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VERTICAL FARMS

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ABSTRACT

The urbanized population is increasing year by year, leaving fewer and fewer inhabitants in the province. This inevitably leads to increased energy and resource consumption, leading to environmental problems. All this, combined with climate change, calls for a more holistic approach to the provision of raw materials and resources in future cities, both in the main aspects of sustainable development, social, environmental and economic. From this point of view, vertical farms can be an instrument that addresses these aspects.

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Today, we are increasingly aware of the serious impact of man on the environment, satisfying basic needs such as nutrition-in the form of production costs, long-range deliveries and the associated carbon footprint, and last but not least the limit of production resources. This is what requires the search for a new, more rational approach in the field of agriculture and in particular the plant growing in the agri-food industry.

Like modern cities, agriculture in the near future will grow not only as a volume, but also in height (1). According to studies of Global Vertical Farming the world market of vertical farms was estimated at 2.23 billion dollars in 2018 and is projected to reach 12.77 billion dollars by 2026, increasing by 24.6% from 2019 to 2026 (9).

Vertical farming is a revolutionary approach used to produce food and medicinal plants in vertically stacked layers with a theoretically limitless height, similar to a skyscraper. It facilitates the production of huge quantities of quality fresh food without relying on favorable weather, large quantities of water, skilled labor and favorable soil qualities. Moreover, it ensures a secure extraction and consistency in the production of crops during the year, absolutely independent of external factors such as intermittent climate, diseases, pest attacks, etc.

Vertical farms will continue their development on economic grounds, given the challenges facing mankind in the future. For example, in the UK, the country's food security forecasts are not positive-the UK population is growing by around 0.6% a year in parallel with the expectation that the shortage of agricultural areas suitable for cultivation will be €2 million hectares to 2030 the situation is similar in the larger European countries, and in Bulgaria the depopulation of the Bulgarian village will still require the use of new, rational approaches.

In the next two years, the German starter Infarm will equip in the EU countries a network of modular vertical leaf vegetable farms. The company has already discovered over 50 farms in Berlin, including large retail chains. By the end of 2020, mini farms will appear in a number of cities in Germany, and also in Paris, London and Copenhagen. Thanks to its modular construction, farms can be installed in kitchens of restaurants, canteens, commercial halls and even small shops. Since the

beginning of 2020, IKEA has published in its product catalog and portable, home vertical farm, with the potential for production of 40-60 kg of vegetables and spices monthly.

Farms use the principle of aquaponics, where there is no need for soil-all the necessary substances are obtained from a nutrient solution. Sunlight has been replaced by LEDs. The complete absence of natural light inside the vertical farm is an opportunity for full control of the light spectrum used. Current by GE have developed a lighting solution that ensures that each individual plant will receive a personal dose of optimum light to ensure constant and even growth in intensive conditions. They used three light spectrum for growth based on a combination of different wavelengths:

• Reproducing: To promote the growth of leaves and fruits (with a greater part of the wavelength);

• Vegetative: To promote the structure of plants and leaf mass (with dominance of blue wavelengths);

• Balanced: To promote overall presentation of growth (with a more balanced light spectrum).

The cost of powering LED grow lights is one of the biggest challenges that a vertical farm must overcome in order for its production to be competitive with the fruits and vegetables from a traditional farm. For this, solar panels can be built nearby to generate solar energy. Nowadays, many experiments to grow the same plants with less light are currently underway. In Middle Eastern countries, the transition to vertical farming is a no-brainer, for example, a vertical farm in Saudi Arabia can use solar energy at a low cost. At present, most of the vegetables are imported from other countries, so if there are local crops, there will be higher incomes at the regional level.

Jones Food Company LTD. Begins to offer a fully automated system for growing crops in ideal, clean conditions.

Fig. 1. The fully automated vertical farms of Jones Food Company with individual, offers lighting.

The techniques used in their farm do not require the use of pesticides, chemicals, herbicides, fungicides-natural or synthetic, as used in traditional agriculture. The plant model provides safe and clean growth in a sealed and controlled environment in which there is practically no risk of diseases of plants causing pathogens. In addition, Infarm technology allows the farm to be operated remotely.

Fig. 2. Fully automated and robotic cultivation of vegetables, allowing minimization of the costs of resources and labour (8).

The status of the crop is fed into the cloud, and company employees can regulate the degree of illumination and other indicators remotely. Large databases help the company adapt the level of illumination, temperature, pH and nutrient composition for each plant. All this helps monthly in one module of area 2 sq. m. to be raised to 1200 plants.

In the beginning of 2019 the old man attracted 25 million. Dollars. Investors in the project became Balderton Capital, TriplePoint Capital, Mons Investments, Cherry Ventures, QUADIA and LocalGlobe. Earlier, the company received a grant of 2.5 million euro. Dollars by the European Commission.

Meanwhile, at the end of 2019 the largest vertical farm in the world was completed (10). It was built by the American company Crop One Holdings together with Emirates. The vertical farm will provide products to the customers of Emirates Flight Catering, as well as to the remaining 105 airlines and 25 lounges at the Inter-National Airport in Dubai.

Fig. 3. Vertical farms of the American company Crop One Holdings.

Fig. 4. Vertical farms of Emirates Flight Catering.

Fig. 5. Warehouse areas of Emirates Flight Catering.

The joint venture is worth 40 million dollars. The area of the installation is 40 thousand sq. m, and it is that the production of leafy vegetables is estimated at about 3000 tons per year, as the used water will be 99% less than that in conventional greenhouses.

Fig. 6.

The demand for a vertical agricultural industry is expected to grow rapidly in the next decade due to the increasing popularity of organic food. In addition, the vertically arranged structure of these farms reduces the need for additional construction work and land. Reduces the use of machines necessary for traditional agriculture. On the face is the optimum use of the vertical space. A balanced use of energy, mainly from renewable sources, contributes to the growth of the vertical agricultural market. The technologies used in the sector allow to monitor the growth and harvesting of plants, which further stimulates the interest in these markets market. However, large initial investments are needed for proper construction, adjustment of the internal vertical installation, for the construction of lighting and irrigation systems, software services, etc. However, the increase in urban population and the development of technology in this field are expected to provide lucrative opportunities for growth of the participants in the vertical agricultural market.

In Bulgaria there is enormous potential for development of vertical farming, especially in the former urban industrial zones, where there are many abandoned production buildings and halls (6), which have good opportunities for urban agriculture, not only as a building stock but also with its infrastructure security. Such an initiative and the development of funding programmes from the European funds would help revitalise these non-urban spaces, while stimulating the opening of new jobs in an innovative and high-tech industry.

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