

POSSIBLE MODEL OF DEVELOPMENT OF VEGETABLE YIELD IN ROMANIA BY 2040

Professor Ph. D. Ion SCURTU

"Constantin Brâncoveanu" University of Pitești, Romania

Email: ucb_scurtu@yahoo.com

Scientific Researcher III Gicuța SBÎRCIOG

Research and Development Institute for Vegetable and Flower Growing Vidra, Romania

Email: ralldom@yahoo.com

Scientific Researcher Delia - Cristina CONSTANTIN

Research and Development Institute for Vegetable and Flower Growing Vidra, Romania

Email: dc.constantin90@gmail.com

Abstract: Food is one of the vital human needs and everything that is alive. In human nutrition, vegetables play a major role, bringing the body an important supply of vitamins, minerals and fibers. Therefore, horticulture is an important branch of the economy, especially since the Romanian people are one of the largest consumers of vegetables in Europe. Unfortunately, it is noted that the value of vegetable imports exceeds that of exports, although our country has the potential to offer a much higher of vegetables yield. The present research aims to outline some possibilities for increasing the economic efficiency of vegetable growing in Romania. For this purpose, the authors propose a number of possibilities, including increasing areas for growing vegetables in protected areas, gradually increasing vegetable production and export, lowering vegetable imports and bringing prices of exported vegetables closer to those imported.

Key words: vegetable growing, decrease of imports, growth of surface of plastic tunnels, balancing import-export prices.

JEL Classification: Q18, R32.

1. Introduction

Vegetable farming is an important branch of the national economy through the contribution to ensuring large quantities of vegetables for population consumption (annual consumption over 180 kg/year/capita) (<https://insse.ro/>, <https://ourworldindata.org/grapher/vegetable-consumption-per-capita?tab=chart&country=ROU>), by providing an important source of income for vegetable producers (using about 240.000 ha) (<https://insse.ro/>, <https://www.madr.ro/>) and contribution to the development of other economic sectors (inputs insurance, trade, transport, food industry, etc.). For these reasons, it is very important to build a development model for this branch, which takes into account the national food habits, the soil and climate conditions of Romania and the economic and social conditions.

After accession to the European Union, the standard of living of the Romanian population has improved. The current trend in food is to diversify the products, to combine the consumption of vegetables obtained in the country with those of import. At the same time, there is an interest in consuming quality vegetables, including by increasing the consumption of "bio" vegetables (Stoian, 2004).

In order to create a Romanian economic model for vegetables growing on the horizon of 2030-2040, we started from the following principles:

- a) the need to cover a larger part of the population's demand with vegetables from local production, to prevent the problems of deficiencies caused by the inability to bring products from abroad (pandemics, truck driver strike etc.) (Lăcătuș et al., 2013);
- b) the tendency of the Romanian population to decrease until 2060 ("Proiectarea populației României, în profil teritorial, la orizontul anului 2060", 2017);
- c) moderate increase of annual consumption of vegetables / capita, considering that at present in Romania the consumption of vegetables / year / capita is among the largest in

Europe (<https://ourworldindata.org/grapher/vegetable-consumption-per-capita?tab=chart&country=ROU>);

d) the need to grow vegetable surfaces in protected areas (mainly in plastic tunnels), especially due to climate change, which makes it increasingly difficult to grow vegetables in the open field (Scurtu and Lăcătuș, 2013; Lăcătuș et al., 2013). The authors propose to invest every year in the construction of protected areas, so that in 2040 most tomatoes for fresh consumption, cucumbers, cauliflower, lettuce, long and sweet peppers and some green vegetables to be obtained in plastic tunnels. In the open field will continue to grow tomatoes for industrialization, bulbous vegetables, root vegetables, watermelons, peas and beans for canning and smaller quantities of vegetables for fresh consumption. The authors estimate the need to reach an area of 15,000-20,000 hectares of protected areas, while decreasing the cultivated areas in the field. Starting from about 7000 ha currently existing (Scurtu, 2016), an annual growth of about 500 ha is estimated, which would represent, in 2040, a cultivated area of 16,000 ha;

e) the authors continue to rely on European and national support programs for farmers in the effort to build and modernize protected areas and other necessary farm facilities (refrigerated warehouses, washing and conditioning equipment, packaging facilities etc);

f) further maintaining the import of vegetables at the level of about 10% (of the consumption requirement, because some people have a habit of eating vegetables that are produced less in Romania during the cold season, and their production during that period would be more expensive than those imported;

g) the gradual increase of the export of fresh or processed vegetable products, so that the value of the vegetable export equals and possibly exceeds the value of the imports;

h) the gradual increase of the average production/ha in both the protected areas and in the field, as a result of the use of high-yielding varieties and hybrids, of the modernization of the spaces and technologies of production of the seedlings, of the use of economic systems of irrigation and fertilization and of other technological procedures. (Glăman, 2015) .

The construction of the economic model for vegetable farming started from a series of statistical data obtained from different sources: <https://www.madr.ro/> and <https://insse.ro/> (Tables no.1).

Table no. 1. Vegetable surfaces, total and average production during 2012-2017

| The year | 2017 | Average 2012-2017 | Average yield t/ha |
|---|--------|-------------------|--------------------|
| I. Total area cultivated, (thousands ha), of which: | 224.6 | 241.4 | |
| Tomatoes | 40.0 | 44.5 | |
| Pepper | 17.7 | 18.6 | |
| Onion | 30.0 | 31.2 | |
| Garlic | 10.0 | 10.6 | |
| White cabbage | 46.2 | 48.8 | |
| Watermelons and melons | 23.4 | 27.0 | |
| II. The total production, thousand tons, of which: | 3631 | 3660 | 15.2 |
| Tomatoes | 679.8 | 690.9 | 15.5 |
| Pepper | 226.5 | 219.6 | 11.8 |
| Onion | 352.2 | 360.3 | 11.5 |
| Garlic | 55.7 | 59.7 | 5.6 |
| White cabbage | 1026.6 | 1060.3 | 21.7 |
| Watermelons and melons | 553.5 | 542.8 | 20.1 |

Source: <https://www.madr.ro/> and <https://insse.ro/>, data processed by the authors.

Table no. 1 shows that the surface of vegetables decreased in 2017 compared to the average of the last 6 years, while the average production registered the value of 15.2 t/ha. Every year, in Romania large quantities of vegetables were imported, respectively 373,455 thousand tonnes in 2017, while exports were insignificant (only 18 thousand tonnes in 2017).

The forecast regarding the evolution of the population of Romania shows that it will decrease in the coming decades and will be approximately 18,487 thousand people in 2027, 17,840 thousand people in 2034 and 17,305 thousand people in 2040 ("Proiectarea populației României, în profil teritorial, la orizontul anului 2060", 2017). Table no. 2 presents a possible scenario proposed by authors of vegetable consumption per year between 2027-2040.

Table no. 2. Estimated consumption of vegetables kg/capita/year (domestic production and imported)

| The year | | 2020 | 2027 | 2034 | 2040 |
|---------------------------------------|--------------------------|--------|--------|--------|--------|
| The population (thousand inhabitants) | | 19,259 | 18,487 | 17,840 | 17,305 |
| Tomato consumption | From domestic production | 34.2 | 36 | 39 | 42 |
| | From import | 6 | 6 | 6 | 5 |
| | Total | 40.2 | 42 | 45 | 47 |
| Pepper consumption | From domestic production | 11.4 | 13 | 14 | 15 |
| | From import | 4 | 5 | 4 | 4 |
| | Total | 15.4 | 18 | 18 | 19 |
| Eggplant consumption | From domestic production | 6.4 | 7 | 7,5 | 7.8 |
| | From import | 1 | 1 | 1 | 1 |
| | Total | 7.4 | 8 | 8.5 | 8.8 |
| Onion consumption | From domestic production | 17.7 | 19 | 20 | 22 |
| | From import | 3 | 2 | 1 | 1 |
| | Total | 20,7 | 21 | 21 | 23 |
| Garlic consumption | From domestic production | 2.8 | 3.2 | 3.4 | 3.6 |
| | From import | 0,5 | 0,3 | 0,2 | - |
| | Total | 3.3 | 3.5 | 3.6 | 3.6 |
| Cabbage consumption | From domestic production | 51.7 | 52 | 53 | 53 |
| | From import | 1 | 1 | 1 | 1 |
| | Total | 52.7 | 53 | 54 | 54 |
| Watermelons and melons consumption | From domestic production | 27,9 | 29 | 30 | 32 |
| | From import | 0.5 | 0.5 | 0.6 | 0.6 |
| | Total | 28.4 | 29.5 | 30.6 | 32.6 |
| | From import | 16 | 15.8 | 13.8 | 12.6 |
| | Total | 168.1 | 175.0 | 180.7 | 188.0 |
| Other species consumption | From domestic production | 29.9 | 35 | 38 | 40 |
| | From import | 2 | 2 | 2 | 2 |
| | Total | 31.9 | 37 | 40 | 42 |
| Total consumption /year/capita (kg) | From domestic production | 182 | 194.2 | 204.9 | 215.4 |
| | From import | 18 | 17.8 | 15.8 | 14.6 |
| | Total | 200 | 212.0 | 220.7 | 230.0 |
| Totally required thousand tons | From domestic production | 3505 | 3590 | 3655 | 3757 |
| | From import | 347 | 329 | 282 | 253 |
| | TOTAL | 3852 | 3919 | 3937 | 4010 |

From the data in Table no. 2 it is observed that the demand for vegetables for domestic consumption will increase as a result of the increased consumption/capita/year i, even if the population is decreasing. At the same time, the trend of decreasing imports from 347 thousand tonnes in 2020 to 253 thousand tonnes in 2040 is observed.

Table no. 3 presents a forecast of the import of vegetables, starting from the evolution of population and the annual average consumption for a person.

Table no. 3. Import of vegetables in 2020-2040

| The year | | 2020 | 2027 | 2034 | 2040 |
|--|----------------------------------|--------|--------|--------|--------|
| The population | | 19,259 | 18,487 | 17,840 | 17,305 |
| Tomatoes to be imported | Consumption / capita (kg / year) | 6 | 6 | 6 | 5 |
| | Total thousand tons | 115.6 | 110.9 | 107.0 | 103.8 |
| Peppers to be imported | Consumption / capita (kg / year) | 4 | 4 | 4 | 4 |
| | Total thousand tons | 77,0 | 73,9 | 71,4 | 69,2 |
| Eggplants to be imported | Consumption / capita (kg / year) | 1 | 1 | 1 | 1 |
| | Total thousand tons | 19.3 | 18.5 | 17.8 | 17.3 |
| Onion to be imported | Consumption / capita (kg / year) | 3 | 2 | 1 | 1 |
| | Total thousand tons | 57.8 | 37.0 | 17.8 | 17.3 |
| Garlic to be imported | Consumption / capita (kg / year) | 0.5 | 0.3 | 0.2 | - |
| | Total thousand tons | 9.6 | 5.6 | 3.6 | - |
| Cabbage to be imported | Consumption / capita (kg / year) | 1 | 1 | 1 | 1 |
| | Total thousand tons | 19.3 | 18.5 | 17.8 | 17.3 |
| Watermelons and melons to be imported | Consumption /capita (kg / year) | 0.5 | 0.5 | 0.6 | 0.6 |
| | Total thousand tons | 9.6 | 9.2 | 10.7 | 10.4 |
| Other species to be imported | Consumption / capita (kg / year) | 2 | 2 | 2 | 2 |
| | Total thousand tons | 38.5 | 37.0 | 35.7 | 34.6 |
| Total required from import kg / capita | | 18.0 | 16.8 | 15.8 | 14.6 |
| Total from import, thousands of tons | | 346.6 | 310.6 | 281.9 | 252.6 |

It can be seen from Table no. 3 that it is proposed to keep imports constant or even to increase them for some species that are consumed frequently, even during times when demand can not be covered by own production (these species can be grown in our country only during between spring – autumn period) (like tomatoes, peppers, eggplants, watermelons or melons). However, for some species, like onion or garlic, our country can cover almost entirely the necessary for consumption.

Table no. 4 presents the calculations for the foreign exchange effort for the expected vegetable imports.

Table no. 4. The value of vegetable imports - RON (millions)

| The year | | 2020 | 2027 | 2034 | 2040 | Medium price RON/kg |
|------------------------------------|----------------|--------|-------|--------|---------|------------------------|
| Vegetables imported, thousand tons | | 346.6 | 310.6 | 281.9 | 252.6 | |
| Million RON value | | 1405.6 | 1285 | 1200.9 | 1129.75 | |
| Million Euros value | | 293 | 268 | 250 | 235 | |
| Tomato | Thousands tons | 115.6 | 110.9 | 107.0 | 103.8 | 4 |
| | Value (RON) | 462.4 | 443.6 | 428.0 | 415.2 | |
| Pepper | Thousands tons | 77.0 | 73.9 | 71.4 | 69.2 | 7 |
| | Value (RON) | 539 | 517.3 | 499.8 | 484.4 | |
| Eggplant | Thousands tons | 19.3 | 18.5 | 17.8 | 17.3 | 2.5 |
| | Value (RON) | 48.25 | 46.25 | 44.5 | 43.25 | |
| Onion | Thousands tons | 57.8 | 37.0 | 17.8 | 17.3 | 1.5 |
| | Value (RON) | 86,7 | 55,5 | 26,7 | 25,95 | |
| Garlic | Thousands tons | 9.6 | 5.6 | 3.6 | 0 | 10 |
| | Value (RON) | 96 | 56 | 36 | 0 | |
| Cabbage | Thousands tons | 19.3 | 18.5 | 17.8 | 17.3 | 1.5 |
| | Value (RON) | 28.95 | 27.75 | 26.7 | 25.95 | |
| Watermelons and melons | Thousands tons | 9.6 | 9.2 | 10.7 | 10.4 | 3 |
| | Value (RON) | 28.8 | 27.6 | 32.1 | 31.2 | |
| Other species | Thousands tons | 38.5 | 37.0 | 35.7 | 34.6 | 3 |
| | Value (RON) | 115.5 | 111.0 | 107.1 | 103.8 | |

From the total consumption requirement, we decreased the imported quantities and resulted the quantity of vegetables needed for domestic consumption product (Table no. 5).

Table no. 5. The necessary vegetables to be produced for domestic consumption

| The year | | 2020 | 2027 | 2034 | 2040 |
|---|----------------------------------|--------|--------|--------|--------|
| The population | | 19,259 | 18,487 | 17,840 | 17,305 |
| Tomatoes to be produced | Consumption / capita (kg / year) | 34.2 | 36 | 39 | 42 |
| | Total thousand tons | 658.7 | 665.5 | 695.8 | 726.8 |
| Peppers to be produced | Consumption / capita (kg / year) | 11.4 | 13 | 14 | 15 |
| | Total thousand tons | 219.6 | 240.3 | 249.8 | 259.6 |
| Eggplants to be produced | Consumption / capita (kg / year) | 6.4 | 7 | 7.5 | 7.8 |
| | Total thousand tons | 123.3 | 129.4 | 133.8 | 135.0 |
| Onion o be produced | Consumption / capita (kg / year) | 17.7 | 19 | 20 | 22 |
| | Total thousand tons | 340.9 | 351.2 | 356.8 | 380.7 |
| Garlic to be produced | Consumption / capita (kg / year) | 2.8 | 3.2 | 3.4 | 3.6 |
| | Total thousand tons | 53.9 | 59.2 | 60.7 | 62.3 |
| Cabbage to be produced | Consumption / capita (kg / year) | 51,7 | 52 | 53 | 53 |
| | Total thousand tons | 995.7 | 961.3 | 945.5 | 917.2 |
| Watermelons and melons to be produced | Consumption / capita (kg / year) | 27.9 | 29 | 30 | 32 |
| | Total thousand tons | 537.3 | 536.1 | 535.2 | 5538 |
| Other species to be produced | Consumption / capita (kg / year) | 29.9 | 35 | 38 | 40 |
| | Total thousand tons | 575.8 | 647.0 | 677.9 | 692.2 |
| Annual consumption / capita from domestic, kg | | 182 | 194.2 | 204.9 | 215.4 |
| Totally needed internally, thousands of tons | | 3505.2 | 3590.1 | 3655.4 | 3756.9 |

The necessary vegetables for domestic consumption will be provided from three sources: import (which will decrease from about 9% of the necessary to about 6% in 2040), domestic production in protected areas and production in open field. A certain part of the production of vegetables, both from the field and from protected areas will be destined for export, thus balancing the balance of external payments in this field. Considering the increase of the areas of plastic tunnels and the increase of the average production in both systems (field and protected areas), after about 20 years the quantity of vegetables exported will be greater than the imported one and the value of the exports of vegetables will be slightly higher than the imports.

Table no. 6 presents a possible variant regarding the production of vegetables from protected areas. It can be assumed that the average yields could be higher than the ones proposed, but we have taken into account that in the newly built plastic tunnels, less experienced farmers will work. The production obtained in plastic tunnels is divided for domestic consumption and for export.

Table no. 6. Production of vegetables from protected areas (plastic tunnels + greenhouses) - thousand tons (for domestic consumption and export)

| | | The year | | | |
|---------------------------------|--------------|----------|--------|--------|--------|
| | | 2020 | 2027 | 2034 | 2040 |
| Total * | ha | 5,000 | 8,500 | 12,000 | 15,000 |
| Totally cultivated cycle I + II | ha | 7,400 | 11,550 | 14,870 | 18,940 |
| Tomato (cycle I + II) | ha | 4000 | 6000 | 7500 | 10.500 |
| Average yield (cycle I + II) | t/ha | 50 | 55 | 58 | 60 |
| Total yield, from which: | t (thousand) | 200 | 330 | 435 | 630 |
| for export | t (thousand) | 30 | 45 | 100 | 134 |
| for domestic consumption | t (thousand) | 170 | 285 | 335 | 496 |
| Pepper - long cycle | ha | 600 | 900 | 1100 | 1400 |
| Average yield | t/ha | 46 | 48 | 50 | 52 |
| Total yield, from which: | t (thousand) | 27.6 | 43.2 | 55.0 | 72.8 |
| for export | t (thousand) | 8 | 13 | 16 | 20 |
| for domestic consumption | t (thousand) | 19.6 | 30.2 | 39 | 52.8 |
| Eggplant | ha | 400 | 650 | 770 | 850 |
| Average yield | t/ha | 50 | 52 | 54 | 60 |
| Total yield, from which: | t (thousand) | 20 | 33.8 | 41.6 | 51.0 |
| for export | t (thousand) | 5 | 12 | 15 | 18 |
| for domestic consumption | t (thousand) | 15 | 21.8 | 26.6 | 33 |
| Cucumbers (cycle I + II) | ha | 1050 | 2100 | 2800 | 3240 |
| Average yield | t/ha | 50 | 58 | 62 | 64 |
| Total yield, from which: | t (thousand) | 52.5 | 121.8 | 173.6 | 207,4 |
| for export | t (thousand) | 15 | 42 | 62 | 75 |
| for domestic consumption | t (thousand) | 37.5 | 79.8 | 111.6 | 132.4 |
| Lettuce (5 cycles) | ha | 350 | 500 | 600 | 650 |
| Average yield | t/ha | 120 | 140 | 150 | 160 |
| Total yield, from which: | t (thousand) | 42 | 70 | 90 | 104 |
| for export | t (thousand) | 5 | 10 | 15 | 20 |
| for domestic consumption | t (thousand) | 37 | 60 | 75 | 84 |
| Other species | ha | 1000 | 1400 | 2100 | 2.300 |
| Average yield | t/ha | 30 | 34 | 37 | 40 |
| Total yield, from which: | t (thousand) | 30 | 47,6 | 77.7 | 90 |

| | | | | | |
|---|--------------------|-------|-------|-------|--------|
| for export | t (thousand) | 5 | 12 | 25 | 28 |
| for domestic consumption | t (thousand) | 15 | 35,6 | 52,7 | 62 |
| Total yield in plastic tunnels, from which | Mii t | 372.1 | 646.4 | 872.9 | 1155.2 |
| for export | Mii t | 68 | 134 | 233 | 295 |
| for domestic consumption | Mii t | 304.1 | 512.4 | 639.9 | 860.2 |
| Average yield ^{**} t/ha | On built area | 74.4 | 76.0 | 72.7 | 77.0 |
| | On cultivated area | 50.0 | 56.0 | 58.7 | 61.0 |

*The cultivated surface is larger than the physical surface because some species are cultivated also in cycle II.

**The average yield on the built area is higher than the one reported on the cultivated area due to the use of spaces also for the second cycle.

Determination of the yield obtained in protected areas helps us to calculate the amount of vegetables to be produced in the open field (Table no.7).

Table no. 7. The necessary vegetables to be produced for internal consumption in protected areas and fields - thousands of tons

| The year | | 2020 | 2027 | 2034 | 2040 |
|---|-----------------------|--------|--------|--------|--------|
| The population | | 19,259 | 18,487 | 17,840 | 17,305 |
| Tomatoes to be produced | Total (thousand tons) | 658.7 | 665.5 | 695.8 | 726.8 |
| | From plastic tunnels | 170 | 285 | 335 | 496 |
| | From field | 488.7 | 380.5 | 360.8 | 230.8 |
| Peppers to be produced | Total (thousand tons) | 219.6 | 240.3 | 249.8 | 259.6 |
| | From plastic tunnels | 19.6 | 30.2 | 39.0 | 52.8 |
| | From field | 200 | 210.1 | 210.8 | 206.8 |
| Eggplants to be produced | Total (thousand tons) | 123.3 | 129.4 | 133.8 | 135.0 |
| | From plastic tunnels | 15 | 21.8 | 26.6 | 33.0 |
| | From field | 108.3 | 107.6 | 107.2 | 102.0 |
| Onion o be produced | Total (thousand tons) | 340.9 | 351.2 | 356.8 | 380.7 |
| | From plastic tunnels | - | - | - | - |
| | From field | 340.9 | 351.2 | 356.8 | 380.7 |
| Garlic to be produced | Total (thousand tons) | 53.9 | 59.2 | 60.7 | 62.3 |
| | From plastic tunnels | - | - | - | - |
| | From field | 53.9 | 59.2 | 60.7 | 62.3 |
| Other species to be produced (including cabbage and melons) | Total (thousand tons) | 2108.8 | 2144.4 | 2158.6 | 2163.2 |
| | From plastic tunnels | 89.5 | 175.4 | 239.9 | 278.4 |
| | From field | 2019.3 | 1969.0 | 1918.7 | 1884.8 |
| Total yield needed internally | Total (thousand tons) | 3505.2 | 3590.1 | 3655.4 | 3756.9 |
| | From plastic tunnels | 304.1 | 512.4 | 639.9 | 860.2 |
| | From field | 3211.1 | 3077.7 | 3015.5 | 2896.7 |

By introducing a slightly higher average yield than the present one, we have calculated in Table no. 8 the necessary of the surface with field vegetable for internal consumption.

Table no. 8. Field surface cultivated with vegetables needed for domestic consumption

| The year | | 2020 | 2027 | 2034 | 2040 |
|---|-------------------------------|-------------|-------------|-------------|-------------|
| The population | | 19,259 | 18,487 | 17,840 | 17,305 |
| Tomatoes to be produced | Total (thousand tons) | 658.7 | 665.5 | 695.8 | 726.8 |
| | Average yield (t/ha) | 18 | 20 | 24 | 26 |
| | The surface (thousands of ha) | 37 | 33 | 29 | 28 |
| Peppers to be produced | Total (thousand tons) | 200 | 210.1 | 210.8 | 206.8 |
| | Average yield (t/ha) | 16 | 18 | 21 | 23 |
| | The surface (thousands of ha) | 13 | 12 | 10 | 9 |
| Eggplants to be produced | Total (thousand tons) | 108.3 | 107.6 | 107.2 | 102.0 |
| | Average yield (t/ha) | 18 | 19 | 21 | 25 |
| | The surface (thousands of ha) | 6 | 6 | 5 | 4 |
| Onion to be produced | Total (thousand tons) | 340.9 | 351.2 | 356.8 | 380.7 |
| | Average yield (t/ha) | 15 | 19 | 23 | 28 |
| | The surface (thousands of ha) | 23 | 19 | 16 | 14 |
| Garlic to be produced | Total (thousand tons) | 53.9 | 59.2 | 60.7 | 62.3 |
| | Average yield (t/ha) | 5.5 | 7 | 8 | 9 |
| | The surface (thousands of ha) | 10 | 9 | 8 | 7 |
| Other species to be produced (including cabbage and melons) | Total (thousand tons) | 2108.8 | 2144.4 | 2158/6 | 2163.2 |
| | Average yield (t/ha) | 25 | 27 | 29 | 30 |
| | The surface (thousands of ha) | 85 | 80 | 75 | 72 |
| Total yield needed internally | Total (thousand tons) | 3211.1 | 3077.7 | 3015.5 | 2896.7 |
| | Average yield (t/ha) | | | | |
| | The surface (thousands of ha) | 174 | 159 | 143 | 134 |

If about 10 thousand ha of solar are built during the period 2020-2040, in 2040 Romania will realize the necessary vegetables for domestic consumption on an area of about 150 thousand ha, of which, in field crops only 134 thousand ha (Tabel no. 8). Compared to the average area cultivated with vegetables in the period 2012-2017 (241 thousand ha), the area will decrease by 92 thousand ha, which will stimulate greater investments in mechanization of vegetable farms, irrigation water supply and other inputs. To the areas deduced from Table no. 8, regarding the supply of vegetables cultivated in the field for domestic consumption, is added those proposed in Table no. 9 necessary for field production of vegetables for export. Our country has good conditions for the production of vegetables for export such as tomatoes for industry, peas, green peppers, bell peppers, peppers for industry, melons and others. From this table it can be seen that vegetables for export can be produced on at least 4000-5000 ha, at an average production of 35 t / ha, which means 120-150 thousand tons, thus managing to balance the import-export balance in this case.

Table no. 9. Surface with field vegetables for export

| Cultivated species | Specification | The year | | | |
|--|-------------------------------|----------|------|------|------|
| | | 2020 | 2027 | 2034 | 2040 |
| Tomatoes (turning into pasta, 6/1 ratio) | Thousands of tons | 40 | 50 | 60 | 80 |
| | Average yield (t/ha) | 25 | 30 | 35 | 40 |
| | The surface (thousands of ha) | 2 | 2 | 2 | 2 |
| Bell, long and round pepper | Thousands of tons | 5 | 8 | 10 | 12 |
| | Average yield (t/ha) | 18 | 20 | 22 | 24 |
| | The surface (thousands of ha) | 0.3 | 0.4 | 0.5 | 0.5 |
| Eggplant | Thousands of tons | 6 | 7 | 9 | 10 |
| | Average yield (t/ha) | 20 | 24 | 26 | 28 |
| | The surface (thousands of ha) | 0.3 | 0.3 | 0.4 | 0.4 |
| Onion | Thousands of tons | 10 | 12 | 14 | 16 |
| | Average yield (t/ha) | 25 | 30 | 35 | 40 |
| | The surface (thousands of ha) | 0.4 | 0.4 | 0.4 | 0.4 |
| Other species | Thousands of tons | 30 | 32 | 34 | 36 |
| | Average yield (t/ha) | 25 | 30 | 32 | 34 |
| | The surface (thousands of ha) | 1.2 | 1.1 | 1.1 | 1.1 |
| Total field yield for export | Thousands of tons | 91 | 109 | 125 | 154 |
| | Average yield (t/ha) | 21.7 | 25.3 | 28.4 | 35.0 |
| | The surface (thousands of ha) | 4.2 | 4.3 | 4.4 | 4.4 |

Tables no. 10 and 11 present a separate assessment of the export of vegetables from the field (53 million euros in 2040) and from protected areas (185 million euros).

Table no. 10. The value of the export of field vegetables

| Cultivated species | Specification | Anul | | | |
|--|-----------------------|------|-------|-------|-------|
| | | 2020 | 2027 | 2034 | 2040 |
| Tomatoes (turning into pasta, 6/1 ratio) | Thousands of tons | 40 | 50 | 60 | 80 |
| | RON/kg | 0.5 | 0.7 | 0.7 | 0.8 |
| | Total RON (thousands) | 20 | 35 | 42 | 64 |
| Bell, long and round pepper | Thousands of tons | 5 | 8 | 10 | 12 |
| | RON/kg | 4 | 4.5 | 4.8 | 5.2 |
| | Total RON (thousands) | 20 | 36 | 48 | 62.4 |
| Eggplant | Thousands of tons | 6 | 7 | 9 | 10 |
| | RON/kg | 2 | 2.2 | 2.2 | 2.3 |
| | Total RON (thousands) | 12 | 15.4 | 19.8 | 23 |
| Onion | Thousands of tons | 10 | 12 | 14 | 16 |
| | RON/kg | 1 | 1 | 1.2 | 1.2 |
| | Total RON (thousands) | 10 | 12 | 16.8 | 19.2 |
| Other species | Thousands of tons | 30 | 32 | 34 | 36 |
| | RON/kg | 2 | 2 | 2 | 2,5 |
| | Total RON (thousands) | 60 | 64 | 68 | 90 |
| Total field yield for export | Thousands of tons | 91 | 109 | 127 | 154 |
| | RON (millions) | 122 | 162.4 | 194.6 | 258.6 |
| | Euros (millions) | 25 | 33 | 40 | 53 |

Table no. 11. The value of the export of vegetables produced in plastic tunnels

| Cultivated species | Specification | The year | | | |
|---|----------------------|----------|-------|-------|-------|
| | | 2020 | 2027 | 2034 | 2040 |
| Tomato | Thousands of tons | 30 | 45 | 100 | 134 |
| | RON/kg | 3 | 3.2 | 3.2 | 3.3 |
| | Total RON (millions) | 90 | 144 | 320 | 442.2 |
| Pepper | Thousands of tons | 8 | 13 | 16 | 20 |
| | RON/kg | 5 | 5.2 | 5.5 | 5.8 |
| | Total RON (millions) | 40 | 67.6 | 88 | 116 |
| Eggplant | Thousands of tons | 5 | 12 | 15 | 18 |
| | RON/kg | 2 | 2.2 | 2.2 | 2.3 |
| | Total RON (millions) | 10 | 26.4 | 33 | 41.4 |
| Cucumbers | Thousands of tons | 15 | 42 | 62 | 75 |
| | RON/kg | 2 | 2.2 | 2.3 | 2.5 |
| | Total RON (millions) | 30 | 92.4 | 142.6 | 187.5 |
| Lettuce | Thousands of tons | 5 | 10 | 15 | 20 |
| | RON/kg | 3 | 3 | 3 | 3 |
| | Total RON (millions) | 15 | 30 | 45 | 60 |
| Other species | Thousands of tons | 5 | 10 | 15 | 20 |
| | RON/kg | 2 | 2 | 2 | 2 |
| | Total RON (millions) | 10 | 20 | 30 | 40 |
| Total yield from plastic tunnels for export | Thousands of tons | 68 | 132 | 223 | 287 |
| | RON (millions) | 195 | 380.4 | 658.6 | 887.1 |
| | Euros (millions) | 40 | 79 | 137 | 185 |

If these forecasts are made, we have presented in table 12 a calculation of the import-export balance of vegetable products.

Table no. 12. Import-export balance for vegetables

| Import/export | Specification | The year | | | |
|--|------------------------|----------|--------|--------|---------|
| | | 2020 | 2027 | 2034 | 2040 |
| Total import | Thousands of tons | 346.6 | 310.6 | 281.9 | 252.6 |
| | Value RON - millions | 1405.6 | 1285 | 1200.9 | 1129.75 |
| | Value Euros - millions | 293 | 268 | 250 | 235 |
| Export to vegetables produced in field | Thousands of tons | 91 | 109 | 127 | 154 |
| | Value RON - millions | 122 | 162.4 | 194.6 | 258.6 |
| | Value Euros - millions | 25 | 33 | 40 | 53 |
| Export to vegetables produced in plastic tunnels | Thousands of tons | 68 | 132 | 223 | 287 |
| | Value RON - millions | 195 | 380.4 | 658.6 | 887.1 |
| | Value Euros - millions | 40 | 79 | 137 | 185 |
| Total export | Thousands of tons | 159 | 241 | 350 | 441 |
| | Value RON - millions | 317 | 542.8 | 853.2 | 1145.7 |
| | Value Euros - millions | 66 | 112 | 177 | 239 |
| Differences +/- | Thousands of tons | -187.6 | -69.6 | +68.1 | +188.4 |
| | Value RON - millions | -1088.6 | -742.2 | -347.7 | +15.9 |
| | Value Euros - millions | -226 | -155 | -72 | +4 |

Starting with 2034, Romania can export an amount of vegetables at least as large as the imported one. However, if export prices remain lower than import prices, the balance

of external payments will continue to be unbalanced. In order to create the desired balance, we will increase the quantity of vegetables exported from the plastic tunnels or we will increase the quality of the vegetables exported to obtain prices similar to those of the imported products. Another possibility would be to keep the export at the level shown in Table no. 12 and to reduce the imports at the level of about 200 thousand tons annually.

The economic model of vegetable growing involves the construction of about 500 hectares of protected areas each year. There are a variety of types of solariums with different surfaces and different prices/sqm depending on height, materials used, equipment, etc.

We propose that during the period 2021-2040, by introducing in the National Strategic Plan (NSP) a measure: *Investments in new plastic tunnels*, to build 500 ha new plastic tunnels annually. The costs per m² of a modern plastic tunnel, equipped with fertigation, amounts to 20 € / m², the costs for the period 2021-2027 being 700 million euros for an area of 3500 ha, respectively 100 million euros/year;

The development of vegetables growing also involves other investments:

- Storage spaces for 200 thousand tonnes of root vegetables, bulbs vegetables or cole crops, by introducing in the NSP a measure: *Investments in vegetable warehouses*. The costs are 2000 euros/ton. Between 2021-2027 it is proposed to build warehouses for the amount of 80,000 tons, totaling 160 million euros (about 29 million euros/year);
- Introducing in the NSP (2021-2027) of a special measure: *Modernization of field vegetable farms* (irrigation and mechanization to reduce labor costs). These amounts can be provided by European funds (50%), by NSP (25-30%) and farmers funds (20-25%).

A total of the financial effort for the development of vegetables is presented in Table no. 13.

Table no. 13. Investments needed to support the vegetable development program (2021-2040)

| Specification | UM | 2017 | Proposals for development | | |
|---|--------------------|------|---------------------------|-----------|-----------|
| | | | 2021-2027 | 2028-2034 | 2035-2040 |
| <i>New plastic tunnels constructions</i> | ha | 5000 | 3500 | 3500 | 3000 |
| Costs / hectare | € thousands /ha | x | 200 | 200 | 200 |
| Total investment costs | € (millions) | x | 700 | 700 | 600 |
| <i>Warehouses, including conditioning and delivery facilities</i> | thousands of tones | 12 | 80 | 80 | 30 |
| Costs / 1000 tons | € (millions) | 2 | 2 | 2 | 2 |
| Total investment costs | € (millions) | x | 160 | 160 | 60 |
| <i>Field farm modernization</i> | ha | x | 35000 | 35000 | 20000 |
| Costs /hectare | €/ha | x | 2600 | 2600 | 2600 |
| Total investment costs | € (millions) | x | 91 | 91 | 52 |

Conclusions

Vegetable growing is an economic branch with a big development potential, but has not received support from the successive governments in Romania between 1990-2016. For this reason, vegetable consumption is based too much on imports.

The proposed economic model aims to increase the area of vegetables grown in plastic tunnels (500 ha/year) and to increase the average yield. Thus, the import will be reduced and the quantity of vegetables destined for export will increase, which would lead to a balance of payments while reducing the area under cultivation in the open field.

There are favorable premises for the realization of this model including: human potential and favorable climatic conditions for the production of quality vegetable products, as well as an internal market favorable to the consumption of local products.

The realization of the proposed model involves a series of costs for investments (plastic tunnels, warehouses, machining systems, etc.) and the modernization of production technologies, encouraging local research, restoring the consulting system and encouraging the association to allow farmers to enter into sales contracts with retail networks and export contracts.

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