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Information and Communication Technologies for Agriculture—Theme IV: Actions

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Aims and Scope

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Preface

The Fourth Industrial Revolution in the primary sector is captured by the term Agriculture 4.0, which represents the evolution of digital technologies in four aspects. The first aspect is related to the use of data, computing power, and connectivity aiming at the storage and systematization of the information collected leading to the rapid evolution of Big Data, Open Data, Internet of Things (IoT), Machine-to-Machine, and Cloud Computing. Decision Support Systems (DSS) are enabled through the use of IoT processes that integrate data deriving from various sensors and convert them to decisions and actions. These processes include the successful connection between different sensors, the collection of data as well as their processing in order to supply a DSS with all the required information. The simultaneous consideration of environmental, climatic, and cultural factors results in products of increased quality and in input reduction (savings on pesticides, fertilizers, energy, etc.) improving also the sustainability of agricultural systems. The second aspect is the introduction of "Machine Learning," which facilitates decision-making as well as machine performance from the constant collection and analysis of data. The third aspect concerns human–machine interaction through interface processes. Lastly, the fourth aspect involves all the innovative technology that is used for cost and energy rationalization through performance optimization including Robotics, Machine-to-Machine interactions, etc., facilitating the transition from the digital to real.

The above are the directions of Agriculture 4.0 which incorporate the transition to a new era of action in the agricultural sector. Farmers want to improve the sustainability of their production in all of its pillars (Environment, Economy, and Society) by investing on their business. Conventional agricultural practices were gradually improved by the introduction of precision agriculture while the further improvement of technology has led to Agriculture 4.0 which utilizes interconnected technologies that result to yield and sustainability performance improvement and to the increase of production and processing quality. Basic aim is the systematization and automation of agricultural processes leading to increased production. However, the present times call for immediate actions with respect to the transition of agriculture to sustainable agriculture. To that end, certain challenges must be addressed.

The Food and Agriculture Organization has identified these challenges that concern all three pillars of sustainability. Basic challenge is the increase of agricultural productivity in a sustainable manner in order to meet the increasing demand. However, towards that direction a sustainable natural resource base must be ensured. Sustainable agriculture should also address climate change and the intensification of natural hazards, preventing also transboundary pests and diseases. From the socioeconomic perspective, sustainable agriculture must aim towards extreme poverty and inequality elimination, ending hunger and all forms of malnutrition. The basic stimulants of human migration should also be addressed by improving income-earning opportunities in rural areas. Moreover, resilience towards crises, disasters, and conflicts should be increased while food systems must be made more efficient and inclusive. All the above call for coherent and effective national and international governance.

Many countries around the world adopt strategies towards sustainable agriculture. For example, the Italian Government based the development of rural areas on four critical domains. The first domain concerns the safeguarding of agricultural systems in terms of economic efficiency, profitability, sustainability, and stability with respect to crop, livestock, and forestry activities. The second focuses on the supply of environmental services together with the mitigation of climate change along with the preservation of natural resources and the protection of biodiversity. The third domain includes the continuous and undisturbed production of safe and high-quality food while the fourth involves the development of relationship between agriculture and local communities focusing on the improvement of the quality of life in agricultural areas.

The first chapter of the book **"Towards Sustainable Agriculture: Challenges from the Transition to the New Digital Era"** describes the challenges faced by modern agriculture in safeguarding food security and the need for transition towards the new digital era. A variety of innovative technologies that aim at addressing the challenges of modern agriculture in a sustainable manner are presented including precision agriculture and alternative farming while the importance of farmers' well-being is also addressed through an overview of ergonomics in agriculture. Additionally, the socioeconomic issues that arise from the adoption of technological innovations are discussed along with the most important factors that influence their effective integration.

Based on the experience, so far, from the application of cutting-edge technologies in agriculture, there is strong evidence that they can contribute to improving the sustainability of agricultural systems. However, for successful integration, the issues that arise when farmers adopt innovative systems need to be addressed. These technologies are constantly evolving, adapting to the growing demands of users, making it difficult for unfamiliar users to adapt immediately. Also, the cost of these technologies is another deterrent to their widespread application, especially in the case of small agricultural systems, as their complete economic and technical analysis is not yet sufficient. Taking the previously mentioned into account, the adoption rate may vary among farmers while there is still no consensus with respect to the attributes that favor or discourage the adoption of ICT technologies in agriculture.

Nevertheless, a positive relationship is observed between adoption and wealth, experience, education, participation in cooperatives, access to information, proximity, and size of farms as well as credit accessibility. It is undoubtful that ICT use requires basic computer skills from the farmers' side, while the role of specialists (agronomists, researchers, etc.) must be redefined as fundamental for successful guidance and training.

Nevertheless, farmers remain hesitant in adopting innovative technologies due to the still uncertainty of the poorly presented sustainability benefits. The delayed penetration of digital technologies in agriculture may impede the development of the sector in a regional and international level. Thus, and as a first step before investing in ICT technologies, farmers need to understand the potential benefits of this adoption in terms of improving the sustainability of agricultural processes. To this end, the chapter **"Sustainability in a Digital Farming Era: A Cyber-Physical Analysis Approach for Drone Applications in Agriculture 4.0,"** attempts to assess the integration of unmanned aerial vehicles (UAVs) in agriculture. The use of Unmanned Aerial Systems for the facilitation of precision farming operations constitutes a promising innovation as it facilitates the increase of production abiding by sustainability principles. Indicative application of drones in agriculture may include, among others, agrochemical spraying, livestock tracking, remote sensing of crop and soil health, field maturity, harvest readiness as well as crop insurance claims assessment. Moreover, the execution of monitoring tasks offers the most important benefits of drones' use. These tasks may include weed detection, assessment of nitrogen treatments on crops, biomass monitoring, water stress identification, and field mapping. Considering the severity of the consequences of water scarcity on crop health, the chapter focuses on the facilitation of drone use for sustainable farming processes, focusing on monitoring water stress providing information for precision irrigation. Two research questions are posed by the authors that are examined via a multi-method approach. The first concerns the benefits and challenges associated with the application of UAVs in farming operations. The second regards the applicability of "digital twins" in precision farming operations for ensuring water stewardship.

For the first research question, a critical literature review was performed in order to document the benefits and the drawbacks of UAV application in agriculture, while for the second a framework for the analysis of "digital twins" is proposed. More specifically, this methodological framework, focusing on UAVs, investigates the differences between the cyber space analysis and the physical space testing of digital technology systems. For that purpose, the water stress of individual trees was monitored with the help of an emulation modeling tool that captures a UAV navigating across a theoretical orchard. Using the model developed, two real-world pilot case studies were examined in field. The UAVs use carried sensors for water status monitoring of individual plants, feeding with information for precision irrigation. The chapter contributes to the field by promoting an operationalization perspective of digital technologies for sustainable agriculture. Simulations of real-world conditions along with pilot implementations can assist towards the realization of cyber-physical interfaces that lead to a more effective evaluation, facilitating the integration of drones in agricultural activities.

In the chapter, **"Digital Technologies in the Context of Energy: Focus on the Developing World Agriculture"** the relationship between agriculture, rural electrification, and digital technologies is investigated towards poverty alleviation, especially in rural areas of the developing world. The United Nations have recognized extreme poverty as one of the major challenges that world faces and rural development is acknowledged as an important contributor for the eradication of poverty in these areas. Agriculture, and the evolution of the processes and the technologies used can play a vital role, being the single most important economic sector in poor rural regions. To that end, the potential of investing on agricultural electrification is examined, as it can strongly affect the quality and quantity of agricultural production. The increasing of production leads to an increase in income, triggering further economic activities, promoting overall development. Digital technologies are very important in the realization of rural electrification as they can minimize costs of establishment, addressing also technical and non-technical issues that emerge in the operation stage. Consequently, their application should be pursued in order to rip most of the benefits in the future.

Achieving agricultural sustainability requires the holistic assessment of production systems in the entire value-chain which is the aim of the chapter **"A Circular Precision Farming System Towards the Optimization of Dairy Value-Chains."** The improper use of resources in agriculture (e.g., water, fertilizers, agrochemicals) that is usually related to conventional agricultural practices contributes to the majority of the adverse agricultural environmental impacts. The 10% of the total greenhouse gas emissions in the EU-28 are attributed to agriculture. Enteric fermentation from ruminants, manure decomposition as well as soil nitrification and denitrification are considered as the main sources. In particular, agriculture contributes to over 90% of the ammonia emissions with the number increasing rapidly from 2012. These emissions come at a great financial cost for EU as, for example, the impact of nitrogen pollution's environmental impact which is estimated between a total 70 and 320 billion euros per year. Considering the above, conventional farming cannot be characterized as cost-effective while it contributes to environmental degradation.

Farmers are very often unaware of the best practices that should be followed with respect to the optimal management of livestock and the associated crops. The value-chains created in that case are considered as non-optimal, while the lack of effective data handling and processing leads to inferior production systems. For this reason, it is necessary to convert the data into knowledge that can be used in decision-making. In order to bridge that gap, multidisciplinary expertise is essential to monitor and interpret interrelated agricultural indicators such as soil readiness, nutrient efficiency, product quality, and animal welfare. Digital transformation and the penetration of ICT technologies in agricultural supply chains have led to the development of a plethora of tools that mostly focus on partial solutions. However, a holistic approach is needed in order to provide to farmers with useful and actionable advice, towards efficient, consistent, and optimal results. Moreover, the simultaneous consideration of circular economy principles in the development of ICT technologies related to agriculture triggers the evolution of Circular Precision Farming Systems.

Such systems integrate all the elements that synthesize a farming system, offering the users a unified solution. The holistic approach of farm management results in input reduction via efficient resource management, improving the sustainability performance of production systems.

The chapter examines the realization of a Circular Precision Farming System. Its requirements and basic elements are presented for two agricultural production sectors: dairy farming and crop production. In such complex value-chains, as the ones created with livestock farming and the crops grown for feed, decision support systems are essential in guiding stakeholders towards appropriate actions in the entire supply chain. Tangible benefits include profit maximization, improved environmental footprint, and risk minimization.

Health and safety of workers is one of the most important indicators of social agricultural sustainability. The sector employs a very large number of workers around the world, while the advent of technological advances has considerably increased their quality of living. Nevertheless, the occupations of the sector can be still listed among the most dangerous. Agricultural workers operate under extreme conditions and working environments, while the nature of the tasks they perform is physically challenging. Depending on the working conditions, there is a plethora of health problems faced by farmers around the world, including respiratory, cardiovascular, and skin disorders, reproductive impairments, various types of cancers, heat and illnesses related to the use of agrochemicals as well as noise-induced hearing loss. Fatigue is also one of the most important factors causing health problems to farmers. The nature of the work they perform requires repetitive movements (e.g., bending, kneeling, and lifting) and also abnormal posture of the body leads to a high frequency of musculoskeletal problems. Furthermore, new sources of danger have emerged due to the mechanization of the sector, as for example whole body and hand-arm transmitted vibration, that induce new syndromes that require further examination.

Taking the above into consideration, the protection of agricultural workers requires actions for the reduction of the danger in the performed tasks or their replacement using engineering and administrative controls along with the ultimate use of protective equipment. The chapter **"An Analysis of Safety and Health Issues in Agriculture Towards Work Automation"** presents an overview of all the hazards and health problems related to the execution of agricultural tasks, further to the risk assessment and control measures towards their mitigation. Besides the development of effective management policies, the importance of the consideration of human factors and ergonomics in the solutions given is emphasized.

Safeguarding agricultural sustainability through the adoption of ICT technologies brings to the surface the need for integrated management of production systems. More specifically, in order to sustainably plan agricultural tasks, a thorough examination of agri-food systems is required. At the same time, the lack of awareness in the assessment of territorial values is emerging due to the increased farmland consumption. Considering the above, smart agriculture as a driver of sustainable agriculture should also be aimed towards spatial planning for its successful development.

The size of production units and agricultural holdings as well as their structure, in combination with land availability, the health of soils as well as the relevant availability of resources constitute the main factors with respect to the investment in innovative technologies. Smaller agricultural units imply smaller availability of financial resources for investments. Respectively, the reduction of production capital, with the loss of land or water due to urbanization, further diminishes the potential investments on sustainable practices, deteriorating the effective assessment leading to agricultural crisis. The implementation of sustainable spatial planning, in conjunction with the introduction of new generation smart farming, can contribute to the reduction of inputs through the effective management of cultivations.

The above, in the long term, can lead to increased food security as well as land protection not only through the preservation of non-renewable resources but also through the timely forecasting and treatment of adverse weather events, thus safeguarding the preservation of the landscape. It is therefore easily understood that innovative technologies provide opportunities for the effective spatial planning. The availability and interconnection of data can expand the development options considering also sustainability parameters. However, for the successful implementation and effective absorption of the above, cooperation and participation of all the relevant stakeholders, such as farmers and policy makers, is necessary.

Contributing to the above, the chapter **"Smart Farming as a Game-Changer for Regional-Spatial Planning"** aims at investigating the way that smart farming (and its evolution) can be affected by strategic planning and policy options while emphasis is given on the expression of the economic, social, and ecological policies of a region on its general spatial planning. The cooperation between farmers and policy makers should be promoted, aiming at safeguarding sustainable development through the improvement of food security. The so-called Strategic Farms, which are agricultural holdings that integrate ICT technologies in the cultivation process, can play a fundamental part towards that direction. The wider cooperation between stakeholders of different regions can effectively promote the adoption of the new concepts in the emerging strategies.

The 2030 Agenda for Sustainable Development and the 2050 EU's vision are enabled through contribution of regional/spatial planning towards the promotion of smart farming. Therefore, in the first chapter of the second part of the book, the effect of strategic development that focuses only on urbanization, on the developing trend of smart farming was examined along with the potential obstacles created for farmers. During the recent decades, industrial and commercial land uses (along with extended residential areas and construction sites) prevailed that of agricultural holdings. Nevertheless, the farmers' investments on innovations that improve the sustainability and quality of their products need to be appreciated during spatial planning by offering farmers of increased available land.

For the effective integration and development of digital agriculture, there are a number of primary issues, which are related to primary production and must be taken into account. These issues include the conservation of land, water, plant and animal genetic resources, biodiversity and ecosystems, the prevention of soil sealing, the confinement in change of available agricultural and forest and other semi-natural areas as well as the limiting of the transformation to urban artificial land. Addressing these issues is of utmost importance for smallholder farmers, being the foundations of spatial/regional planning, at a variety of levels. The study taking the example of Italy identified the gap between development strategies at global level and regional/spatial planning which impedes the efforts of agriculture towards achieving SDGs.

In order to address these challenges, a decision-making framework is proposed which considers a complex system for urban and regional planning. Basic aim is to incorporate smart farming into regional/spatial planning by identifying "Strategic Farms" as rural sustainable development factors. Preserving food security in soils used for agricultural production leads to further benefits related not only to the conservation of soil and water but also the protection from natural phenomena, thus enhancing the possibilities of enjoying the landscape. That is why the connection of agri-food systems with the corresponding soil systems reveals the way in which strategic spatial planning affects the availability of financial resources and consequently the willingness of producers to invest in innovative practices. Given the above, it is understood that in order to promote the penetration of the 4.0 revolution in agriculture, there must be progress at local, regional, and global level. Innovative technologies support the holistic management of agriculture and food systems. The vertical management of the agricultural industry without the simultaneous evaluation of land uses leads to irreversible results as in this way agriculture achieves its economic but not its environmental goals.

In summary, the first part of the chapter tackles with the future of the development of smart farming examining the most important concerns and opportunities along with potential strategy possibilities for planners and policy makers in Europe. Firstly, the Agenda 2030 key challenges for smart farming are presented which include the increasing of available food along with the achievement of higher quality standards with respect to safety, environment, welfare, energy, and climate change. Subsequently, and in order to guide farmers towards the digital evolution, the consequences of spatial planning on agri-food systems are examined. Finally, the inconsistencies between global development regional/spatial planning strategies are examined, as they form the framework conditions for the development of smart farming. Since farmers, through innovation, aim at improving the environmental and social performance of their production, their intention should be considered thoroughly during spatial planning, while possible approaches towards that direction should be made available to policy makers and planners.

Adding on the importance of regional/spatial planning, the chapter **"Agriculture in Latin America: Recent Advances and Food Demands by 2050"** investigated the potential of agriculture in Latin America. Having a quarter of the world's arable land and a third of the world's freshwater resources, Latin America and the Caribbean can become major contributors in achieving food security in the planet. To the above it should be added that these regions are responsible for 15% of the global export of agricultural products, being the world's largest net food exporting region.

More specifically, the chapter summarizes the current state of agriculture in Latin America, along with the most recent developments for the increase of production via advanced processes that simultaneously aim at mitigating the adverse climate and environmental impacts of agriculture. These advancements aim at maintaining food security for the continuously growing population, meeting the relevant demand projections for the year 2050. The issues elaborated in the chapter include the impact of these regions to climate change, the policies that are used to increase the production of food, the area suitability for agriculture as well as the projections on food demand for 2050, taking into account that these areas' population growth rates rank third below the Asian and African regions.

The chapter **"The Development Opportunities of Agri-Food Farms with Digital Transformation,"** having as a case scenario Italian agri-food farming, aims to provide a picture of the perception that agricultural operators have about the opportunities and limitations related to the adoption of intelligent agribusiness as a part of the digital transformation of agriculture. Authors analyze digital transformation to identify new approaches and opportunities in the agri-food sector based on integrating participatory planning and a novel approach based on suitable tools to acquire and process qualitative and quantitative information concerning the possible alternative scenarios of digital transformation. Results show that the Italian agri-food sector has begun to understand that digital innovation is a strategic lever able to guarantee greater competitiveness to the entire supply chain, from production in the field to food distribution.

However, it becomes clear that simply introducing technologies is not enough to generate results. Digital transformation requires social, economic, and policy systems to provide the basic conditions and enablers for digital transformation. It is worth mentioning here the "law of disruption" stating that although technology changes exponentially, economic and social systems change progressively.

Towards that direction the chapter **"Precision Agriculture's Economic Benefits in Greece: An Exploratory Statistical Analysis"** attempts to examine innovations in agriculture in Greece with the view of their economic benefits. Basic aim of the work is to group Greek regions with respect to the crop type, size of arable land, the process innovations used, and the eventual economic benefit. Three groups were identified. The first group includes the regions of Eastern Macedonia and Thessaly, where the largest agricultural plains are located (fields greater than 40 hectares). This group mostly consists of no horticulture crops, improved sowing, and improved plant disease prevention. Nevertheless, there are no improvements in the use of fertilizers, irrigation, and harvesting while no advancements are reported in labor productivity and the quality of the final products. Even though the latter are not as important as the former, the results indicate that the economic benefits of those regions derive from the availability of land rather than the implied application of innovative technologies such as variable rate planting/seeding (VRP/VRS) and UAVs.

The second cluster concerns the regions of Epirus, Peloponnese, and Crete which contains mostly no arable crops, arable lands below 20 hectares as well as permanent crops. No improvements in sowing are indicated by the research, but a series of less intense characteristics were identified including improved fertilizer use and irrigation. This group is mainly characterized by permanent crops and small arable land; however, only a small number of innovative technologies have been used recently (e.g., variable rate nutrient application - VRNA and variable rate irrigation - VRI) with no tangible economic benefits. The third and last group involves farmers in Western and Central Greece and mostly includes horticulture cultivations. This group applies improved harvesting, ploughing, and agricultural machinery use and demonstrates improved labor productivity, increased income, and quality of final products. In addition, precision agriculture (PA), machine guidance (MG), and UAV are also applied, making this group the only one with tangible economic benefits compared to the other two.

Taking the convention that a business can be characterized as innovative in case it applies at least one innovation in the last 3 years, it is conducted that Greek agriculture is innovative; however, the economic benefits are not calculable yet. More specifically even though all groups displayed innovation on the applied processes, only the third demonstrated economic benefits. The differences between the examined clusters are observed in the crop type and the number of innovative processes. The first group mostly includes arable and the second permanent crops while the third mostly horticulture crops. Simultaneously, in the first two groups two types of innovation are observed while in the third group, which includes the most benefited farmers of Western and Central Greece, there are three. Considering the above, the authors conclude that horticulture crops are considered as more productive, requiring less arable land than the other crops while greenhouses provide with safety against extreme weather conditions which is a major concern for farmers. Additionally, for economic benefits to start increasing, a minimum of three types of innovations should be applied in the farm.

The acceptance of the digital transformation of agriculture requires the successful dissemination of these technologies to the stakeholders through the establishment of interaction methods among users. The development of user-friendly interfaces can benefit the progress of smart agriculture. Simultaneously, the integration of innovative technologies into existing environments with the users that is already familiar can further assist to the diffusion of digital transformation. The chapter **“AI-Based Chatbot System Integration to a Social Media Platform for Controlling IoT Devices in Smart Agriculture Facilities”** introduces an easy-to-use, efficient, and safe framework for the operation of IoT agricultural devices in natural language dialogs, via the development of an intelligent Conversational Agent (chatbot) using Artificial Intelligence (AI). As a communication user interface, an instant messaging application of a popular social media platform is used. The users are offered with context-aware services with respect to monitoring and controlling agricultural facilities through question-answer sessions. Due to its technological readiness and features as well as its high penetration to mobile users, the messenger application of “Facebook” was chosen for the implementation. According to the conclusions of the research, the use of an intelligent conversational agent via a popular social media platform contributes to the maximum penetration of IoT technologies in the agricultural sector, in the most effective and user-friendly manner.

Familiarity with state-of-the-art technologies mainly concerns older farmers who need training to understand them and incorporate them into agricultural processes. Younger farmers are already familiar with ICT technologies in their everyday life, thus the use and the development of ICT technologies has to be integrated into their education programs in order to create effective and flexible learning environments. Flexibility in education is becoming in recent times imperative as certain external factors, as the COVID-19 pandemic, have created extra burden on institutions that struggle to safeguard the continuity of education. These new needs have increased the interest in online education even though its strategic importance in addressing global need of education has been stressed for decades. However, online education has fundamental differences from conventional teaching, and consequently new pedagogical approaches are required especially since until now little attention is paid during the development of online educational material.

A number of institutions worldwide have integrated online programs for resident and distance learning. However, mostly budgetary constraints impede the progress of the adoption of online learning platforms for many educational institutions. Online teaching and learning are considered as an opportunity to promote creativity, critical thinking, and entrepreneurship to students, modernizing conventional education. This is the reason why it is preferred mostly by higher education institutions. Nevertheless, the challenge is to discover the ways to efficiently introduce online teaching in educational programs. The above also apply for agricultural, biological, and engineering educational programs with the added challenge of obtaining the necessary resources (financial and infrastructure) for such courses considering their applicational nature.

Addressing the above issues, the chapter **"IT in Education: Developing an Online Course"** investigates the integration of ICT technologies in education. Towards that direction the elements of the learning environment for online teaching are presented along with the required outcomes and objectives that constitute the desired student behavior. For the enrichment of the above, the basics of learning theory are presented followed by the best practices that should be followed in delivering online courses. Moreover, the differences of instructional and curriculum design are presented, and also the guidelines for designing an online course. The chapter also provides with information for the flipped classroom concept and also the relevant tools that can be used for online teaching.

The chapter **"Assisting DIY Agricultural Robots Towards Their First Real-World Missions"** deals with the issue of the continuity of robotic skill sets obtained through high school and university level education practices that leads to a noticeable gap is between educational and commercial agricultural robotic solutions. This gap should be closed in order to promote future engineering careers, as it can be inferred by observing successful attempts that bridged education and future employment by moving educational effort to mass production. Considering the above, the chapter investigates the potential of transforming university level DIY robotic solutions to marketable products to be able to perform real-world missions. To perform considerable agricultural operations, these vehicles should at least have adequate accuracy and power. The recent advancements in the electronics industry has triggered the development of a large number of devices with a plethora of attributes at a reduced cost. The benefits of this increase in accessibility and affordability are ripped from both students that can develop marketable products in the context of their education and also from entrepreneurs that can design tailored products at lower prices. A project-based learning model (PBL) approach is built upon a previous work on creating/upgrading electric vehicles that can undertake light-duty agricultural tasks. The approach design was based on cost-effectiveness and avoiding complicated processes, focusing on the use of everyday, simple material and electronic components. In the context of the work, two applications are presented. The first concerns a vehicle that performs all-terrain soil-specific measurements and the other a robotic sprayer for fertilizers, pesticides, and herbicides. The basis of both platforms includes Arduino uno boards and raspberry pi units for more complex scenarios along with the use of navigation units (e.g., navio2 and pixy2 cameras). The vehicles were controlled through various methods (e.g., smart phones) while basic automatic control functions were employed. Simple Artificial Intelligence (AI) modules were also integrated in the testing process and both visual and textual programming interfaces were utilized for designing the platforms' logic. Wi-Fi was used for the majority or remote operation scenarios; however, for longer controlling distances, LoRa interfaces were also deployed. Lastly, the use of small solar units in order to increase the autonomy and efficiency of the platforms was also examined.

With respect to actions taken inside educational institutions for the evaluation of technological innovations, the chapter titled **"Evaluation of Spray Coverage and Other Spraying Characteristics from Ground and Aerial Sprayers (Drones—UAVs) Used in a High-Density Planting Olive Groves"** attempts to compare the performance of the most common ground sprayer types against a spraying drone in a high-density olive grove located in Perrotis College of the American Farm School of Thessaloniki, Greece. The work aims at addressing best-practice issues faced by farmers with respect to the accurate estimation of coverage percent, uniformity, drifting, etc. of spraying materials. The development of Unmanned Areas Systems offers new potential to farmers; however, these systems haven't yet been adequately evaluated with respect to their performance. In order to evaluate the spraying coverage and certain other characteristics Water Sensitive Papers and scanning software were used. The results highlighted the potential of drones with respect to material savings and efficiency increase, while important differences were observed between the different types of sprayers. Among the most important limitations of the use of unmanned systems is the deficiencies in the EU legislation.

The rapid progress of digital strategies has revolutionized conventional marketing tactics, thus in order to attract new potential customers, the approaches used within logistics sites must be re-evaluated. For efficient decision-making, developers, marketers, and designers need to take into account the complicated and interconnected behavioral characteristics of the users. Towards that direction in the chapter entitled **"Predictive Model for Estimating the Impact of Technical Issues on Consumers' Interaction in Agri-Logistics Websites,"** an identification approach of the various correlations existing between the variables which affect the efficiency of the digital marketing strategy is presented. Based on existing literature, the presented work sets as a hypothesis that the existing correlations between different web-variables have a direct impact on the efficiency of an agri-logistic digital marketing strategy. This hypothesis is considered with a view to prognosticate the most efficient digital marketing strategies that can be employed by agri-logistic websites and, as a second step, to enable the long-term forecast of digital marketing within the agri-logistic sector. A three-stage methodology is presented starting with the extraction of numerous web analytics from different world-leading agri-logistics websites followed by a statistical analysis for the examination of possible intercorrelations between the web analytics metrics, and finally a Fuzzy Cognitive Map (FCM) approach was implemented to build a predictive model as the basis for a process and agent-based simulation model for the evaluation of the consumers' interaction in agri-logistics digital marketing.

In conclusion, the fourth book of the series *Information and Communication Technologies for Agriculture* under the theme **Actions** investigates the implementation of cutting-edge technologies on real-world applications. From the compilation of the chapters presented, it becomes apparent that the penetration of ICT in agriculture can result in several benefits related to the sustainability of the sector. However, to yield the maximum benefits successful management is required. It must also be highlighted the importance of proper education in the adoption of innovative technologies starting from the adaptation of educational systems to the new era and moving to the familiarization of farmers to the new technologies.

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