Main trends of dynamic development of the vegetable products and fruits global market

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Abstract
In the world food market, a high-priority trend is to ensure year-round demand for vegetables and fruits. The rational combination of vegetable cultivation in the open and closed ground and their proper storage make it possible to arrange a year-round supply to consumers. The article shows a dynamic analysis of the development of the world fruit and vegetable market in general, by type and by region, and calculates the forecast level of world vegetable production. In general, the global market for fruits and vegetables is marked by positive trends in increasing production and processing volumes, expanding the range, which is reflected in the level of consumption by the population. In most countries, the production of vegetables and fruits is completely focused on the domestic market. It should be noted that only 5% of products are intended for export, but the share of the export market of vegetable products tends to increase (Mexico, Spain and the Netherlands). An assessment of the dynamics of export and import of vegetables and fruits was given, a forecast was made for the development of the world market for organic products. The results of the analysis are necessary to assess the level of food safety and to develop a strategy that takes into account the current trends in the global fruit and vegetable market. Prospective trends for sustainable production of fruits and vegetables have been developed: development and effective use of innovative technologies, improvement of quality and competitiveness, taking into account the production of ecological and quick-frozen vegetable and fruit products, personalization of healthy nutrition and strengthening of competitive market positions.

Keywords: food market, development, vegetable production, global market, strategy, prospective trends, innovative technologies, competitiveness.

Introduction

The Food and Agriculture Organization of the United Nations (FAO) has declared the year 2021 the International Year of Vegetables and Fruits, which, through innovation and modern technologies, involves the increase of sustainable production of food products that make the basis of a healthy diet, reduction of food waste, and the opportunity to raise awareness of the importance of vegetables and fruits for nutrition, food safety and health.

At the present stage, there are more than 1,200 species of vegetable plants in the world, belonging to 78 families, about 600 species of which are cultivated, the rest are used in a wild state. At the same time, industrial vegetable growing in most countries is engaged in the cultivation of a limited set of vegetable crops (about 30-35 species). The main types of vegetable crops are tomatoes, onions, cucumbers, cabbage, eggplant, carrots.

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peppers, lettuce (Mamedov, M. I., 2015).

Vegetable growing, with its variety of crops, in comparison with other industries, is more affected by soil and climatic conditions, risks, which causes variation in production volumes in general and by type. Products are distinguished by a wide range, quality, heterogeneity. Its delivery is marked by seasonal differences in the volume of trade flows, a mismatch between the time of supply and demand. Vegetables can be farmed in open or protected ground. Many consumer properties of vegetable products are preserved for a short time.

In this regard, the world market for quick-frozen vegetable products is currently actively developing, the share of which is about 11% in the structure of the world market of vegetable products (or 6.9 billion US dollars) and is marked by stable growth rates (an average of 3% annually) (TRADE MAP, Electronic resource, 2022).

The culture of consumption of frozen convenience foods in the US is one of the most sustainable in the world, where this type of product accounts for more than 70% of total consumption.

However, China is currently the most promising market due to its growing population, urbanization, economic development, which accounts for more than 60% of the global frozen vegetable market.

Trends indicate an increase in demand for ready-to-eat or cooked vegetables, vegetable snacks, greens, all types of salads, sweet potatoes, which are popular for their visual appeal and reputation as a healthy snack.

The level and growth rate of consumption of frozen vegetable products differ significantly in different countries, which is associated with different levels of development, income, varying degrees of urbanization and social modernization.

In general, their consumption is much higher in the most developed countries; among social groups, there is an increase in the consumption of frozen vegetables among wealthy people and pensioners (Biryukova, D., 2016).

According to the definition of the Food and Agriculture Organization of the United Nations, organic agriculture is an integral production management system that promotes the development and improvement of the agro-ecosystem condition, including biodiversity, biological cycles and soil biological activity. Special attention is paid to the use of natural resources (mineral and vegetable products), and to the elimination of synthetic fertilizers and pesticides. The International Federation of Organic Agriculture Movements (IFOAM) bases organic agricultural production methods on the principles of health, ecology, fairness and care. By the beginning of 2020, 72.3 million ha were occupied by organic farming in 187 countries of the world (an increase by 1.1 million ha as compared to 2019). Over the past 20 years, the area of land certified for the production of organic products in the world has increased by about 6.5 times.

Australia (35.7 million ha), Argentina (3.7 million ha) and Spain (2.4 million ha) have the largest areas of organic farmland. By 2021, there were about 3.1 million organic food producers in the world, of which the largest number are in India (1.37 million), Uganda (210 thousand) and Ethiopia (204 thousand) (Organic agriculture in the Republic of Belarus: Current condition and prospects, Electronic resource, 2022).

The objective is to study the main trends in the dynamic development of the world fruit and vegetable market, to develop upcoming trends of the market for quick-frozen and environmentally friendly products.

**Material and methods**

Vegetables and fruits play an important and irreplaceable role in human nutrition; they are valuable sources of fiber, vitamins and minerals, and useful phytochemicals. FAO and the World Health Organization recommend that every adult include at least 400 grams of vegetables and fruits in their diet every day, which will help prevent chronic diseases (including cancer, diabetes, heart disease, obesity) and micronutrient deficiencies. The COVID-19 pandemic has highlighted the need for change and a new balance between food production and consumption, including
vegetables and fruits. Within the study, general scientific methods of analysis and synthesis, generalization, comparison, abstract-logical analysis, etc. were used.

At the present stage, the trend in the development of vegetable growing is marked by an increase in the amount of world production and products of their processing. The global vegetable market includes two segments: fresh vegetables and canned vegetables. The average structure of the global vegetable market in 2016-2020 is shown in Figure 1.

Figure 1. Structure of the global vegetable market, %
Source: suggested by the author

Figure 1 shows that fresh vegetables (64%) and dried vegetables (24%) have the largest share in the structure of the world vegetable market. According to Food and Agriculture Organization of the United Nations FAO, over the past 20 years the production of fresh vegetables has increased by almost 70% (about a billion tons). The dynamics of indicators of global vegetables production is given in Table 1.

Table 1. Dynamics of indicators of global vegetables production

<table>
<thead>
<tr>
<th>Indicators</th>
<th>2004</th>
<th>2008</th>
<th>2012</th>
<th>2016</th>
<th>2020</th>
<th>Growth rate, 2020/2016, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvested area, million ha</td>
<td>44.85</td>
<td>48.28</td>
<td>53.58</td>
<td>56.34</td>
<td>58.30</td>
<td>103.5</td>
</tr>
<tr>
<td>Gross yield, million tons</td>
<td>764.48</td>
<td>886.96</td>
<td>999.78</td>
<td>1087.83</td>
<td>1148.45</td>
<td>105.6</td>
</tr>
<tr>
<td>Crop yield, t/ha</td>
<td>17.05</td>
<td>18.37</td>
<td>18.66</td>
<td>19.31</td>
<td>19.70</td>
<td>102.0</td>
</tr>
</tbody>
</table>

Source: build by the author

The data in Table 1 show that in 2020, compared to 2016, there was an increase in the harvested area for vegetable crops in the world by 3.5%, gross yield – by 5.6% and vegetable yield – by 2%.

The volume of vegetable production varies greatly in different regions of the world, with the main concentration of vegetable producing countries in Asia (Figure 2).

Figure 2. Structure of world vegetable production by regions
Source: suggested by the author
The data shown in Figure 2 show that in 2020 the largest share in the total structure of world vegetable production by region belongs to the countries of Asia (76.9%), Europe (8.2%), America (7.3%), Africa (7.3%), Australia and Oceania (0.3%).

### Results and discussion

The EU countries and the UK produced 93.69 million tons of vegetables and fruits in 2020 (50.99 million tons of vegetables and 42.7 million tons of fruits). Spain is the largest producer of vegetables and fruits among the countries of the European Union (9.92 million tons of vegetables and 13.2 million tons of fruits), in 2019 – 10.11 million tons of vegetables, in 2018 – 9.86 million tons, in 2017— 9.75 million tons. Italy is the second largest producer with a total amount of 17.37 million tons, the share of vegetables is 6.88 million tons. France is the third largest vegetable producer (5.61 million tons) and Poland is the third largest fruit producer in the EU (4.3 million tons). At the same time, the main vegetables and fruits grown in the EU countries are tomatoes (16.35 million tons), apples (10.71 million tons), onions (6.19 million tons), oranges (6.17 million tons), carrots (5.18 million tons) and pumpkin (3.37 million tons).

The dynamics of the gross yield of vegetables is given in Table 2.

**Table 2. Dynamics of the gross vegetable yield**

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>75.79</td>
<td>77.87</td>
<td>80.36</td>
<td>82.97</td>
<td>85.15</td>
<td>185.9</td>
</tr>
<tr>
<td>America</td>
<td>78.56</td>
<td>78.05</td>
<td>78.48</td>
<td>78.35</td>
<td>77.40</td>
<td>98.5</td>
</tr>
<tr>
<td>Asia</td>
<td>836.33</td>
<td>856.19</td>
<td>866.33</td>
<td>879.82</td>
<td>898.15</td>
<td>107.4</td>
</tr>
<tr>
<td>Europe</td>
<td>93.76</td>
<td>93.89</td>
<td>82.49</td>
<td>85.19</td>
<td>84.58</td>
<td>90.2</td>
</tr>
<tr>
<td>Australia and Oceania</td>
<td>3.39</td>
<td>3.34</td>
<td>3.38</td>
<td>3.34</td>
<td>3.17</td>
<td>93.5</td>
</tr>
<tr>
<td>Total</td>
<td>1087.83</td>
<td>1109.34</td>
<td>1111.04</td>
<td>1129.67</td>
<td>1148.45</td>
<td>105.6</td>
</tr>
</tbody>
</table>

Source: build by the author

The data in Table 2 show that in 2020, compared to 2016, there was an increase in the gross yield of vegetables in Africa – by 85.9%, in Asia – by 7.4%. In general, for this period there was an increase in the gross yield of vegetables by 5.6%.

The dynamics of the gross yield of certain types of vegetables in the world is given in Table 3.

**Table 3. Dynamics of the gross yield of certain types of vegetables in the world, thousand tons**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomatoes</td>
<td>177,383</td>
<td>178,024</td>
<td>180,231</td>
<td>183,015</td>
<td>186,821</td>
<td>105.3</td>
</tr>
<tr>
<td>Bulb onion</td>
<td>94,949</td>
<td>96,780</td>
<td>96,879</td>
<td>99,521</td>
<td>104,554</td>
<td>110.1</td>
</tr>
<tr>
<td>Cucumbers and gherkins</td>
<td>80,778</td>
<td>82,294</td>
<td>84,864</td>
<td>87,976</td>
<td>91,258</td>
<td>113.0</td>
</tr>
<tr>
<td>Cabbage</td>
<td>70,846</td>
<td>71,059</td>
<td>69,592</td>
<td>70,259</td>
<td>70,862</td>
<td>100.0</td>
</tr>
<tr>
<td>Eggplants</td>
<td>51,680</td>
<td>52,883</td>
<td>54,122</td>
<td>55,377</td>
<td>56,619</td>
<td>109.6</td>
</tr>
</tbody>
</table>
Carrots, table beets, etc. & 39,626 & 40,345 & 39,793 & 41,249 & 40,952 & 103.3  
Pepper & 33,607 & 35,028 & 35,717 & 36,026 & 36,137 & 107.5  
Spinach & 26,706 & 27,794 & 28,962 & 30,132 & 30,995 & 116.1  
Garlic & 25,853 & 26,473 & 26,990 & 27,299 & 27,963 & 106.5  
Pumpkin & 26,217 & 26,634 & 27,116 & 27,299 & 27,963 & 106.5  
Leaf lettuce and chicory & 26,355 & 26,657 & 27,064 & 27,285 & 27,660 & 105.0  
Cauliflower and broccoli & 24,444 & 25,207 & 25,321 & 25,786 & 25,531 & 104.4  
Beans & 22,377 & 22,712 & 23,332 & 22,950 & 23,277 & 104.0  
Green peas & 18,623 & 19,269 & 19,463 & 19,564 & 19,867 & 106.7  
Green corn & 11,498 & 11,469 & 9,035 & 8,765 & 8,773 & 76.3  
Okra & 8,830 & 9,156 & 9,575 & 9,957 & 10,549 & 119.5  
Asparagus & 8,267 & 8,388 & 8,513 & 8,404 & 8,452 & 102.2  
Green onion & 4,581 & 4,674 & 4,569 & 4,360 & 4,453 & 97.2  
Leek and other alliums & 2,119 & 2,172 & 2,119 & 2,150 & 2,120 & 100.1  
Artichokes & 1,412 & 1,660 & 1,629 & 1,583 & 1,517 & 107.4  
Other vegetables & 331,676 & 340,557 & 336,158 & 339,972 & 342,083 & 103.1  
Vegetables in total & 1,087,829 & 1,109,345 & 1,111,045 & 1,129,673 & 1,148,446 & 105.6  

Note – Prepared by the author using data from FAOSTAT.

The data in Table 3 show that in 2020, compared to 2016, there was an increase in the following vegetable crops in the world: tomatoes – by 5.3%, onions – by 10.1%, cucumbers and gherkins – by 13%, eggplants – by 9.6%, peppers – by 7.5%, spinach – by 16.1%, garlic – by 8.5%, etc.

Let’s a forecast for the world market of organic products for the period up to 2025. Let’s set up a trend equation; for this purpose we picked a linear growth curve, since it more accurately repeats the dynamics of the original time series (Figures 3 and 4).

Figure 3. Forecast of growth in harvested area and vegetables yield

Source: suggested by the author
Using the equations obtained on the graphs, we calculate the forecast for the global vegetables production (Table 4).

### Table 4. Forecast of global vegetables production

<table>
<thead>
<tr>
<th>Description</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>Growth rate, 2025/2021, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvested area, million ha</td>
<td>62.75</td>
<td>66.25</td>
<td>69.75</td>
<td>73.25</td>
<td>76.75</td>
<td>122.3</td>
</tr>
<tr>
<td>Crop yield, t/ha</td>
<td>20.5</td>
<td>21.11</td>
<td>21.8</td>
<td>22.4</td>
<td>22.9</td>
<td>112.1</td>
</tr>
<tr>
<td>Gross yield, million tons</td>
<td>1,268.15</td>
<td>1,365.1</td>
<td>1,461.9</td>
<td>1,558.8</td>
<td>1,655.7</td>
<td>130.5</td>
</tr>
</tbody>
</table>

Source: build by the author

Calculations showed that the growth rate of global vegetable production by 2025 will be 30.5% compared to 2021, with an increase in harvested area by 22.3%, and in yields – by 12.1%.

The total global fruit production is more than 800 million tons per year and is growing at by ca. 3% annually. The largest fruit producers are China, which occupies 20% of the total world production, India (13%), Brazil (6%), the USA (4%) and Indonesia (3%). In terms of production, citrus fruits (more than 200 million tons) and bananas, with more than 150 million tons produced annually, have the leading position in the world. Grapefruits and oranges account for the largest share in the structure of citrus production.

In 2020, onions (905 thousand tons), apples (894 thousand tons) and oranges (289 thousand tons) have the biggest share in the structure of European fruit and vegetable export. In 2020, there was a negative trade balance for fresh fruits and vegetables in the EU; to a greater extent, this is due to an increase in imports of bananas (6.26 million tons), oranges (1.12 million tons), pineapples (912 thousand tons), table grapes (675 thousand tons) and avocados (657 thousand tons) from non-EU countries. 17% of bananas imported into the EU come from Africa, the Caribbean and the Pacific. Deliveries from these regions enjoy preferential trade access in the EU, but their share of import has been declining in recent years. Citrus fruits rank second in the amount of imported fruits of the EU countries. The largest exporter of citrus fruits in the EU is Spain. South Africa, Egypt and Morocco are the leaders in deliveries to the EU, as well as South America, which specializes in...
the supply of lemons. (Leading European fruit and vegetable producing countries in 2020, Electronic resource, 2022).

As studies have shown, the effective organization of the marketing of vegetables and fruits depends on the development of infrastructure and logistics. Currently, the most popular are cooperative sales systems (contracting and cooperative sales) (Volkova, E.V., Bondarovich, N.A., 2021).

Poland is a manufacturer of quality food products, including ecological products. Since the country became the member of the European Union, customs barriers have disappeared and certificates are not required for products sold in the EU. The result is an increase in food exports, in particular fruits and vegetables. Quality, timeliness of delivery and price are the competitive advantage of agro-food companies (the price is on average 30% lower than the price of products produced in other EU countries). Poland is the largest producer of apples in Europe, most of which are grown for export, both fresh and processed fruits. The country is also the European leader in the cultivation of so-called soft fruits: raspberries, currants, strawberries and cherries. The Warsaw agricultural and food wholesale market Bronisze is one of the main pricing centers for fruits and vegetables in the EU. The prices of this market are a reference point for wholesale companies selling vegetables and fruits, for producers and processors of vegetables and fruits, which will make it possible to use the information and intensify the international trade in vegetables and fruits.

In Germany, a significant part of the products are sold through wholesale trade centers owned by cooperative associations of manufacturers. Trade centers carry out the purchase, storage of products and their sale to wholesale buyers. Similar experience exists in Western European countries, Great Britain and China.

An important role in the sales of agricultural products belongs to the wholesale and intermediary form of marketing; exchange and auction trade have become widespread. In the USA, Canada, Germany, Belgium and Australia, exchange trading covers almost all types of agricultural products.

Organic vegetables and fruits are also increasing their share in the global market. The number of organic product consumers in the world is steadily growing and in 2020 is approximately equal to 700 million people. Another obvious fact is the rapid growth in demand for organic products from Western countries, which involves importing organic products to meet the growing demand. In 2019, the EU imported 3.24 million tons of organic products (+0.4%), while the number of importing companies in the EU countries increased by 14% and exceeded 5,700. Germany is the largest organic market in Europe, with the largest number of importers. The main exporters of organic products to the EU market are shown in Figure 5.

![Figure 5 – Structure of the main exporters of organic products to the EU market](image)

Source: suggested by the author

The data given in Figure 3 shows that the main exporters of organic products to the EU market are the following countries: China (14%), Ukraine (10%), Dominican Republic (10%), Ecuador (9%).

The structure of imports of organic products to the EU market is shown in Figure 6.
The data, given in Figure 6, show that the biggest share in the structure of organic product import to the EU market belongs to the tropical fruits (27%), other fruits (31%), and cereal crops (12%).

The organic food market is one of the fastest growing markets in the world. During 2019-2020, retail sales of organic agricultural products increased by more than seven times (from 18 to 129 billion USD). According to experts’ forecasts, the market will continue to grow by about 11% per year and by 2025 will reach the level of 220 billion US dollars, which is equal to 5% of the global market for agricultural products and food. In the United States, the annual turnover in the organic market is over 54 billion dollars, which is approximately 40% of the global market. The EU countries market in 2019 grew by 8% compared to 2018 and amounted to 50 billion dollars, which accounted for 39% of the retail turnover of the global market for eco-products. However, the domestic supply of organic products does not satisfy the growing demand for it, therefore, in order to maintain a high level of organic products consumption, developed countries will increase imports from third countries.

Let’s make a forecast for the global market of organic products for the period up to 2025. Let’s set up a trend equation; for this purpose we chose a polynomial growth curve of the second degree, since it more accurately repeats the dynamics of the original time series (Figure 7).

Figure 6. Structure of organic product import to the EU market
Source: suggested by the author

Figure 7. Forecast of the global market for organic products
Source: suggested by the author
Using the equations obtained on the graph, we calculate the forecast for the development of the world market for organic products (Table 5).

**Table 5. Forecast of the development of the global market for organic products**

<table>
<thead>
<tr>
<th>Description</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>Growth rate, 2025/2021, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail sales of organic products, bln. USD</td>
<td>138.7</td>
<td>158.6</td>
<td>180</td>
<td>203</td>
<td>227.4</td>
<td>164.0</td>
</tr>
<tr>
<td>Area of organic land, million ha</td>
<td>79.7</td>
<td>89.5</td>
<td>101.3</td>
<td>113.3</td>
<td>126.1</td>
<td>158.2</td>
</tr>
</tbody>
</table>

Source: build by the author

Calculations showed that the growth rate of the global volume of retail sales of organic products by 2025 will be 64% compared to 2021, with an increase in the area of organic land by 58.2%, which reflects the positive dynamics of the studied indicators.

**Conclusions**

The modern global fruit and vegetable market is marked by a state of dynamic development due to income growth, increase in the level and quality of life, as well as urbanization. China has a leading position in the production of vegetables in the world (67%), then India (14%) and the United States (4%). According to FAO data, production growth has been observed in China for 40 years (during this time, the vegetable crop increased by more than 10 times). The reform of the agricultural and food sector is taking place as part of the establishment of international economic relations under the One Belt One Road project, which includes the idea of creating transport corridors between the countries of the Asia-Pacific region (primarily China) and Western Europe, with the development of the appropriate infrastructure (Silk Road Economic Belt).

A significant share of the world’s vegetable production belongs to India, which is the world’s largest producer of ginger and okra (gumbo) and ranks second in the production of onions, cauliflower and eggplants.

The United States is among the countries with a significant volume of vegetable production (about 32811 thousand tons per year). The main feature of the development of vegetable growing in the United States is the concentration of production in highly specialized family-type farms with an average farm size of about 180 hectares. Vegetable production in the country is focused in areas with the most favorable soil and climatic conditions, regardless of their population.

Significant volumes of vegetables are also produced in Turkey, Nigeria, Egypt, Vietnam, Russia, Mexico, Iran, Spain, Italy and Indonesia, which together account for approximately 13% of the world’s vegetable crop.

The main exporters of vegetables to the EU are Spain, the Netherlands, and Morocco. A significant change in the world vegetable market is associated with an increase in importing countries: USA, Western Europe, Japan, India, China and United Arab Emirates.

As world experience shows, the most efficient enterprises are full-cycle enterprises which include all stages of the production of frozen vegetable products from growing raw materials to packaging and storage of finished goods. The market of quick-frozen vegetable products is the fastest developing segment of the food market. Its active development is associated with the growth of consumer demand, which is due to such factors as a change in the pace of life (consumers prefer products intended for easy and fast cooking), the growth of the population’s ability to pay, the trend of growing popularity of healthy eating (modern freezing methods retain most of the vitamins in vegetables).

The share of organic fruits and vegetables in
the global market is increasing. In countries with high per capita income (Austria, Denmark, Switzerland, Sweden), the share in total sales reaches about 10%. The main organic products that are in demand among the population are vegetables, root crops, fruits, berries, etc. In general, the production of organic food is a guarantee of the safety and health of the nation.

References


