EVALUATION OF APPLE ORCHARDS VIA THE EXPERT SYSTEM CROM

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Abstract

Although the cultivation of fruit trees is a traditional activity in Romania and our country has natural potential in this regard, both the cultivated area and the fruit production have decreased lately. That is why the NRDP 2014-2020 included a sub-programme for this sector, with sub-measures to redress the field and successfully respond to current challenges, including the impact on the environment. Today, growing concerns about the negative impact that agriculture has on the environment have led to the adoption of agricultural systems aimed at achieving sustainable yields. In this context, Expert System CROM ensures the sustainable development and the conservation of natural resources existing in tree plantations. The following study focuses on some research carried on the management of natural resources, using the CROM Expert System, in the field of apple orchards and lands. Apple orchards and farmlands were graded with additional points starting from 36 to 100 by implementing the Expert System CROM and were classified into three classes: unrestricted, with some restrictions and unsuitable for apple cultivation.

Key words: *apple orchards, Expert System, consumption, Romania*

INTRODUCTION

It is known that Romania has pedoclimatic conditions favorable to the cultivation of a large number of fruit-growing species and that it has a tradition in the field of fruit growing, materialized by the existence of acknowledged fruit-growing basins.

Despite these facts, the cultivated area and the fruit production constantly decreased. Thus, the fruit-growing area of Romania involved more than 100,957 km^2 and covered 1,341 localities [11].

In 2018 a total fruit-growing area of 137.3 thousand ha was obtained [8].

One of the main reasons of the decline in the case of the fruit growing division may be the low preference for the consumption of local fruits manifested by Romanians, although fruits are important components of diets and healthy lifestyles, which more and more people are adopting lately.

As will be seen from the materials presented, Romanians rank well below the European average of the daily consumption of fruits and vegetables. Thus, at the level of 2019 and 2020, according to NIS, Romanians included in the monthly menu an average of 4 kg of fruits [9].

The expected recovery of the fruit growing sector will bring on Romanian's tables fresh fruits, new varieties, more attractive and tastier, but will address to fruit growers challenges related to the impact that the

technologies applied in orchards will have on the environment. Consequently, the achievement of future harvests must be based on sustainable practices.

Their starting point is the fruit-growing ecosystem, which is characterized by specific relationships on the exchange of energy and substances with the environment [4].

Over time, in these interconditioning relationships, food chains are formed and stabilized, determining and influencing the absorption processes through the exchange, formation, translocation and deposition of newly formed substances and energy exchanges.

In the case of plantations under the impact of pollution, in the food chains of the ecosystem also enters the pollutant, which disrupts its normal functioning with direct consequences on tree growth, fruit production and quality [5].

In this situation, CROM Expert System asseses the meteorological components that affect the phenological phases of the apple adopting an original method.

MATERIALS AND METHODS

Expert System CROM develops and establishes scientific indicators and criteria proper for the plantations characterizations. This system is depending on an authentic methodology developed by "ICPA", which evaluates the soil, climate and land resources, with addition points [3], [5], [13], [14], [15].

In this research, Expert System-CROM was used to determine the natural resources of apple orchards and trees lands:

- meteorological components were graded depending on the repetition frequency of the excellent climatic intervals and temperature thresholds, during a period of 10 years. The mark for climate resources can fluctuate between 0 and 40 addition points;
- soil conditions are allocated from 0 to 25 addition points;
- relief conditions, considering their role in the ecosystem of fruit trees receive 0-15 addition points.

In order to examine the fruit-growing orchards and lands with the Expert System, depreciation points are deducted and addition points are added.

Considering the values achieved, the fruit-growing orchards and lands will be categorised in three groups:
o without natural restrictions;
o with natural restrictions;
o unsuitable for apple trees cultivation.

RESULTS AND DISCUSSIONS

A study published by Eurostat, which was based on a questionnaire conducted in 2019, shows that small amounts of fruits and vegetables were consumed in the European Union. Thus, 33% of the respondents stated that they did not eat fruits or vegetables daily, 12% of the population consumed daily more than five snacks recommended by specialists, and 55% up to four servings of vegetables or fruits each day.

According to this study, Romania ranked last in the EU due to the quantities of fruits or vegetables that people include in their daily menu (Fig. 1). Thus, 24% of the respondents indicated that they prefer to eat a portion or up to 4 portions containing vegetables or fruits per day, while only 2.4% consumed more than five servings. The questionnaire showed that 67.5% of Belgians ate 1-4 portions of vegetables or fruits per day. Following are Spain and Italy with a percentage of 65.7%, as the Mediterraneans are well known for their healthy lifestyle. In the top states that commonly eat much more than 5 servings of vegetables or fruit per day we found on the first place with 32.9% Irish people, second the Dutch - 29.5% and third Danes with 22.9%. An interesting fact can be observed, namely that among the Dutch surveyed, there were a higher percentage of those in the category who consume more than 5 fruits per day.

At European level, the average number of vegetables and fruits consumed per person per day indicated that 12.4% ate more than 5 servings per day and 54.7% of Europeans surveyed had up to 4 snacks of vegetables and fruits in their daily menu [7].
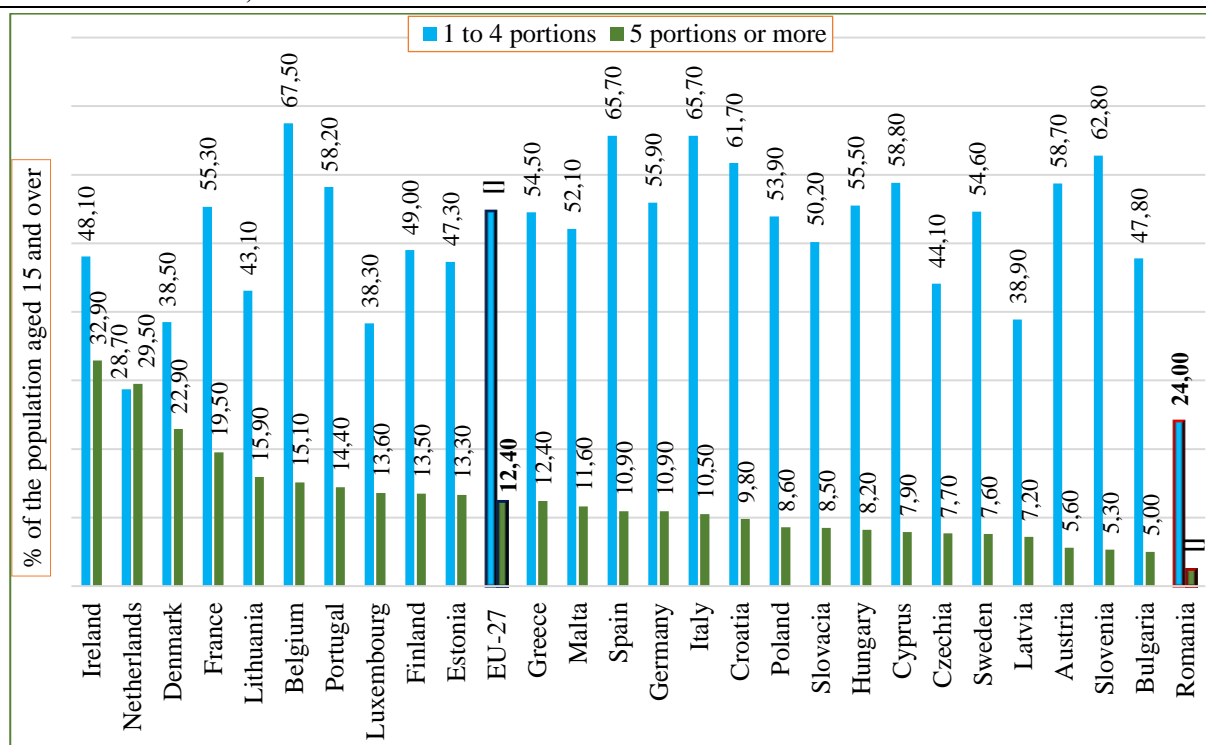
Fig. 1. Situation of vegetables and fruits consumption per day in EU Member States, 2019.
Source: own design after [7].

In order to eliminate the deficiencies in this sector and to capitalize on the country's fruit potential, including research in the field, both of which are not properly exploited, a thematic sub-program for the fruit growing domain has been set up. For the first time in Romania's rural development policy, the sub-program was achieved in PNDR 2014-2020. Within it, the fruit-growing sector is approached in an integrated way, starting from production to the consumer [1].

5 sub-measures were granted for The fruit-growing sub-program:

Measure 4:

• 4.1a - investments in orchards,

• 4.2a - investments in the processing / marketing of fruit products.

Measure 9:

• 9.1a - establishment of producer groups in the fruit sector.

Measure 16:

• 16.1a - establishment and operation of operational groups,

• 16.4a - supports horizontal and vertical cooperation between actors in the supply chain.

Along with plums, the apple is a fruit appreciated by Romanians, a fact highlighted by the cultivated areas and the obtained productions. Studies conducted by Dana D. et all., 2020, show that the area cultivated with apples ranked Romania in 2018 on the 3rd place in the European Union, and the production of apples occupied the 2nd place after that of plums at the level of the country [6]. Therefore, the projects with non-reimbursable funds financed by PNDR 2014-2020 had as main objective this species.

Fig. 1. Map of climatic and pedological favorability areas for apple species in Romania
Source: [10].

Apple is an important element for the health of the population, primarily due to its

composition, where we find, among other things, vitamins and soluble fibres.

In Romania, the old saying "Un măr pe zi ține doctorul departe/one apple a day keeps the doctor away" is well known, which emphasizes the aspect mentioned above.

Another reason why this fruit is appreciated is because it has few calories and is therefore used in diets [12].

The Expert System CROM comes to the aid of apple growers, which assesses the climatic, soil and land resources that must be analyzed when setting up apple orchards and other fruit farms. These resources are listed below:

Quantification and expertise of climate resources

Such indicators are the minimum temperature with different values when decrease suddenly or slowly, thermic amplitude and rainfalls in the period of V-VII months. According to this method, the frequency of repetitiveness of thresholds and optimal climatic intervals in the last 10 years is expressed by frequency (%) in five classes: null, very low, low, moderate and optimum. Thermal resources are the decisive factor that influences the normal development of the growth and fruiting phenophases, expressed as intervals and thresholds:

o Air temperature:
- minimum absolute which may drop sharply or slowly - 0 to 4 addition points;
- thermal amplitude for the months XI-II - gained 1-2 addition points;
- average for the month V- gained between 3 and 11 addition points;
- average for the months V-X - 3 to 13 addition points;
- annual average granted between 8 and 17 additional points;
o Rainfalls (in months V-VII) - 9 or 10 addition points (Table 1).

Table 1. Quantification and expertise of climate resources for apple trees

Expertise class	The climatic intervals and thresholds														Addition points
	The average air temperature (^{0}C)						The minimum absolute air temperature (^{0}C)				The thermic amplitude of air (0C)		The rainfalls (mm)		
	Annual	Addition points	Months V-X	Addition points	Month V	Addition points	Decreases abruptly	Addition points	Decreases slowly	Addition points	Months XI-II	Addition points	Months V-VII	Addition points	Total
	7-10		≥16		>12		<-22		<-32		>20		250-300		
	Frequency %		Frequency %		Frequency %		Frequency %		Frequency %		Frequency %		Frequency %		
Without climatic restrictions	90-100	17	90-100	13	90-100	11	90-100	3	90-100	4	90-100	2	90-100	10	60
With climatic restrictions	60-80	11	60-80	10	60-80	10	60-80	1	60-80	2	60-80	1	60-80	9	44
Excluded for apple trees	< 60	8	< 60	3	< 60	3	< 60	0	< 60	0	< 60	1	< 60	9	24

Source: [3], [5].

Quantification and expertise of land resources
When setting up a fruit plantation, the land resources are taken into account, which are obtained following specific research. The results of these studies are materialized by the land characterization indicators. They are of several categories and indicate the availability for the cultivation of apples in the respective land. Thus, they can be:
o unsuitable for growing apples,

o land suitable for apples, of two categories: with or without restrictions.

The addition points awarded by the land due to the above-mentioned indicators are as follows (in ascending order):
-The slope: from 0 to 2;
-The deep erosion: from 0 to 3;
-The landslides: from 0 to 4;
-The land exposure: 1;
-P.A. (Porosity of aeration): 1;

- V.S.N.P.G. (Non-pseudo gleyed and non-gleyed soil volume): 1 or 2;

-The erosion of surface: 2 or 3 (Table 2).

Table 2 Expertise and quantification of land resources for apple trees

Expertise class	Slope		Aspect		Quantification of relief conditions							Quantification of drainage conditions				Addition points
					The erosion				The landslides		V.S.N.P.G.		P.A.		
					Surface erosion		Deep erosion								
	%	Addition points	Orientation	Addition points	Characterization	Addition points	Characterization	Addition points	Characterization	Addition points	% vol.	Addition points	% vol.	Addition points	Total
Without land restrictions	≤ 10	2	Plan E, NV, S, SV	1	without erosion / weak erosion	3	Absent / stream, drain	3	Absent	4	≥ 91-71	1	16-30	1	15
With land restrictions	11-15	1	V, SE, N-NE, in Dobrogea	1	moderate-strong erosion	3	low density deep erosion	1	stabilized landslides	2	51-70	2	≥ 31	1	11
Excluded for apple trees	> 15	0	N, NE, in Dobrogea	1	very strong-excessive erosion	2	high density deep erosion	0	semi-stabilized and active landslides	0	≤ 50	1	≤ 10	1	5

Source: [3], [5].

Quantification and expertise of soil resources
Soil resources characterization indicators received differentiated addition points. These indicators are as follows:

o alkalization and salinization of soil,
o content of calcium carbonates,
o content of exchangeable Al,
o V.E.A. (edaphic active volume),
o industrial pollution of soil,
o reaction of soil (Table 3).

Table 3 Expertise and quantification of soil resources for apple trees

Expertise class	V.E.A.		Soil reaction		CaCO₃ content				Salinization of soil		Alkalization of soil		Industrial pollution of soil		Addition points
	%	Addition points	pH (H₂O)	Addition points	Depth of Cca, Cpr, Rrz horizons Cm	Addition points	Active CaCO₃ in carbonates horizon %	Addition points	Characterization	Addition points	Characterization	Addition points	Pollutant concentration ppm	Addition points	Total
Without soil restrictions	101-76	1	5.1 - 8.4 exchangeable Al content < 50 ppm	2	≥ 150-101	1	Absent / ≤ 8.0	2	Non salinized	4	Non alkalized	6	Pollutant concentration < alert values	9	25
With soil restrictions	51-75	1	> 5.0 exchangeable Al content < 50 ppm / > 8.5 V_{Na}< 5%	1	100-51	1	8.1 - 12	2	Salinization >100 cm	2	Alkalization >100 cm	2	Alert threshold	4	13
Excluded for apple trees	50	0	> 8.5 V_{Na} < 5%	3	≤ 50	1	>12	1	Salinization <100 cm	2	Alkalization <100 cm	0	Intervention threshold	0	7

Source: [3], [5].

According to Table 3, the additional points received for soil resources were as follows (in ascending order):

- 0 or 1 - for the edaphic active volume of soil;
- from 0 to 6 - for the soil alkalization;
- from 0 to 9 - for the industrial pollution of soil;
- 1 or 2 - for the calcium carbonate content;
- from 1 to 3 - for the soil reaction;

- from 2 to 4 - for the soil salinization.

In Table 4 we will see how is calculated in the CROM Expert System the value of natural resources for apples, land and orchards.

Table 4 Assessment and calculation of the natural resources for apple trees lands and orchards in the Expert System-CROM

Expertise class	Natural resources			Total addition points
	Climate	Land	Soil	
Unrestricted	60	15	25	100
With some restrictions	44	11	13	68
Unsuitable for apple cultivation	24	5	7	36

Source: [5].

Depending on the addition points they have obtained following the Expert System method, the orchard lands will be divided into three categories, which indicate whether or not they are suitable for apple cultivation:
o without natural restrictions,
o with natural restrictions,
o excluded for apple trees cultivation.

For the fruit sector in Romania, the EU's food policy is a real support because it promotes a healthy diet and thus stimulates the consumption of fruits and vegetables, products that have superior nutritional value.

As the EU attaches great importance to nutrition, which is highlighted in its food policy, where the importance of this area continues to grow, the CAP can also support nutrition by supporting supply and demand, ie the consumption of vegetables and fruits [7].

The production, processing and promotion of healthy food are priorities of the Farm to Fork Strategy regarding the food security and sustainable food systems.

Healthy diets have also been found to be environmentally friendly, as they help reduce animal emissions and carbon sequestration [2].

CONCLUSIONS

Currently, the focus is on obtaining products through sustainable technologies. At the same time, consumers are demanding healthy foods, which are the result of environmentally friendly technologies.

The Expert System CROM meets these demands through its assessment ensemble that points out the natural resources needed for orchards.

Apple is included in the category of elements on which are based the nutrition and diets of the population and in this regard, the CROM Expert System has been used to determine the land and apple orchards natural resources.

The CROM Expert System aims to conserve the natural resources of tree plantations through efficient and sustainable management.

By applying the CROM Expert System, the apple orchards received 36 - 100 additional points for resources, as follows:
- land resources receive 5-15 addition points,
- climate resources receive 24-60 addition points,
- soil resources receive 7-25 addition points.

These points will help classify the lands in the 3 types of categories, favorable or not for growing apple trees.

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