SUSTAINABLE MANAGEMENT OF AN INTEGRATED VIRTUAL FARM

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Abstract
For over two years we have been through a pandemic and now we can see the results of a war. All this time we bought a lot of food from stores, but we haven't had the time to think if the food was healthy. As time passed by, we can think of a better way to take care of ourselves. For example, we can buy toxic-free and eco-friendly food from local farmers. A farm like that should have a good management to work.
Our virtual farm is divided in six departments (plant department, animal department, green energy, auxiliary department, sale department and economic department). We cultivate our own land and the final product we'll be distributed by the sale department to our restaurants, shops, H_2 filling station and electric charging station. Using photovoltaic panels and H_2, produced from waste and biomass on our farm, we fight against pollution and we use that energy for our vehicles to transport the products and for the agricultural machinery to work at the farms. The management team will deal with the realization of an association of producers with the largest land area and with the same vision. Due to the data-driven management of the farm based entirely on state-of-the-art technology, low costs, quality of products and services, low labor force due to advanced equipment and robotics, a closed circuit is created in which the major criterion is the circular bioeconomy.
To summarise, by eliminating all obstacles, the good implementation of the business plan, the circular bioeconomy that ensures all the goods from our own production, our farm is a business model that can be the starting point for any entrepreneur who wants to develop a successful business.

Key words: toxic-free, eco-friendly, data-driven management, circular bioeconomy.

INTRODUCTION

In order to increase the resilience of the company and reduce the risks related to phenomena such as pandemics, war, natural phenomena or others, we tried to build an integrated farm that meets the requirements of the circular bioeconomy.

As research and farming communities became aware of the need to balance productivity with environmental and social outcomes, the concept of sustainable agriculture was increasingly promoted. Sustainability is a concept which considers the economic, environmental, and social aspects of farming, while also promoting the resilience and persistence of productive farming landscapes. When we are talking about a sustainable farm, we must emphasize the importance of an integrated pest management. Also, organic agriculture, precision farming and sustainable intensification are becoming

more common.

Given the main needs of the people are related to food and energy, in order to achieve long-term sustainability, several policies have been established, including the Green Deal. Some of EU's Green Deal objectives are: the market for organic food is continuously growing, organic farming is promoted worldwide and consumers start to recognize its value.

Sustainability, the only successful strategy for the business of the future, that's what the Farm and Fork strategy says. This strategy's goals are to reduce the environmental and climate footprint, food system and strengthen its resilience, ensure food security in the face of climate change and biodiversity loss and lead a global transition towards competitive sustainability from farm to fork and tapping into new opportunities. The Farm to Fork Strategy will strengthen farmers efforts to tackle climate change, protect the environment and preserve biodiversity.

We'll also access government funds, EU funds, private equity funds and finally, the farm will be floated to the stock exchange. The circular economy action plan will include a 'sustainable products' policy to support the circular design of all products based on a common methodology and principles. It will prioritize reducing and reusing materials before recycling them. In Romania the tendency to consume local products was born both from the desire to support small entrepreneurs, local farmers and, implicitly, to encourage the development of agriculture, but also to have as many products of "controlled origin" as possible.

MATERIAL AND METHODS

In order to increase the sustainability and resilience of the farm, the structure adopted for the management of the enterprise is presented in Fig. 1.

The wheat farm covers an area of 250 ha, cultivated with ecological technologies. The cultivated varieties are: *Triticum turgidum* (from which the pasta will be obtained) and *Triticum aestivum*, for the production of the flour necessary in the production of bread and pastries. The technology used will allow farmers to carry out on-farm operations with greater ease and accuracy, and the wheat crop will remain intact, as there is no need for a tractor to pass over it. A good example is a drone that can accurately perform various operations (monitoring, fertilization, herbicide etc.)

The fodder farm is divided into 4 main cultures: sunflowers, corn, soybeans and biomass for H_2 production. Each crop occupies a well-calculated area because it is necessary to ensure the necessary feeding of the animals within the zootechnical farm. Thus, the sunflower occupies an area of 150 ha, corn occupies 200 ha, soybeans occupy 200 ha and 140 ha for

biomass. Besides the use for obtaining grist for animals, the sunflower culture is also used for procuring oil. Precise and advanced technology is used to grow fodder. In addition to precision sowing with a variable rate, Fendt Xaver robots are also used.
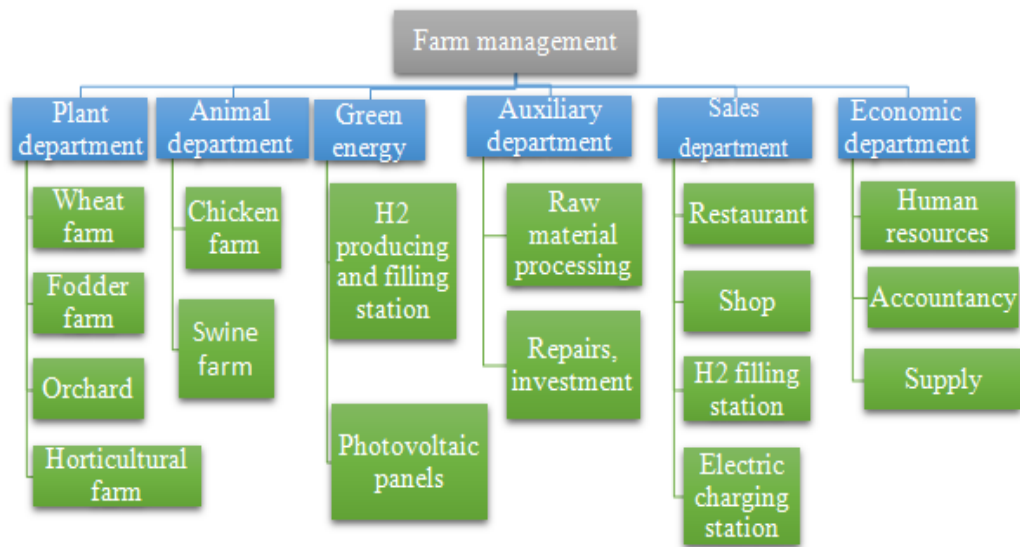
Fig. 1 Farm management structure

The poultry farm consists of 20k broilers and 10k laying hens. The broilers and the laying hens are raised in the free range system. This means they are able to graze and roam naturally. The chickens and hens are feed with corn, sunflower grist, soybean grist, which are produced by our fodder farm. The chicken eggs obtained will be used in the bakery and sold in the chains of stores managed by the farm together with other products obtained on the farm. The chicken meat will also be sold in the same stores and restaurants. Both eggs and chicken are organic certified. To maximize profit and ensure a good bird development environment we use robots that help us track certain parameters through sensors.

500 pigs are raised on stables in boxes within the swine farm. Pigs are raised up to a weight of 130 kg, with organic food from our farm (fodder consisting of corn, wheat and soybeans and sunflower) and will eventually be slaughtered and capitalized in our restaurants. Being followers of the latest development and technologies, we have integrated monitoring and robotics in the zootechnical farm as well. The Evo cleaner robot is the most advanced robot on the market, the only fully autonomous and programmable, designed for washing pig breeding boxes.

The horticultural farm within our company is spread over an area of

26 ha and produces several varieties of ecological vegetables and fruits such as *Solanum tuberosum* (potato), *Solanum lycopersicum* (tomatoes), *Capsicum annuum* (bell pepper), *Fragaria* (strawberries) and *Allium cepa* (onion). The total area is divided into 10 ha of potatoes, 8 ha of onions, 2 ha of tomatoes, 2 ha of bell peppers and 3 ha of strawberries. The pepper and tomato crop is entirely in greenhouses. Our farm uses new technologies that stimulate high production, low labor, minimum costs and the quality of the finished product, which is largely capitalized by our chain of stores and restaurants.

The orchard is composed of two crops: apple (15 ha) and pear (20 ha). Treatments are necessary to have a rich, bio and healthy harvest. These are done at the right time and as soon as possible to prevent disease. We are proud of the fact that in less than 3 hours, thanks to the drones (also used on the vegetable farm), we can carry out the necessary treatments for the fruit trees for the entire orchard. The main cost to the fruit sector was the payment of labor needed to harvest the fruit. Thus, our orchard has the new Apple Harvester 3 Robot (photo) that harvests the fruits thanks to 3D recognition technology, a flow of approximately 600 kg per hour, 24 hours per day. This robot has minimal operating costs and is friendly to nature, being 100% electric and charging is done by solar panels that can be mounted on top of the device.

Hydrogen energy on farm can be produced from waste and biomass from our farm. That way we can reduce fossil fuel use and save water for other agricultural purposes. To convert biomass to hydrogen we'll use biomass gasification. Trucks, tractors, combines and any other machines in our farm would produce water vapor as the only emissions, avoiding the impacts of carbon legislation and potentially allowing our farm to become net carbon negative. Hydrogen is a Clean and Flexible Energy Source to support Zero-Carbon Energy Strategies. Hydrogen fuel cells provide an inherently clean source of energy, with no adverse environmental impact during operation as the byproducts are simply heat and water.

By using the Agriculture 4.0 on a farm, you use new technologies to bring food production to consumers, increasing efficiencies in the food chain and incorporate cross-industry technologies and applications. For a better planning and tracking on the farm, you would like to use a farm management software based on data-driven technology. It can also help to manage the savings on inputs and costs and on the social responsibility and sustainability. Farm Management Software is used to optimize and manage farm operations and production activities. The software helps in automating farm activities such as record management, data storage, monitoring and analyzing farming activities, as well as streamlining production and work schedules.

RESULTS AND DISCUSSION

From each part of the farm, we can get a final product. From the wheat farm we'll use the raw material for our bakery to produce bread and any other pastry products. The bread, pasta, meat, eggs, oil, fruits and vegetables will be our main ingredients for the food at the restaurant. Also, these final products can be put up for sale in our shops. First of all, our H_2 Plant we'll use vegetable, animal and manure waste. The resulting solid matter will be used as natural fertilizer. On the other hand, another source of energy for the H_2 Plant will be the photovoltaic panels.

One of our main goals is to reduce the loss and waste of by-products resulting from the processing. Due to the importance that our farm gives to this idea of making the most of the business potential, the major impact is the increase of the farm's value.

These examples are: from the oil production technology results the seed residues to which we give importance being an extraordinary grind used in the feeding of pigs and birds; by processing the food scraps from the restaurant and the manure that is in the process of fermentation anyway, we produce the necessary hydrogen that provides the energy power for the farm.

Our virtual farm is illustrated in Fig. 2.

Fig. 2 Illustrated virtual farm

CONCLUSIONS

The farm will be a source of inspiration, a model for young farmers, to combine the production of healthy food and green energy at the same time with environmental protection in order to achieve sustainable profits.

After we finish our studies we would like to implement this idea of a toxic-free and eco-friendly farm by accessing government funds, EU funds, private equity funds and the farm will be floated to the stock exchange.

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