AGRICULTURE EVOLUTION TO HANDS-FREE FARMS

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Abstract

To feed the growing population, food production must increase with 70 percent by 2050. Sustainable development of agricultural production will be done using new data-driven business models and digital technologies. Precision agriculture and digital technologies are the most influential trends affecting farming practices and structures through 2030. It enables an information based decision-making approach to farm management, to optimize returns on inputs. Simply put, enabling more to be done with less. Unlike previous agriculture revolutions, which have focused on further intensification and standardization, this offers a new set of tools. It is not about drastically increasing yields, but tailoring the cultivation of each square foot: adopting a 'per plant' 'per animal' approach. This revolution in data available to the farmer, in contrast to those before, is an agricultural revolution. This revolution carries different names, Digital Farming, Farming 4.0, Agriculture 4.0, Smart farming, but its essence is the same, being supported by the industrial revolution Industry 4.0.

Key words: ICT, IoT, precision agriculture, hands-free farm.

INTRODUCTION

The Department of Economic and Social Affairs, Population Division, of the United Nations, (United Nations, 2015) has predicted that the global population will reach 8.55 billion people by 2030 and 9.77 billion people by 2050. In order to feed this growing population, according to FAO (Food and Agriculture Organization of the United Nations, 2016), food production must increase with 70 percent by 2050 and a 60 percent increase in demand for high quality protein such as milk, meat, and eggs.

"Promoting sustainable agriculture requires a renewed focus on innovation and investment in research, technology and capacity development", FAO Director General José Graziano da Silva said at a meeting of agriculture ministers of the G20 in China. He pointed out that "ICT (Information And Communication Technologies) helps in the monitoring of crop growth, utilization of new techniques, field management and harvests" (Da Silva, 2016).

In E-agriculture Strategy Guide (Food and Agriculture Organization, 2016) are set many roles of ICT in agriculture. Enabled ICT environment can unleash the real potential of agriculture being the first step towards Digital Farming. The base of ICT environment is a communication and data network which interconnects people, data and equipment's, as presented in figure 1 (CEMA, 2017).

In ICT, one of the main buzzword in last years is IoT (Internet of Things) alongside Big Data. This, in fact, is an evolution of the Machine to Machine (M2M) concept and describe a universe of connected physical devices and data. Internet of Things is not just about the "things", but moreover about connecting people to the right data, automating processes for cost reduction and enabling inter-dependencies between the operational level and the business level of the organization. Specifically, IoT becomes a tool for predictive maintenance or an intelligence assurance policy aimed at improving products and services quality through optimizing processes.

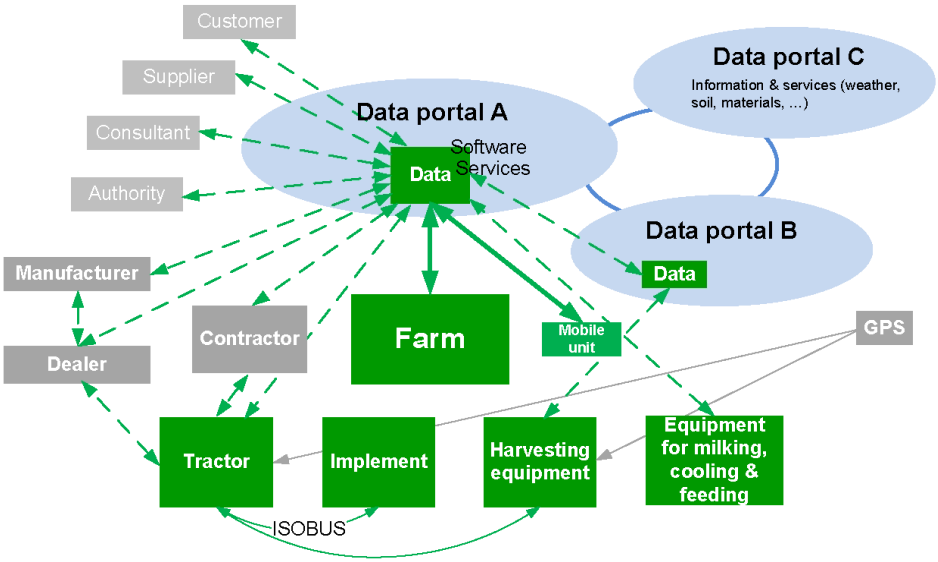

Fig.1. ICT network for agricultural farm (CEMA, 2017)

MATERIAL AND METHOD

This study analyzes the state of achievements and the directions of evolution for the new agricultural revolution.

Because agriculture is regarded as an industry, most analyst's transposes industry forecast in agriculture. In the manufacturing industry, after the term Digital Revolution, the Industry 4.0 or Fourth Industrial Revolution (i4.0) concept appears. Similarly, in agriculture, appear initially the term "Digital Farming" and after that Agriculture 4.0 and Farming 4.0.

Unfortunately, there are two major issues affecting agriculture, the evolution of the weather and the environment protection in the long term (especially soil) which complicates achieving optimal solutions.

On the other hand, due to the inherent mobility of the basic components of IoT, the advantages that bring them in agricultural technology will be higher than in industry. The basic elements on which is

built smart and precision agriculture today are WoT and IoT.

The challenges are different from those of industrial environment.

Sensors provide the IoT data. In theory, we can deploy as many sensors on field as we wish. The main problems are energy supply for sensors and the transfer of data to the storage and processing systems. Satellites and drones will be the basic tools to get necessary data to support agriculture development.

Before discussing the state of the agricultural revolution in the EU, it is important to present at least two examples out of it.

In Thailand, Prime Minister Prayut, at Kasetsart University conference entitled "Mobilising Thailand 4.0: Agriculture, Food and Biotechnology", stated that the Ministry of Agriculture and Cooperatives is the key to helping farmers learn how to adapt by changing traditional ways of farming to technology-led cultivation through more than 2,000 learning centers countrywide and that farmers should have proper plantations in line with soil quality and geographic locations suggested by the "Agri-Map" developed by the ministry (Wipatayotin, 2017).

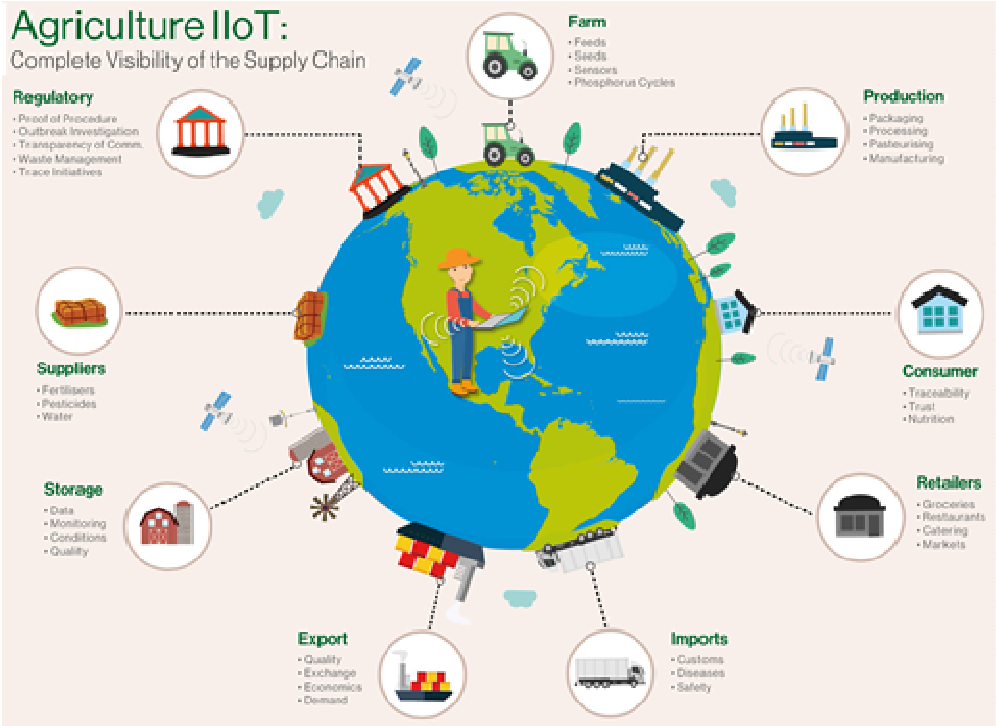

Fig. 2. USDA vision of agriculture (Challenge Advisory, 2017)

In US, United States Department of Agriculture, National Institute of Food and Agriculture, at Agriculture 4.0 Conference, present (Fig.2.) key themes opportunities, incentivise and updates vision for data science in

agriculture (Challenge Advisory, 2017). Among companies based in the US who have significant achievements in this area we highlight Deere & Company, Trimble Navigation Ltd., Raven Industries, AgJunction Inc., Monsanto and DuPont. DuPont launched its Encirca farm services, which have a powerful analytics models (Poston, 2016). John Deere created the open platform, MyJohnDeere, an information system to help agricultural producers optimize the management of production data, equipment information and farm operations (Perlman, 2017).

In the EU, the Future Internet Accelerator Programme for Internet-based innovation in the food and agribusiness have three projects domains, FInish, SmartAgriFood and Fractals to give 14 million euros in grants for application developments (Verdouw et al., 2014). One of them, QUHOMA (QUalitative HOrticulture Marketplace) is an example of Future Intelligence's farm services (Geissler, 2015). Hardware (FINoT equipment) is provided for free to farmers and access to relevant data is provided upon subscription to agronomists/mentors and Quality Certification bodies. In Italy, AgriAware is a traceability project that follows the transformation of olives and other fruits from the tree to the packed product (AIOTI, 2015).

The European Innovation Partnership 'Agricultural Productivity and Sustainability' presented at a seminar (EIP-AGRI, 2016), how agricultural and rural development policy can support the data revolution for an enhanced productivity and sustainability in the wide agri-food chain, covering different sectors, farm types and production systems. These data, generated by components of networks IOT will determine in many cases the implementation of data-driven business (Poppe, 2016).

RESULTS AND DISCUSSIONS

Carlo des Dorides, Executive Director of European GNSS Agency (GSA) at CEMA Summit Farming 4.0, synthesized through figure 3 (Dorides, 2017) the evolution of the revolutions in agriculture.

In this battle came not only traditional producers for agriculture but also those from ICT. In 2015, Fujitsu and Microsoft announced an offer for a solution that blends Fujitsu's Eco-Management Dashboard, an IoT service for the agricultural sector, and Microsoft's Azure database services (Microsoft News Center, 2015). This solution is based on the innovative work Fujitsu performed – the largest low-potassium vegetables "Plant Factory" (Fujitsu, 2013).

Horizon 2020, the EU's framework program for research and innovation, is investing nearly €77 billion over seven years (from 2014 to 2020) in research and innovation projects to support Europe's economic competitiveness and extend the frontiers of human knowledge. A Work

Programme of Horizon 2020 called “Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy” (European Commission, 2016) will fund “Robotics Advances for Precision Farming” which will help attain high levels of precision in modern farming through the smart use of robotics. Research and Innovation Actions will focus on the design, development and testing of robotics systems for precision farming, including autonomous or semi-autonomous farm vehicles or sophisticated sensors and intervention mechanisms. The actions will prioritize technologies such as selective harvesting, more targeted weed reduction or environment friendly fertilization, and / or livestock management, based on better planning and targeted intervention, using sensors (local and aerial, even maybe earth observation satellite).

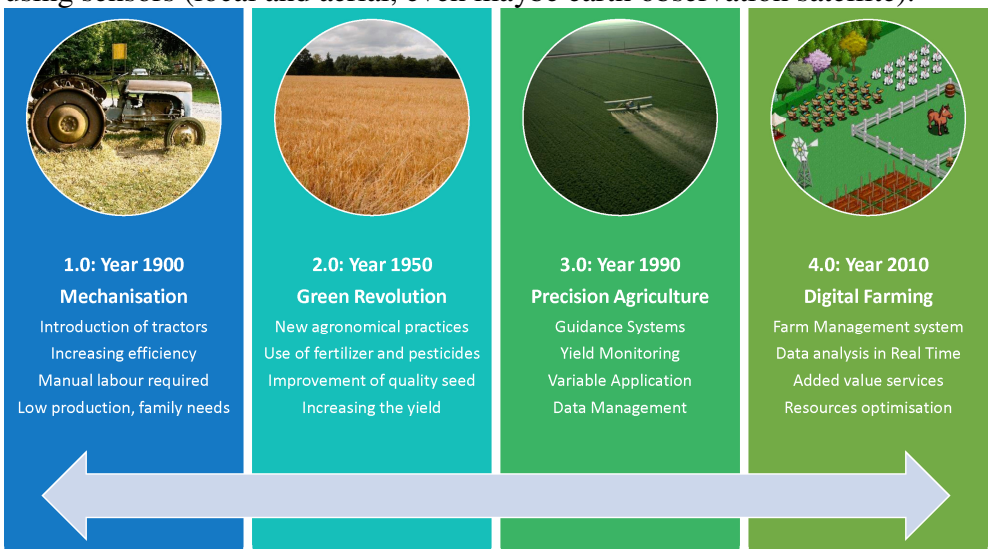

Fig. 3. Agricultural revolutions (Dorides, 2017)

CONCLUSIONS

The European Innovation Partnership ‘Agricultural Productivity and Sustainability’ was highlighted the importance of developing an EU ICT Architecture Strategy for AGRI-FOOD. In the current H2020 call for proposals there is a call to submit a proposal for a multi-actor project on business models in agriculture (Boot, 2016).

In short, we can conclude that the agricultural industry is about to be disrupted and will transform into a high-tech industry. At the same conclusion reached by several experts (Laugerette and Stöckel, 2016). Richard Markwell, President of CEMA, the European trade association of the agricultural machinery industry said, at CEMA Summit 2017, “To reap the full benefits of digital farming, the EU needs to devise supportive, coherent and forward-looking policies which encourage those who push the

boundaries of innovative digital farming technologies further, such as the farm machinery industry, and help those who can make a real difference on the ground by using them: farmers and agricultural contractors".

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