Economics of agriculture
SI – 2
UDK: 339.13:633.8

HARVESTING SPONTANEOUS VEGETATION OR PURCHASE MEDICINAL PLANTS FROM THE MARKET? – CASE STUDY

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Abstract

The paper analyses the efficiency of material resources supplying of an enterprise that processes medicinal herbs. The objectives of the research are to identify the most cost-effective alternative of supplying herbs, out of two possible sources: spontaneous vegetation, by initiating a campaign of collection, or purchase them from contractors.

Econometric models are developed for choosing the optimal solution, entering data from a business of processing medicinal herbs in a computer program. The results show that there is a quantity of material resources for which is more profitable to get it by initiating a campaign of collecting plants from spontaneous flora, after which, for any additional quantity, it becomes more efficient to be purchased from the market.

Key Words: *econometric models, medicinal herbs, spontaneous flora*

Introduction

In this paper we develop econometric models to underpin the decision of supplying medicinal herbs, models made based on actual data provided by an operator. The activity of the company is processing and trading medicinal plants and products made from them.

Enterprises wishing to supply medicinal herbs have to choose among their acquisition from intermediaries or directly from farmers and initiate a campaign of harvesting spontaneous vegetation. There are advantages and disadvantages in cases, but the most important, the managers must take into account in underpinning decisions,

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are those related to economic aspects.

The research tries to answer the question: Which is better option to supply the medicinal plants for their processing: harvesting vegetation or purchase them from the market?

Given the different ecological features of species of medicinal plants, a general answer can not be provided. But the answer can be identified using a concrete example of medicinal plant for which data are sufficient to draw conclusions and econometric shape. *Arhangelica Angelica* was chosen as a medicinal plant, which is found in the spontaneous flora, and which was cultivated, as well.

The relevance of the research results from the fact that any enterprise can use the results for underpinning decisions of providing material resources, by introducing specific data of a company.

Material And Method

The data used to develop the econometric model is provided by SC Naturalia Impex. The company conducted a campaign of collecting fresh plant, from spontaneous flora, Angelica Arhangelica variety of Bucegi Mountains – Cheile Pesterii area of lalomitei Valley, at an altitude of 1660 m. This area is very good for growth and development of this variety of plants that are very demanding to air conditions. Since the plant needs high humidity, the area is favourable, with many irrigated valleys of springs, rivers and streams and hills are positioned away from direct sunlight because of their position and the existence of secular pine forest with tall trees. This is one of the few areas suitable for growth and development of plant species Arhangelica Angelica, this being very sensitive to environmental.

Table 1. Quantities of plants harvested from spontaneous flora and costs

NO. DAYS	TOTAL COST (MDL)	Herb Quantities (kg)	Quantity of roots (kg)
-0 -	-1 -	-2 -	-3 -
1	90	7	3
2	180	16	7
3	270	27	12
4	360	35	14
5	450	43	17
6	540	51	22
7	630	59	24.5
8	720	66	27
9	810	72	29
10	900	77	31
11	990	83	34
12	1080	88	36
13	1170	91	37
14	1260	93	37.5
15	1350	94	38

(Source: Data provided by SC Naturalia IMPEX SRL)

Harvesting campaign lasted 15 days and was supported by 2 people specialized in picking plants from spontaneous flora. They worked 8 hours / day, with breaks, so the actual time worked is 7 hours / day. A person receives 45 lei / day. Thus, for 2 people, the company registered costs of labour of 90 EUR / day. After 15 days of plant harvest campaign of spontaneous vegetation, results have been presented in Table 1.

The workers harvested both vegetative part (herba) and the root, because this is one of the few plants of which all components are used. The amounts collected are reported in fresh plant, weighed immediately after being harvested. The two components, herba and root, are analyzed separately because they have different prices to the market.

Thus, the National Institute of Research and Development for Potato and Sugar Beet (INCDCSZ) provided the amount of 150 kg of fresh plant (without root), with a sales price of 9.312 lei / kg (excluding VAT), to SC Naturalia Brasov Impex Ltd. to secure raw material Arhangelica Angelica plant for a year. The root is harvested, usually every four years when this species is replaced in another area. Price quotations for Arhangelica angelica root were about 16 lei / kg (excluding VAT), freshly harvested root.

For comparing the acquisition costs between plants purchased from the manufacturer and the harvested one of spontaneous vegetation, we do not consider their transportation, because in both cases the distances are almost identical.

Results And Discussions

To determine differences in the costs of plants purchased from the manufacturer and the harvested of spontaneous vegetation, we consider the resulting quantity of one plant components as constant and we see how to change the quantity of the other component, depending on the minimum cost of acquisition.

In other words, y_1 records the result of the quantity component of fresh plant (herba), and y_2 the quantitative component of fresh root. It results the following relationship:

$y_1, y_2 = f(x)$ Considering two cases:

1. y_1 = constant $y_2 = f(x)$, 2. y_2 = constant $y_1 = f(x)$

Following the introduction of computer data and their processing using Office Excel program, it results the data in columns 4 and 5 of Table 2.

In column 2 of the table are presented data reported by workers, correlated with minimum cost, till the 15th day of the campaign. To forecast, for the next 5 days, the quantity of plants collected from the spontaneous flora, an econometric model is developed, where the endogenous variable is the amount of fresh plant that has been reported by collectors and the exogenous variable is the minimum cost that can be paid by the company to purchase the plant collected (under the conditions considered).

Table 2. Quantities of plant from data processing and costs

NO. DAYS	TOTAL COST (MDL)	Herb Quantities (kg)	Quantity of roots (kg)	y 1 = f (x) y 2 = constant	y 2 = f (x) y 1 = constant
-0 -	-1 -	-2 -	-3 -	-4 -	-5 -
1	90	7	3	4.5	1.6
2	180	16	7	7.3	1.9
3	270	27	12	8.4	1.2
4	360	35	14	14.6	2.1
5	450	43	17	19.1	3.1
6	540	51	22	20.2	4.1
7	630	59	24.5	25.6	5.0
8	720	66	27	30.9	6.6
9	810	72	29	37.2	8.7
10	900	77	31	43.4	11.4
11	990	83	34	47.9	13.6
12	1080	88	36	54.1	16.3
13	1170	91	37	62.1	20.2
14	1260	93	37.5	70.9	24.6
15	1350	94	38	79.7	29.7
16	1440	97.2	39.0	87.6	33.4
17	1530	98.4	39.3	96.8	38.4
18	1620	98.9	39.4	106.3	43.7
19	1710	99.0	39.4	116.0	49.3
20	1800	99.0	39.4	125.6	54.9

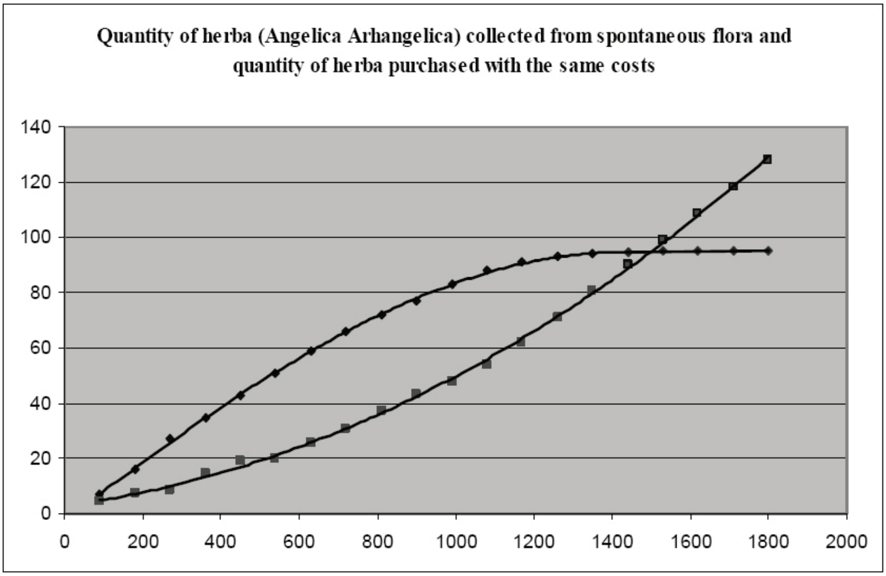
(Source: processing data provided by SC Naturalia IMPEX SRL)

$f(x) = -3,8 * 10^{-5} * x^2 + 0,125653 * x - 4,90194$, $y = f(x)$, if $f'(x) > 0$

$y = \max f(x)$, if $f'(x) \leq 0$, or, in other words $\forall x \geq 1653, y = 9$

In other words, the function will grow to the point of inflection (maximum), then it remains constant. Using the EViews program, it can be determined the correlation coefficient of variables, but also it can be tested the prediction model applied to data for the next 5 days, using the function above. Also, the function can be represented as shown in Figure 1.

Figure 1.



The economic interpretation of the chart above is that, regardless of plant varieties collected from spontaneous flora and regardless of where it is harvested, it results a function which has a limit the productive potential of the area. This is due to the limited feature of environmental resources which is specific to medicinal plants found in the spontaneous flora.

To enter a new upward slope, it is necessary that the team of pickers to move into a new area, where the campaign of harvesting the plant considered to continue. But the time for harvesting plants from spontaneous flora is limited and varies from one species to another, depending on a number of ecological factors. Thus, by the amount of quantity $Y^*_{1,}$ is profitable for a firm to initiate a campaign to collect herba *Angelica Arhangelica* of spontaneous vegetation. After this value, it is more profitable to buy fresh herb of the same species from the market. There is point of coordinates (X^*_1 ,$Y^*_{1)}$ which defines the threshold of profitability on the way a company should focus on buying fresh herbs (herba), in our case the point has the coordinates (1578, 98.7).

To check the significance of parameters and of function found for estimations expected, we used statistical tests and we developed them, only for explaining this model. Since the number of degrees of freedom is T = 15 <30 we use the Student distribution with T-k-1 degrees of freedom, where k is the number of explanatory values. For a threshold of significance α=0,05, in the distribution table Student is taken the value $t_{\alpha;T-k-1}=t_{0.05;13}=2.16$.

To check the significance of the correlation ratio, it is used Fisher-Snedecor:

$$F_c = \frac{T-k-1}{k} \cdot \frac{R^2}{1-R^2} = 8061.534$$

From the table of distribution Fisher - Snedecor, according to a threshold of significance α=5% and number of degree of freedom υ_1=k=1 and υ_2=T-k-1=13, it is taken the value $F_{0.05;1;13;}=4.67$.

$$F_c=8061,534 > F_{0.05;1;13;}=4.67 ,$$

so the value of ratio correlation is significantly different from zero, with a significance threshold α=0.05.

In column 3 of table 2 are presented data reported on the root of plant gathered by collectors, correlated with minimum cost, by the 15th day of the campaign. Doing the same as for results of quantities of herba collected, it is developed the econometric model to forecast the quantities of root harvested of spontaneous vegetation, in the following 5 days. The model will be represented as follows:

$$f(x) = -1,62 * 10^{-5} * x^2 + 0,0516 * x - 1,710989 ,\ y = f(x) \text{, if } f'(x) > 0$$

$$y = \max f(x) \text{, if } f'(x) \le 0 \text{, or, in other words, } \forall x \ge 1593, y = 39,4$$

Without repeating calculation, results of Eviews program show that the function estimators are well chosen because the level of significance is almost 0. It results that the econometric model explains almost 100% the total variation of the fenomenon, with one exception – the coefficient c(3), whose significance threshold is 0,0196.

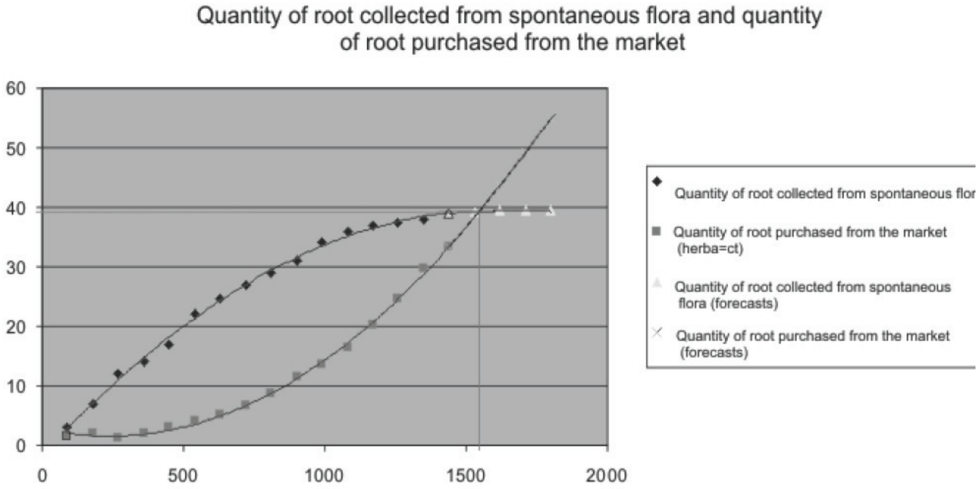
The data resulted after applying the model are presented in column three of Table 2.

In column 4 of table no. 2 is presented the quantity of fresh plant that could be purchased from the market, while taking account of the purchase of an equal quantity of root to the amount collected from the spontaneous flora. In other words, we identify the variation of the quantity of herba purchased from the market (with the same costs in the 2nd column) while it is purchased a quantity of root of *Arhangelica Angelica* equal to the amount collected from the spontaneous flora.

In column 5 of table no. 2 is presented the amount of fresh root that can be purchased from the market, while taking account of the purchase of an equal quantity of fresh plant to the amount collected from the spontaneous flora. In other words, we identify the variation of the quantity of root purchased from the market (with the same costs in the 2nd column), while it is purchased a quantity of herba *Angelica Arhangelica* equal to the amount of fresh plant collected from the spontaneous flora.

In Figure 2 are presented the two functions: the quantity of root purchased from the market and the amount of root collected from the spontaneous flora, reported the lowest costs.

Figure 2.



As in the case of herba, by the amount of quantity $Y^*_{2,}$ it is profitable for a firm to initiate a campaign to collect *Arhangelica angelica* root of spontaneous vegetation; after this value is more profitable to buy the root from the market. There is point of coordinates (X^*_2 ,$Y^*_{2)}$ which defines the threshold of profitability on the way a company should focus on buying fresh root, in our case the point with coordinates (1552, 39).

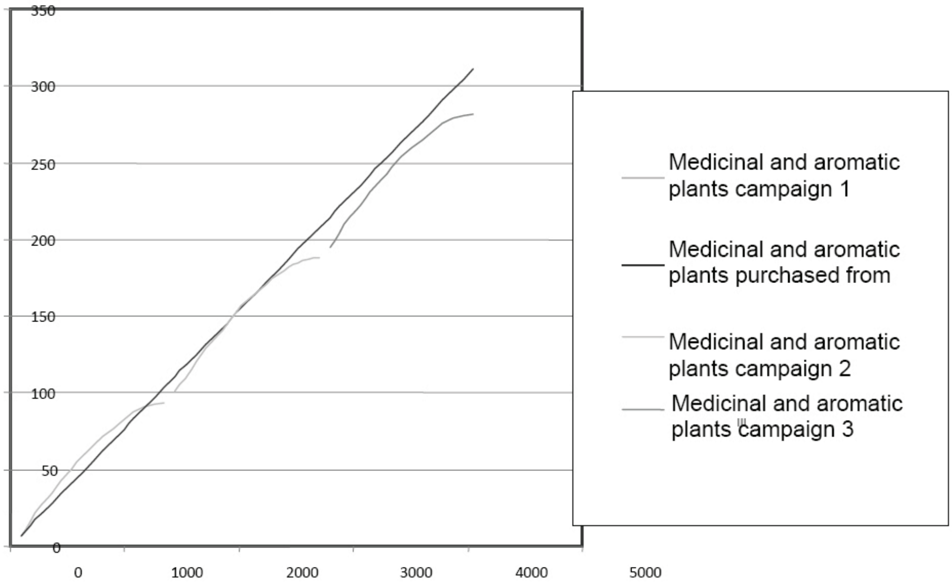
To start increasing again, it is necessary that the team of workers to go in another area, where to continue the campaign of harvesting the considered plant. But, the spontaneous flora has limited time of harvesting, which is different from one species to another, considering ecological factors.

There are two ways of improving efficiency in harvesting medicinal herbs from spontaneous flora: increasing the number of workers and changing the areas of harvesting. In both cases the results are the same, but in the latter situation, the time may impose limits, because the initial number of workers might need for harvesting longer time than the time the plant may be harvested. In the first situation, space may be a problem, because, for rare species, this version is not efficient.

Analysing one of the two solutions, we suppose that the two workers continues the campaign in another place, with the same flora loading as the first area, and located closed to the first one (the costs with movement are almost 0). Then they go to the third area, identically with the second one. In reality, the following areas have less plant loading than the first, because the producer chooses the area with the highest load level from the very beginning. In addition, the yield of workers decreases.

The results of figure 3 show that the first campaign is more efficient than the following. If the campaign continues in areas as rich in plants as the first and the yield decreases, still the following campaigns are less efficient. In conclusion, the efficiency of harvesting medicinal herbs from spontaneous flora is directly proportional with identifying and keeping the most rich and closed areas, and, indirectly proportional with the time needed to harvest medicinal plants from different areas (especially in the case of rare species).

Figure 3 – Efficiency of different plant collecting campaigns and plant purchasing



Conclusions

Decisions on underpinning the acquisition of material resources are grounded on economic principles. Taking into account the economic efficiency of the acquisition the plant *Angelica Arhangelica* by an enterprise of processing plants, there is a quantity of plant Y* till is more profitable to purchase it by initiating a campaign to gather plants from spontaneous flora, after which, for any additional quantity acquired, it becomes more efficient buying from the market.

Data may differ from one species to another. What is important is the scientific approach to determine the threshold of efficiency for purchasing these plants, and that wherever initiating these campaigns, there is a maximum quantity that can be collected from spontaneous vegetation (due to limited resources of nature) which is profitable for a business to start picking medicinal plants campaign, and after this amount, the company shall be guided in acquiring plants from the market.

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