

To a Performance Management of the Subsistence Households in the Eutric Cambisoils' Area of Brebu Commune, Prahova County, Romania

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ABSTRACT

The objective of the present paper was to conduct some researches in the inhabited area of Brebu Commune – Prahova County, an area with eutric cambisoils. By using local varieties of corn and monocultures over a ten-year period, the landholders of Brebu Commune in Prahova County used to obtain about 1050 kg corn/ha, with 9.5% protein, even under favourable moisture conditions. Taking into account that feeding pigs with corn grain only, the consumption was of 10/1 this means that the corn yield per one hectare was used entirely for the nutrition of one pig in 2 years. We therefore tried to demonstrate that by abandoning the monoculture and the corn local varieties and by introducing a crop rotation system with ameliorative preceding plants, such as peas and alfalfa, as jumping field, and of some performance hybrids, the yield could increase up to 5500 kg corn/ha. This way, up to 16 pigs could be raised and they could obtain a net income/ha of over 11.000 lei (2.000 Euros). Our experiment did not involve the use of any synthesis chemical fertilizers. In order to replace them, we built an ecological hole of compost fermentation, where by the mixture of the manure from different species, of the household and agricultural land remnants, there was obtained a compost with 6-8% N, which meant that at a dose of 25 t/ha was enough to supply the plants with nutrients and to force the householders to an advanced greening of the household and of the lands.

1. INTRODUCTION

According to FAO, the eutric cambisols in the temperate zone are among the most productive soils on earth [1]. The data provided by NISAR (National Institute for Soil and Agrochemical Research – Romania), reflect that eutric cambisoils in Romania cover a surface of 1.37 million ha, usually placed at altitudes of 500-1000 meters, in the peripheral area of the Carpathian Mountains [2]. Brebu Commune and its surrounding area lies on such type of soil of medium fertility (about 2.8% humus) [3], sitting on the platform of Doftana and Lupa rivers and occupying a surface within the town and on its outskirts. The total surface is of 5852 ha, out of which 2000 ha are represented by the

agricultural land in the town, used by the farmers for their households [4].

The main crops sown or planted on these lands are corn (70%), potato (5%), fruit trees (5%), vegetables (3%) and alfalfa (3%). The remaining surface (14%) is allocated to other crops. All crops have a great role in the nutrition of population, but corn is granted with the utmost importance for the following reasons:

- it is used in the feeding of pigs and meat and eggs poultry, which are the main animals from households;

- it is directly used in the human nutrition as polenta and mash.

At the same time, in a study realised on the Timiș county soils [5], it is shown that the fertility class

of the eutric cambisol is IV for corn, V for wheat and sun-flower and VI for barley. It is then obvious that corn should be chosen over the other crops.

At the beginning of our experiments these were composed only from local populations and varieties of white grain, mainly used for the preparation of mash, whereas those with yellow grain were especially used for polenta and animal feeding [6], [7]. It is to be mentioned that improvement of crop production involves solving some issues regarding cropping practices, especially those related to the nitrogen nutrition and to the hybrid selection [8].

At our arrival and establishment in Brebu commune, corn hybrids were not actually known by the local population. They completely dismissed them, considering that neither polenta does taste good, nor the meat animals do have the same quality, especially the fat bacon, whilst the poultry are making fewer eggs. It is to be mentioned that corn monoculture had been practiced for an unlimited period of time.

The objective of this paper was to introduce a crop system in the urban and rural peripheral areas that would certainly enhance peasant agrarian economy on these eutric cambisols.

The purpose of our research consisted in implementing the mid-early hybrids and exclusively using farm inputs so as to avoid nitrate pollution and to green the surfaces. A second aim was to convince the farmers (householders) about the superiority of the new system and argue in favour of and its extension on a surface as extensive as possible out of the 1.3 million ha, as eutricambosol occupies in Romania, in the area between 500-1000 meters above the sea level.

2. THEORY AND METHODOLOGY

The experimentations were conducted for a period of 10 years in the household of Mr. Sorescu Dumitru, unfortunately now deceased, and covered an area of around 1 ha, out of which 10% were orchards (fruit trees) and 15% were pastures and meadows. The rest of it, nearly 7,500 sq m, divided into 4 parts, was intended for agriculture.

Until 1993, the land was cultivated with corn – local varieties, whose best yields hardly exceeded 1000 kg/ha – zucchini, fodder beet, potato from their own production seed, alfalfa and small quantities of vegetables, as much as needed for consumption.

The soil was included in the category of eutric cambisol with about 3% humus, formed mostly on calcareous rocks. Experimentations carried out were organized in a perimeter of 4,000 sq m, in the form of a simple trifactorial experiment, namely:

The 1st factor – previous crops:

- a). Corn – 10 years monoculture.
- b). Potato.
- c). Peas.

d). Alfalfa – as jumper field [1].

The 2nd factor – variety + hybrid [9], [10]:

a). It was used a white-colour variety arising from a local population, man-made local selection directly from the field.

b). It was used a double hybrid from the group FAO 300, not the same every year, from multinational companies producing hybrid seeds.

The 3rd factor – application of some local compost in 2 stages:

a). Without compost and without chemical fertilizers.

b). With compost manufactured in a composting pit near the animals' stable. The compost was made from a mixture of manure from several livestock species: pigs, poultry, cows, turkeys, sheep, to which plant and animal remains were added which were carefully collected from the household, shredded and placed in the fermentation pit. Mowed and chopped grasses, weeds and even some chopped alfalfa were also put there to raise the N content of the compost. The fermentation pit, built of concrete, had a decisive contribution to the household ecologization, absolutely the entire organic waste being directed there. Compost fermentation lasted for a year, after which it was removed and applied in the experiment at a dose of 25 tons/ha/year.

The chemical composition of compost was as follows [1], [2]:

- D.S. (dry substance) = 29%;
- N = 8.2%;
- P_2O_5 = 7.8%;
- K_2O = 7.1%.

It is also to be mentioned that the fermentation must had 4% nitrogen (N) and 4.5% K_2O .

It resulted in a polifactorial experience of $4 \times 2 \times 2 = 16$ variants, disposed on land in 4 stages, with a total of 64 plots, each one of 60 m², cumulating a total occupied surface of 3,840 m². The eutric cambisols had a depth of 30 cm in A – B_v profile, above the rock layer. Water was sufficient for plant consumption and, when required, it was irrigated with an installation that captured water from the buildings (the rainwater).

Soil tillage consisted in one fall ploughing done with a 40 HP tractor and a double disc plough. In spring, excepting alfalfa, as jumping field, the land was worked with a disc harrow adapted to the 40 HP tractors. There were not applied any herbicides or other plant protection products. Weed control was done with moto-hoeing machines between rows and manually per row.

Harvesting was also performed manually. Concerning the yields, only the corn ones were pursued. All yields were brought to the standard value and that was given to the IT system in order to perform the statistical calculation and interpretation of production differences.

For making a distinction between the yield results, we used the dispersion analysis (analysis of variance) and the „t” test applied on the Student distribution. This way the coefficients (r) and the correlation reports (r^2) were calculated, as well as the corresponding production functions.

3. RESULTS AND DISCUSSION

The average influence of previous crops, regardless of variety, hybrid and manure treatments is presented in Table 1 and Figure 1.

Table. 1. Previous crop average influence for the corn yield on the eutric cambisoils from Brebu – Prahova (10 years average).

Previous crop	Average value	Control ratio (%)	Control difference	Significance
Monoculture	10.47	100	-	Control
Potato	24.69	235.88	14.22	***
Peas	34.79	332.3	24.32	***
Alfalfa	40.54	387.28	30.08	***
Overall average = 27.62				

The average yield variety x hybrid in a 10-year monoculture of corn amounted a little over one ton. The potato brought 1.4 tons supplementary, peas another 2.4 tons and alfalfa 3 tons.

The graph shown in Fig. 1 confirms the growth rate of corn production, with the use of pre-ameliorative crops, peas and especially alfalfa.

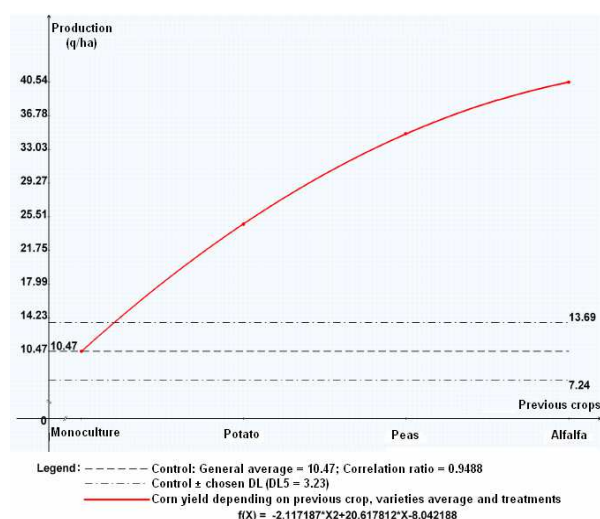


Fig. 1. Evolution of the corn average production (variety x hybrid) based on previous crops.

From Figure 2 we can conclude that, even with the contribution of plant fertilizers and of ameliorative previous crops, corn hybrids still produce 20% more yield than the local varieties. This means that the

technical services of the communities have the obligation to persuade the householders to abandon the local varieties in favour of hybrids.

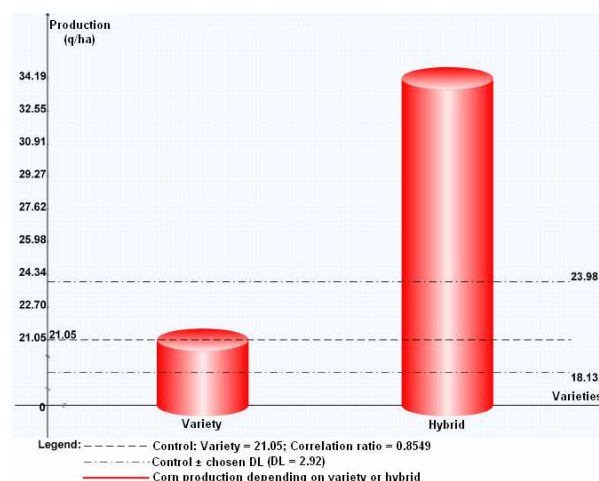


Fig. 2. Differences of yields between variety and hybrid, in average for the other investigated factors (20.01.2010, Brebu).

Regardless of the previous plant, but also by the genetic material used, treatments with 25 t homemade compost/ha bring, on average, an increase of production of over 5 q/ha, which covers the full cost of composting and administration (fig. 3).

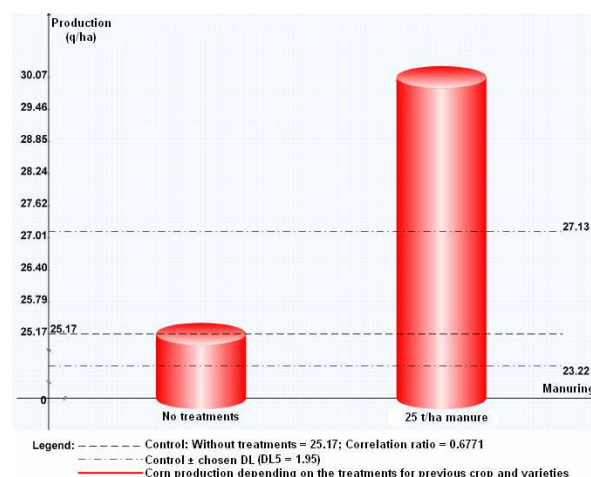


Fig. 3. Influence of homemade compost treatments on corn yield – average varieties x hybrids x previous crops.

The largest variation in the corn yield is given by the interrelation between varieties x previous crops (table 2). In a 10 years monoculture the variety relation only obtains a yield of 645 kg/ha.

Due to variety, potato brings an increase of production of 1495 kg/ha, and having peas or alfalfa as background, the production increases by 400-500 kg/ha.

In the same 10-years monoculture, the hybrid gets twice a production than the variety in monoculture. For hybrid, yield significantly increases when it comes

after peas and especially alfalfa. It reacts better to the previous crops, namely 3711 kg/ha compared to 2301 kg/ha, that is a 1.6 times higher production. This is another argument for our householders to accept the hybrid.

Table. 2. Influence of variety/hybrid and previous crop on the corn yield, regardless of the manuring degree.

Option	Previous crop	Average value	Control ratio (%)	Control difference	Significance
Variety	Monoculture	6.45	23.35	-21.17	000
	Potato	21.41	77.52	-6.21	000
	Peas	26.89	97.34	-0.73	-
	Alfalfa	29.46	106.66	1.84	-
Hybrid	Monoculture	14.49	52.45	-13.13	000
	Potato	27.97	101.27	0.35	-
	Peas	42.69	154.53	15.06	***
	Alfalfa	51.63	186.89	24	***
Overall average = 27.62					

The absolute difference between variety and hybrid, both in monoculture, after alfalfa is of $5163 - 645 = 4518$ kg/ha. It is the most convincing argument for the householders to switch from monoculture and varieties to hybrids and ameliorative previous crops. It seems surprising, but the manuring with 25 t manure/ha, on average for variety and hybrid, does not bring the expected yield increases (fig. 4).

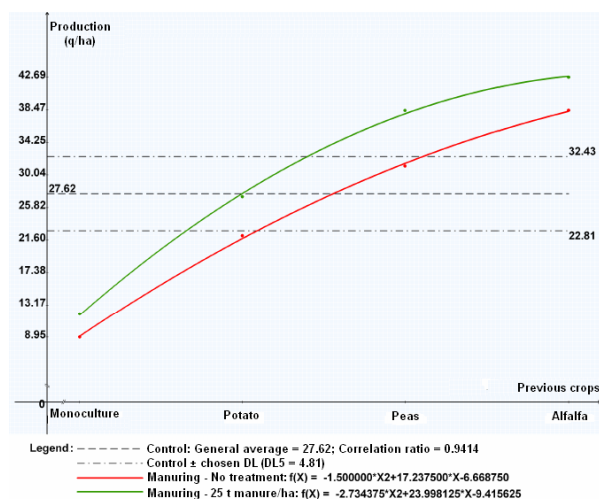


Fig. 4. Concordance between the manuring level and the previous crop considering the variety – hybrid average, Brebu 2001-2011.

Only after peas and alfalfa does the livestock manure bring significant increases. Alfalfa also brings significant yield increases for the corn variety, hence the need for it to enter into the crop rotation system as jumper plant. Please note that in this case the manure was administered to alfalfa and not to the corn crop.

Treatments with homemade compost do not bring significant increases neither to the variety nor to

the hybrid (fig. 5). However, the application of 25 t manure/ha offers a very meaningful production increase for hybrid. It reacts much better to the manure than the variety does.

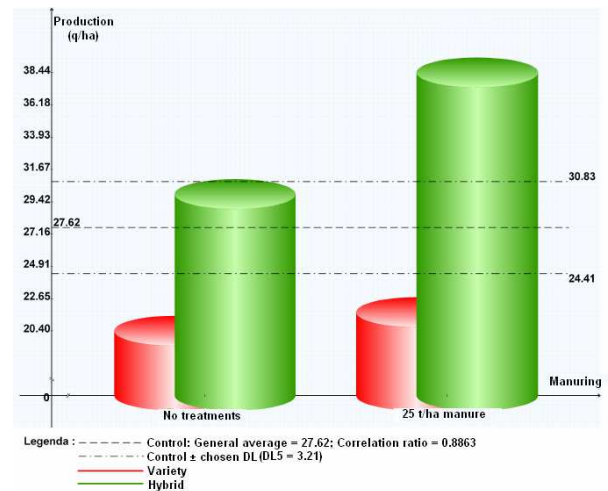


Fig. 5. Influence of manure treatments on the corn yield level under medium conditions of previous crop and varieties/hybrids.

Applying compost compared to monoculture (fig. 6) shows greater increases of harvest in peas and alfalfa and lower, even the lowest ones, in monoculture. Manure's reduced effect in monoculture is also due to the powerful attack of smut (*Ustilago maydis*) – Figure 7, mainly occurred in the last 3-4 years of monoculture. This will be seen more clearly in the analysis of yield growth in monoculture.

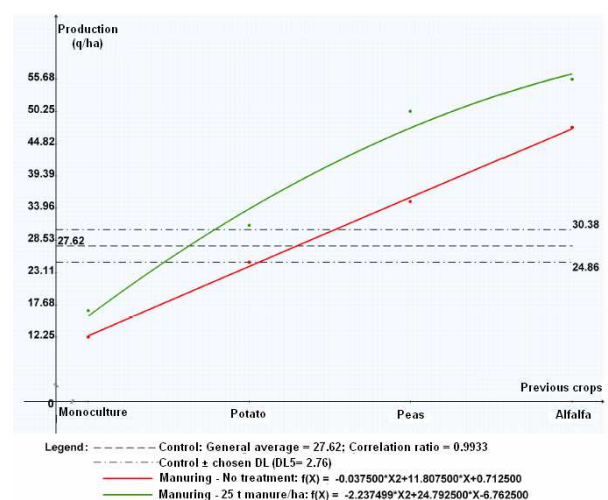


Fig. 6. Influence of crop rotation and of manuring level on corn crop yield – average variety/hybrid, Brebu 2001-2011.

The phenomenon is even clearer in Fig. 8, which shows that in the absence of manure the local variety is capping at the same level as the preceding peas and alfalfa, plants considered ameliorative, while the hybrid is developing on an ascending linear

dynamic with the previous plant evolution, very significant development, which is recommended to farmers in such areas.



Fig. 7. Smut attack on corn (*Ustilago maydis*) on an experimental plot.

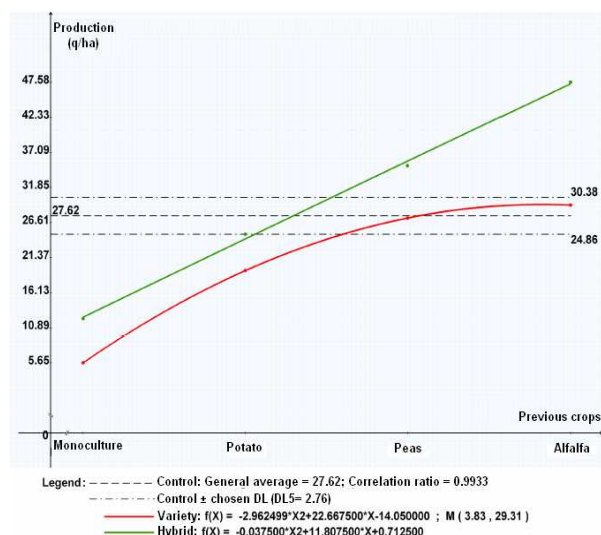


Fig. 8. Analysis of corn yield depending on the previous plant and varieties/hybrids in conditions of lack of fertilization – Brebu, 2001-2011.

Yields increase in the presence of manure, but the behavioural dynamics remains almost identical to the presented case (fig. 9).

Local variety does not react significantly to the pre-ameliorative plants and not even to the potato. The

hybrid, instead, strongly reacts, raising production to 56 q/ha, a convenient production to any farmer in the area.

a). Peas (as previous crop) + hybrid = 50.28 q/ha;

b). Alfalfa (as previous crop) + hybrid = 55.68 q/ha;

c). Monoculture + local variety = 5.65 q/ha \rightarrow the current situation.

It is easy to conclude that is necessary for the current eutric cambisoils technologies to be urgently changed.

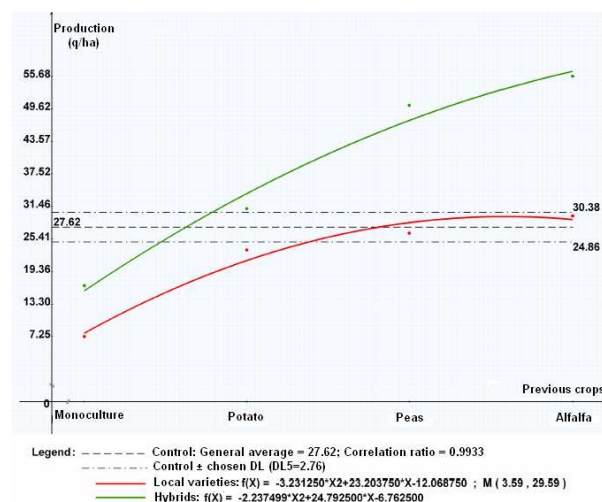


Fig. 9. Influence of previous plants and of variety in the presence of compost applied in 25 t/ha – Brebu, 2001-2011.

We end this exposure by demonstrating that, both for local variety and hybrid, the yield is reduced in the years' dynamics mainly due to monoculture.

In addition, the last 3 years the crops have been abundantly infected with smut, disease that significantly reduced the corn yield from local varieties, as well as from hybrids (fig. 10).

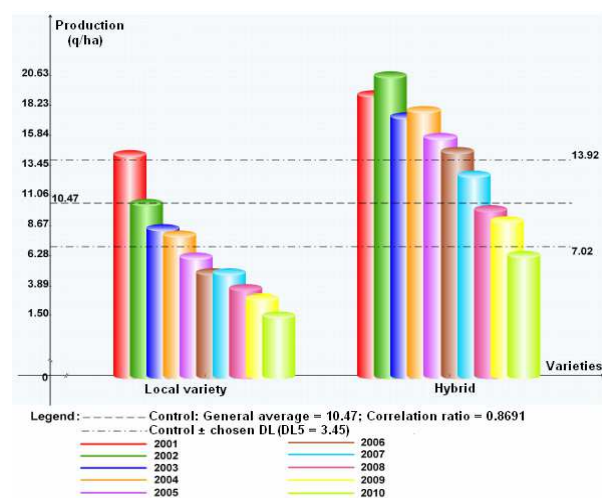


Fig. 10. Dynamics of corn yield for local variety and for hybrid, average previous plants and manuring – Brebu, 2001-2011.

In conclusion, from this experiment we retain that:

1). Householders have the material and moral obligation to make the transition from the local varieties to the efficient hybrids, which can be an opportunity for increasing their harvest level by over 4 times.

2). It is necessary for the small farmers to know that they can get high yields and can live much better if they give up monoculture and introduce, even on small surfaces, crop rotations with other crops, but especially with ameliorative plants (peas + alfalfa).

3). By composting the manure and the remnants from households, farmers can obtain a good organic fertilizer, but they equally provide an ecological process, a cleaning of their own household.

4). By adding a quantity of 25 t manure or homemade compost per ha makes the use of other chemical fertilizers unnecessary and, consequently, the nitrate pollution is avoided. The compost, depending on the composting raw materials and application methodology, may have 4-6% nitrogen. The recommended dose is sufficient for a good nutrition of the plants from the crop rotation. Starting from the knowledge that the soil is formed on limestone and basalts, its reaction is neutral or slightly alkaline and does not require application of amendments (CaCO_3).

3.1. Discussions about improving the household

We start, therefore, from a one-hectare household and assume that, except for a few hundred of square meters with vegetables, the householder wants to sow field crops in order to feed a cow, pigs and laying hens.

Considering how they cultivated the land in monoculture until 2001, 8000 m² with corn and almost 2000 m² with potato, they obtained:

- 800 kg corn;
- ≈ 300 kg potato.

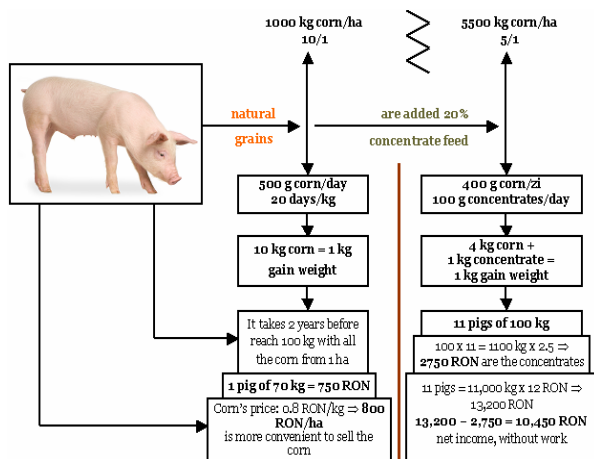


Fig. 11. Pig growth management with modern technologies.

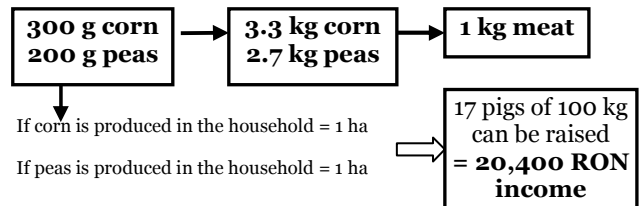
A pig eats about 10 kg of corn to obtain a weight gain of 1 kg. Also using swill and some potatoes, he can only raise one dominant fat pig/year with the entire production. In Figure 11 we expose the metamorphosis of the household based on the new data.

Similar calculations can also be made for laying hens, chickens, calves at fattening, dairy cows.

Another version is the one with peas, in which:

- peas is extruded or not;
- peas is included in recipes in a ratio of 15% for youth and 40% for adults;
- peas replaces 80% of the concentrates, which means a saving of 2,400 RON.

The recipe:



4. CONCLUSION

Our calculations show that if a householder has 4 ha cultivated by an agricultural system of 4 years with ameliorative plants, peas plus alfalfa (also as jumper field), they can achieve an annual net income of up to 40,800 RON, which is nearly 10,000 EUR, with growth opportunities as the householder adopts more managerial knowledge to work on the market niches.

Rational use of lands is one of the finest skills for village households, which makes the connection between universe, nature and the human spirit in the metabolic and esoteric form.

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