Industrial Revolution 4.0 With a Focus on Food–Energy–Water Sectors

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INTRODUCTION

As the world is trying to cope up with a pandemic, it has brought to the fore the need for automation, machine based intervention and the use of Artificial Intelligence to fuel the sustainability of human civilization. Manufacturing and production took a massive plunge during the COVID-19 pandemic and this affected the world economy to a great extent. However, the major players quickly understood the need of the hour is to adopt a "human-less" operation in such a scenario and it has spurred a rally of research and development in lines of Artificial Intelligence (AI) and Machine Learning (ML).

Artificial Intelligence (AI) and Machine Learning (ML) are some of the newest fields in science and engineering with interest in these topics increasing primarily in the last half a decade, but as a field of research, these fields have existed for the last 6 decades. The most prestigious journals where cutting-edge research is being published in this field are about 5 decades old. Thus, these are not a new field of research from a holistic perspective.

The three intricately related sectors of Food, Energy and Water sectors are experiencing the need for such AI-ML interventions for (i) sustained production, (ii) optimized resource utilization, (iii) economically and financially rewarding supply chain management and (iv) wastage minimization including time and resources and (v) providing rapid solutions and automated predictive decision-making abilities.

This chapter explores the possibilities of intervention in the above 3 sectors by exploring production, processing, and distribution as this can be an expected norm during this Industrial Revolution 4.0 era. The global distribution of AI technologies and investments in farming, forestry and the marine/aquaculture sectors are illustrated in **Figure 1.**

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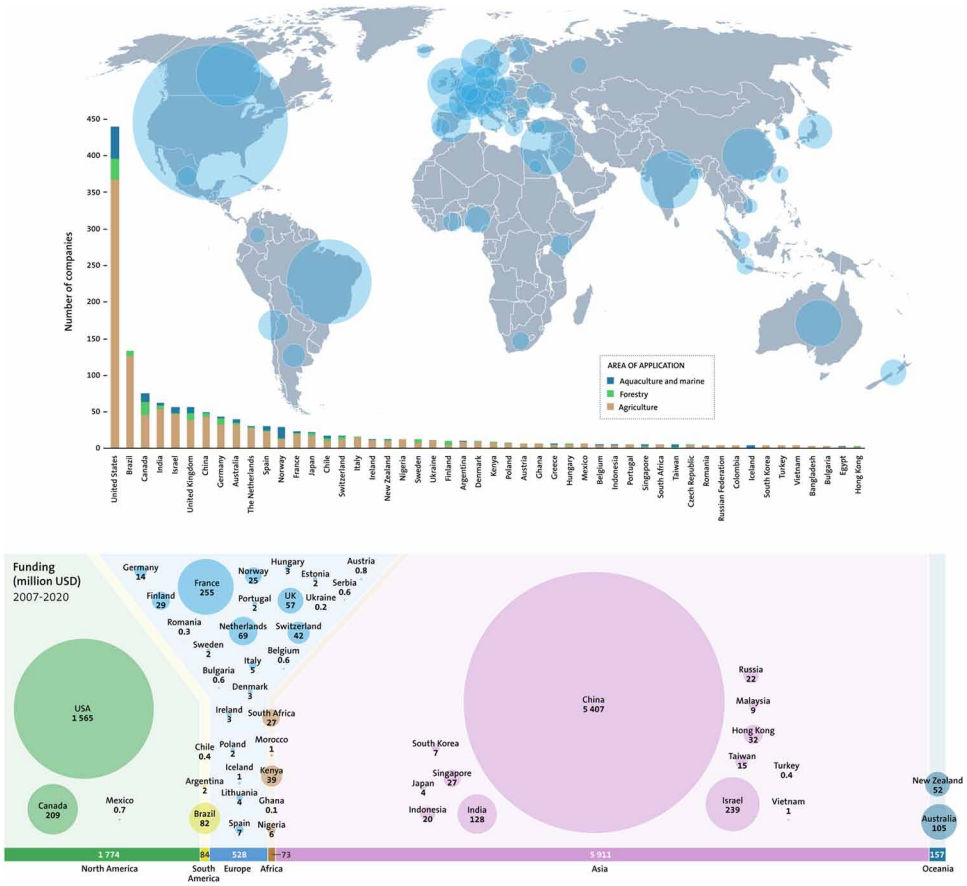
Figure 1. Global distribution of AI technologies and investments in farming, forestry and the marine/ aquaculture sectors. Fig. 1A. Geographical and sectoral distribution of companies that develop applications of IoT, sensors, robotics and AI-supported analytics for aquaculture, forestry and agriculture. Total number of companies N =1114. Fig. 1B. Geographical distribution of investments in companies listed in 1A. See Supplementary Information for details about methods and data (adapted from Galaz et al., 2021).



BACKGROUND

In order to understand how AI can drive innovations in the sectors of Food, Energy and Water, it is important to first review the historical perspectives of AI and each of these sectors.

Background: AI-ML

The importance of AI and its applications have experienced exponential growth in the last few years, due to (i) high computing speed, (ii) low cost of operation, (iii) affordable hardware manufacturing, and (iv) using a data-driven approach (due to an increase in the amount of data) to capture non-linearities in modeling. AI includes/spans a multitude/variety of subfields including computational intelligence, knowledge representation, logic, robotics, machine learning, and many more. Machine Learning, as seen, is a subfield of AI but draws its concepts from multiple fields such as AI, statistics, biology, etc.