup>3</sup> of gas. So after production of pellets from straw and implementation of them, will be available to get the revenue – in 2.35 – 2.2 times higher that will not settle in the agricultural enterprise.

The above mentioned information allows us to state that agricultural farms in Ukraine are not profitable to sell straw to other enterprises that use it for making pellets, because it leads to the decrease of potential and effective in the future soil fertility and brings losses on each hectare over 3.5 thousand/UAH, so we should look for other sources of raw materials for the production of pellets, and straw should ne used for fertilizing. If it wasn't practiced, non commodity products of row crop of beet, sunflower and soybean couldn't return the used organic matter, which leads to soil degradation [10].

To avoid it, all non commodity products for growing agricultural crops should be used as a source of organic matter and fixed in it the elements of fertilizers and supplemented by other mineral sources of organic fertilizers – manure, chicken manure, peat, straw, sapropel, compost, green manure. Besides, should be applied the bacterial preparations OOO "ZASHCHITA AGRO", which accelerate decomposition of plant residues and prevent the development of diseases and pests, and also fertilizers, which will first suspend and then promote the growth of potential and effective soil fertility.

Data about effectiveness of wood pellets usage are known [9]. In Uzyns'kyy Sugar Factory last year paid daily 400 thousand for gas, today sugar and bioethanol

production consumes 180 tons of pellets a day – 180 thousand, costs decreased in 2.22 times.

In perspective, expediency of making wood pellets grounded by the fact that, according to scientists' data, in Ukraine should be reduced the area of arable land at least by 10 million hectares (from 34,342.3 thousand ha to 24,227.4 thousand to ha) and transfer it into natural feed lands for forestation and thus arable lands fund will decrease from 81% to 57.5%. At the same time it will resume disturbed correlation between natural complexes – areas of grasslands, forests, water, crops, and will stabilize ecological balance in agricultural landscapes. Forests and grasslands will prevent erosion and reduce the negative impact of drought.

Reduction of arable land area (which, for example, in the United States during 1981-1983 amounted 26.4 million hectares, and now they reach the level of 1900) in Ukraine will allow to conduct the redistribution of mineral and organic fertilizers introduction. Experience in Germany shows that on the natural forage lands during the introduction of only mineral fertilizers, a positive balance of organic matter in them is achieved.

Should be strengthened public attention to the problem of increasing forest plantations areas, which mitigate the deleterious impact of weather conditions. Today in Ukraine area under forest plantations is only 16% of the territory and in the European Union established forestation rate is 30%.

V.F. Sayko [4] notes that Ukraine should be planted first of all 3794 hectares of forest plantations, and secondarily – 2091. At the same time lands covered with forest vegetation will amount 15,520.5 hectares or 25.7%. Among these plantings should be given a significant place to fast-growing species (poplar, alder, willow, etc.) and should be used not divisible wood during caring for plants (sanitary cuttings) and replacement of species composition by clear-cutting neighborhoods including root out stumps, which can also serve as material for making wood pellets.

**Conclusions.** Consequences of studies indicate that the use of not divisible production of agricultural crops, including straw (and other) for the production of pellets are not economically justified because it reduces the potential and effective fertility.

An alternative direction to overcome the energy crisis will be production of pellets from wood, forest vegetation of fast-growing species – poplar, alder, willow, etc., with significant expansion of areas under forest vegetation to their optimum value in Ukraine.

In addition, should be increased mining of coal, oil, gas, power production using water power plants and other unconventional sources.

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