

TECHNOLOGICAL ADVANCEMENT IN AGRICULTURE AND THE IMPACT ON ENVIRONMENT

Dr. Megha virmani Arya¹, Yavana Rani², Jayalakshmi Prasanna Kumary³

JAIN (Deemed-to-be University), Bengaluru, India

Email Id-¹dr.meghavirmani@cms.ac.in, ²dr.yavanarani@cms.ac.in, ³p.jayalakshmi@jainuniversity.ac.in

Abstract

Agriculture is among the most significant sector in India and is important for the maintenance and the growth of India's economy. Around 70% of the household & 10% of urban-population is reliant on Agriculture as the source of livelihood. Today, India is the largest producer of various agriculture products like coffee, tea, rice, oil meals, spices, meat, fresh fruits and fresh vegetable and its preparation & marine-product to an international market. The Agriculture Research System in India is a height of the process that was started in 19th century & resulted in establishment of ICAR (Indian Council of Agricultural Research) on the suggestion of a Royal-Commission-On-Agriculture in the year 1929. In the current research system, Indian-Council-of-Agriculture-Research (ICAR) at the National-level mainly help, promote & collaborate research & Education in India. Advancement in technology is the basic to coming future of farming because farmer struggle to feed world with partial natural-resource. The agri-tech solution helps to provide backbone to all over growth of Sustainable-Agriculturing & food-production. The investment is focused at agri-tech startup & disruptive market-newcomer. New technology, resources input & economic-incentive that leads to increase in agricultural production. The future technology development for food-production & handling system should be non-polluting, should reduce environmental & health-hazards & not inspire new-regulatory restriction.

Key words: Agriculture, Economic, Environment, Innovation, Sustainable.

Introduction

Agriculture is main land-use all over the world. At present approximately 1.2 billion –1.5 billion of hectares are under crop, with 3.5 billion hectare being grazed[1]. Agriculture is strength of economy of India that play the very important role in social and economic domain of the country. The production of farming has 4 (four) main sustainability metrics- Productivity, economic viability, environmental impact and social well-being. In today's scenario, the greatest challenge is to provide sufficient food supply to world's population. The environmental impact of Agriculture (Figure1) in various farming practice have on ecosystem and how that effect can have traced to the agriculture practice. The impact on environment of agriculturing vary broadly based-on practice employed from farmer and by the scale of practices. Agri-practices which tries to lessen impact on the environment by altering the practice will follow Sustainable-Agriculturing practice. The main developments are placing pressure on the consequence of agriculture model in fulfilling the needs of future are: natural resources scarcity, climatic-change & food waste. These all are increasing hunger and food scarcity problem. When analyzing the environmental-impact, expertise uses two different types of indicator; mean-based, that is dependent on grower's production method & effects-based that is the impacts of farming method on agriculture-system. Example of mean-based method is the superiority of groundwater that is affected from presence of the nitrogen in soil. Indicators detecting the damage of Nitrate to ground-water is "effects-based". Means-based assessment looks at the farmer's practice of agriculturing & effects-based assessment comprises actual-effect of agriculture-practice. The "mean-based" analysis on pesticide & fertilizers method that farmers use and "effect-based" assessment considers what amount of Carbon-di-oxide is emitted and what content of Nitrogen present in the soil [2].

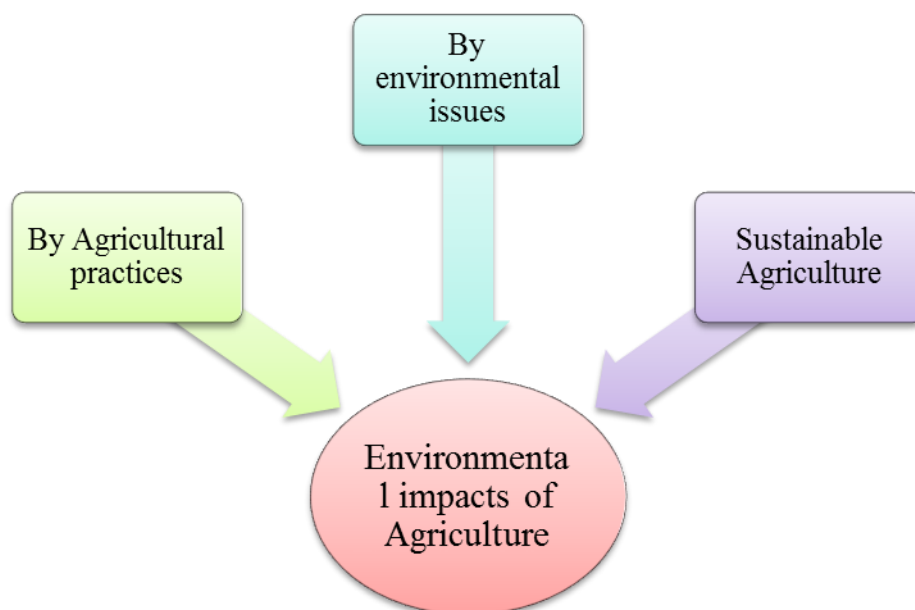


Figure 1: Environmental impacts of Agriculture in Different Farming Practices that on the Ecosystem.

The impact on environment of Agriculture comprises various impact on number of factor- soil, air, water, animal & soil-variety, plants, people & food itself. Agriculturing adds to large sum of environment degradation issue like- climate change, irrigation, genetic engineering, soil pollutants and waste. Sustainable-Agriculture is an idea that Agriculture must follow ways so that we could continue to yield what is essential without damaging on capability of future-generation to do same. In today's decades, Rapid population had increased the practices of the Agriculture land-conversions to fulfill needs for the food that in turn have increase the effect on Environment. Agriculture could give negative impacts on biodiversity also. Organic-farming is multi-branched sustainability agricultural set of practice that have least impact on environment at small-scale. Organic-farming result in less produce in terms of production/unit/area. The practice of organic-agriculturing require further land area that be clear & water-resources removed to meet the same-level of making[3]. To meet all the challenges government, investors and innovative agriculture technologies will require efforts.

Technological applications to agriculture productivity is believed being the solution that fulfil food demands of the increasing population. Agricultural output requires 70 percent rise of production level & effective growth in the harvesting and distribution & in-take of resource to fulfil the demand the demand of rapidly increasing population. There are different inventions in Information & Communication Technology which can applied in agriculture sectors in area of precision-agriculture the use of the farm-management software; use of Agricultural-machinery and wireless sensors. Remote-sensor technologies have an important role by precision-agricultural practices. The paper highlight the advances in technology in Agriculturing by use of aerial-vehicle for the images capturing, its processing & its analysis. Agriculturing-development is not enough for our country's economy to develop from Agriculture to its emerging states. There is strong relationship between agriculture development & non-farm sector. Like: supplying food & its processed material & labor by farming and demand to product & services providing by non-farm sector in rural-area. In Figure 2, Alain de Janvry, et al.[4] and Estudillo & Otsuka demonstrate that how the technological innovation in Agriculture & irrigation which leads to the Green-Revolution that affects rural households' earning directly from enhancing the efficacy and productivity of agriculture & indirectly from growth-linkages effects on the non-farm sector & change in prices of agriculturing products[5].

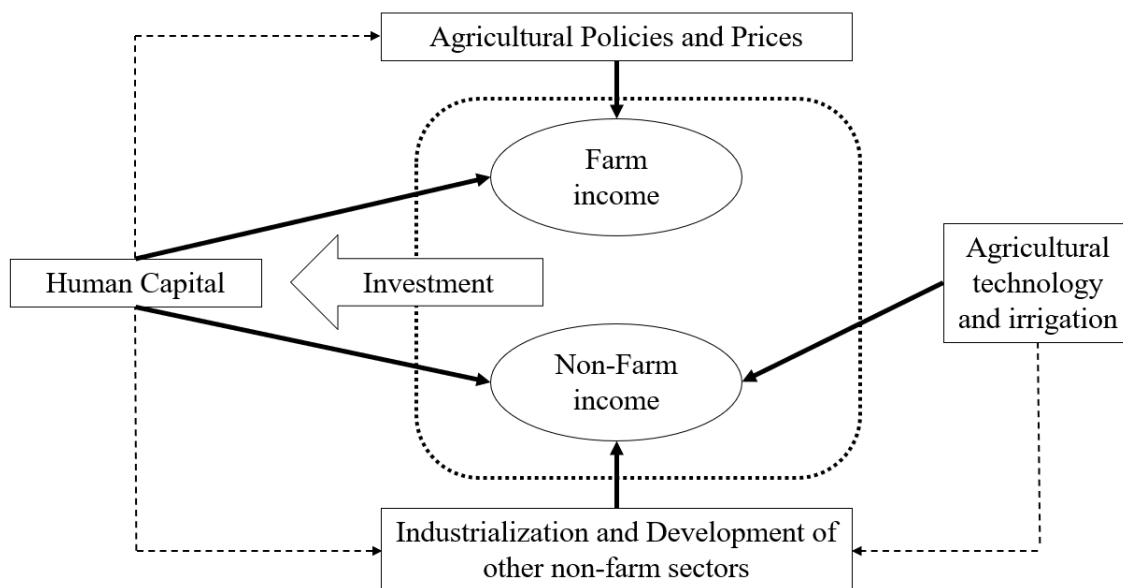


Figure 2: Technological Innovation, Technology Transfer and Area of Development in Agriculture

Advancement in technology like- devices, sensors, machines & information-technology, Agriculture and Farm operation will have to be run in very different manner. Future agricultural use advance technology such as-temperature & moisture sensors, robots, ariel images & GPS technology[6].

The advanced device & robotic-system will allow farm to be extra environment friendly, efficient, profitable and safe. Innovation of new technologies is a major mechanism in socioeconomic development especially ecofriendly innovations that increases production and the effective use of natural resources also. The use of different technologies in agriculture increase the growth & development with effectual yield through various process. The subsequent impacts of technology use & innovation can have achieved in declining poverty by rural-development. Increasing productivity and improving the income of farmers in the agriculture are the main goals of the industry in agriculture.

Literature Review

The usage of innovation technologies in world economy is a defining factor in race and gives highly impact on the agricultural industry. Innovation is main mechanism in social & economic growth particularly ecofriendly innovation that stimulate production and a well-organized use of natural-resource also. J Pretty[7] studied the principles and concept of agriculture sustainability and emphasis on genotype improvement through modern ecological approaches and the improved understandings a benefit of ecological & scientific-agricultural organization, redesign and manipulation. Neill Schaller[8] discussed the reason for growing interests in agriculture sustainability. Sustainable agriculture is a general term to people who are interested in environmentally-beneficial & healthy farming and also to people concerned with their economic & social dimension. The idea of sustainable-agriculture is the destination of agriculture that could move it to meet needs at both ends. Papageorgiou[9] studied that agriculture sector has to re-establishment which is based on the principle; sustainable agriculture that adds up to agriculture effectiveness & the re-established use principle of sustainable-agriculturing and show proper respect to the social, economic & environment characteristic of region.. Rigby and Caceres[10] examined the organic-farming and its relationship to various alternative agricultural practices. To those who do-not see sustainable-agriculture as necessary indicating the end of largescale farming, who appreciated the sector's continuing to provide food for an urban-population that has little or no-contact with agriculture producer, the greater regulations & protecting of standard is critical.

As per future prospective, agriculture sustainability had restricted entirely to search for possibly more sustainable agriculture practices. These practices have also emphasized on the crop and livestock that are

currently in each producing area. All requirements of sustainability- resource conservation, environment protection and farming with nature will enhance the global food production not reduce. There are around 570 million farms in the world, funding circles in technology-innovation in agriculturing & the food chain value has increased about like \$570 million in the year 2014[11]. Much of the investment is engaged at agri-tech startup & disturbing market new-comers, need remains almost same as ever – the invention in the use of resource, specifically in the terms of land & water & energy also for boosting competence & profits. The growth of agriculture food industry & combined supply-chain with globalisation, high-tech & business developments & environment effects all have expanded the scope of Agriculture. Also, world's economy crises in recent year have reveal a lack in application & sustainability of current-growth model & agriculture strategy. New-structural solution is therefore required. Apart from all issues, the modern-growth-theory consider high-tech changes as the appliances of economic enhancement. This use of technologies will contribute considerably to countryside enlargement and decline in a poverty. Development in science, engineering and technology are major implements that help to reach the goals and bring to the changes that stated above.

Innovation is a good idea and is more than the technology. Innovation is a process where individual or organization that brings new/existing products and processes or the way of organization in use for first time. Agriculture cut all scopes of invention-cycle along with the whole valuable chain from- crop, fishery, forestry or live-stock production to management of input & resource to market-access. The American Seed Trade Association (ASTA) & Biotechnology Innovation Organization (BIO) both together launched Innovator. This novel platform will inspire a significant and attentive discussion around innovation in food and agriculture and the real profits bringing to our planet, health and food. It is possible for farmers to utilize scientific data and technology that increase crop-yield & keep themselves up-to-date by cutting-edge method of agriculture.

Ag-tech application to agricultural yield is the key to achieve food demand of the increasing population. Agricultural productivity needs 70 % growth in manufacture level and proficient development in the harvesting, consumption and its distribution of the resource to fulfil the needs of fast-growing population. Inventions in Information & Communication Technology which can be helpful to agriculturing sector in different area of the sustainable agriculture, the usage of the farm-managing software, the use of the agriculture machinery & wireless-sensors. Remote-detection technology has an important role in sustainable farming. Novel technologies, source effort and profitable inducements will result in rise in agriculture production. Advanced high-tech developments for food processing and other practices should be non-polluting, lessen environmental hazards and should not reassure new regulatory forms.

Research Questions:

1. What are the advancements of technology innovations in Agriculture?
2. How sustainable agriculture helps in socioeconomic issues?
3. What is the impact of technological innovations on environment?

Discussion

Advancement in technologies are the future of agriculturing because farmer make every effort to feed all over the world with inadequate natural resources.

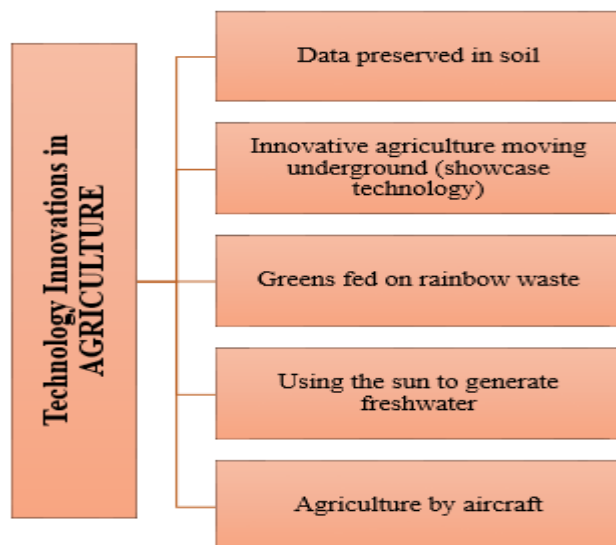


Figure 3: Illustrating the Advancement in Technological Innovation in Agriculture

New-technologies, resources input & economic-incentives will result in increase in agriculture productivity. Future-technological-development for food-processing and other practices must be nonpolluting, reduce environmental-hazards & must not inspire new controlling check. The priority of this study is- Innovation in resources in term of land, water and energy that increase the efficacy and yield. Figure 3 represents the five ag-tech startup solutions that are useful to support world's development of sustainable-agriculturing & the food handling is:

1. Preserved data in the soil:

The primary need of old agricultural models is obtainability and appropriateness of land. The African-Soil-Information-Services (AFSIS) is emerging soil-maps by using novel analysis, field trials, statistics and crowd-sourcing. Inventive-farming idea like: mapping of soil digitally is the key in planning sustainable agriculture development & natural resource management. These all map are openly present to get explored on the Google-Earth.

2. Underground moving inventive agriculture:

The underground agriculture has big advantages over traditional practice. Farmers can deliver fresh produce to a large urban market by situating within a major city. They have no pests, so they don't need to spray pesticides and they never have to worry about the weather. The use of technologies in farming advances growth & expansion with active manufacture by said processes. Cultivation by means of hydroponics are developed at twice more than speed of the normal creation. In this process, specific LED lightning device is used to enhance the process of photosynthesis.

3. Rainbow waste green fed:

Embracing a moral circle of interchange is one of popular invention in the agriculturing. Hydroponic is method that uses water enriched with mineral. Aquaponics are getting fish farming & plant farming together in the recirculating system. Fish offers almost of the plant's nutrition of aqua-culture sewage which in reverse fish wastage metabolite is detached by direct-uptake & nitrification by the plants by appropriately preserved water and then curving to back to the fish. This innovative farming idea requires a smaller amount of water as compared to horticulture's traditional agriculturing. At Bioaqua Farming, (Blackford) which is in the Somerset: the biggest combined aquaponics farms in the Europe: vegetable is grown & Rainbow Trout's rear organized in an organic association lacking the chemical/pesticide but by help of the bees & the worm.

4. Usage of solar-energy to generate fresh water:

The main trend in the farming are increasing the water proficiency in farming & food-production. The point is that 71% of our earth planet is covered with the water still there is water scarcity. Sundrop Farms is one of the innovations in agriculture that draws on rare renewable-resource in rich supply than sea-water- sunlight. Sundrop Farm harvest solar power to produce energy for purification to supply hydroponics greenhouse. Sundrop farms reduces dependence on finite natural resources when compared to conventional greenhouse production (Figure 4).

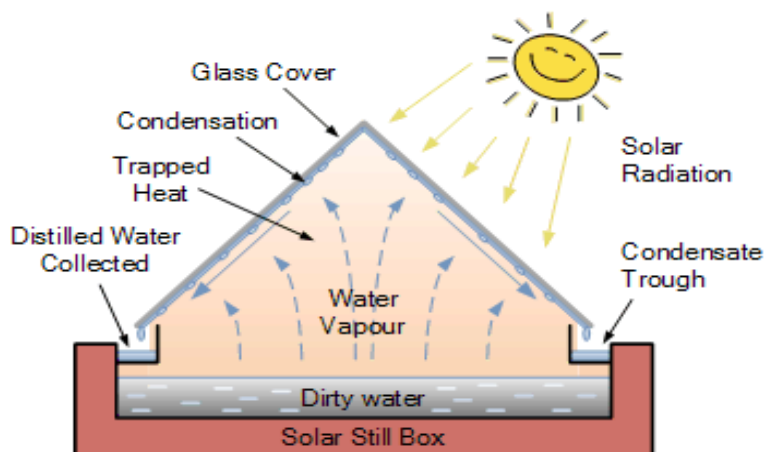


Figure 4: Freshwater production using sun, a new technological innovation in Agriculture

5. Agriculture by aircraft:

Aircrafts are becoming an important element of the agriculture industry. The use of agriculture aircrafts is generally for crop dusting, fertilizer spraying, spreading insecticides, topdressing and hydro-seeding. Crop dusting is also known as aerial-application in the agriculture industries & is one of the keys to modern efficiency in agriculture. There is a need to increase efficiency, cost-effectiveness, environmental compatibility and safety of such aircrafts. Aircraft design are limited to conventional fuels and tube wing configurations.

Conclusion

Innovation is the main mechanism in social & economic growth particularly ecofriendly innovation that stimulates production and effective usage of natural-resources. As changing political, economic and environmental condition in world, innovation now support high values in organic raw-material with in a series-processing then packaging then storage then delivery & distribution of the food after the production & food-safety. Accordingly, the use of machinery in farming speed up the growth & development with the effective making through defined process. The eventual effect of technology use & innovation can have achieved in lessening poverty over rural development. A conceptual framework must have established for modernization, mainly for the use of machinery. In R&D & scope the farmer must obviously appreciate that how growth of and application of invention will allow possible influences in agriculture. R&D's goal should not be limited to particular percentage of budget-distribution. It should be valued that the contribution of science in the society are amongst most significant basics to sustain agriculture production.

Increasing productivity in agriculture, improving the income of farmers, declining poverty & rising rural area as well are not inaccessible goals. Income growth amongst small-farmers and corporate companies as well in the agriculture industry & food-chain that will convert into a significant development in social benefit in country. Thorough and inclusive studies & plans are desired to rise efficiency and decrease poverty in rural-areas with the development. Considering the well-organized use of natural-resource, food-security & the effect of climatic change, taking-action in no time become authoritative. Various technological advancements such as- sensors, machines, devices and information technology, Farm house and Agriculture operation will have to be run in very differently. Future farming will use advanced technology such as: moisture, robots & ariel images,

temperature sensors & GPS technology. These devices & robotic structure will allow farm to be further environment approachable, cost-effective, proficient and safe.

High-tech application to agricultural yield is solution to fulfil food demands of increasing population. Agricultural productivity requires 70 % growth in making levels & proficient development in harvesting & marketing & in-take of resources to fulfil all the demands of rapidly growing population. Various inventions in Information & Communication Technology that can useful to agriculturing sectors in the areas of precision-agriculturing, the usage of farm-managing-software, use of wireless sensing technologies & agriculturing machine technology. Remote detecting machinery is playing an important role by precision-agriculture. The paper identifies the way in which precision-agriculturing which is affecting on agricultural practices by use of ariel vehicles for imaging, handling & examination. Innovation in technology is significant to future of agriculture because farmer make every effort to feed all over the world with restricted natural resource.

New technologies, source effort and profitable inducements will result in rise in agriculture production. Upcoming high-tech developments for food processing and other practices should be non-polluting, lessen environmental hazards and should not reassure new regulatory forms. The importance of this study is Invention in sources in term of land, energy & water that rise the effectiveness & produce. There are 5 hi-tech solutions that are helping to support worldwide expansion of sustainability farming & food manufacture preserved data in the soil in the form of maps, underground innovation of agriculture by means of hydroponics with LED lightning for photosynthesis, greens that fed on rainbow waste without chemicals or pesticides, use of sun to generate freshwater by means of Sundrop farms, agriculture by aircraft my means of various sensors and drones. Technological inventions have significantly shaped agriculture during the course of phase. By the making of the tool to Global-Positioning-System (GPS) focused on precision-farming equipments, human have developed new way to make agriculture more effective & grow more food. A technological uprising in farming is controlled by advancement in robotic & detecting the technologies look set to interrupt modern practices. Main technology innovation in space have focused everywhere such as: automation & robotics, vertical indoor farming, live stocks technology, precision agriculture, up-to-date greenhouse practice & the artificial intellect & the block-chain.

Innovations are very significant in recent agricultural practices than ever. The agriculture industry is fronting large challenges: inaccessibility-of-labor, rising costs of supplies & change in consumer preference for the transparency & sustainability. There is growing appreciation from cultivation establishments that solution is needed on behalf of these concerns. From sustainable urban-growth to capitalize on crop produce with cheap employment costs, the advantage of indoor-vertical-farming are deceptive. Vertical-farming can regulate variables such as humidity, light and water to accurately measure year round, growing food manufacture with consistent produces. Farm robotics related with ‘smart farming’ is technology which make farm more efficient & computerize the crop/livestock manufacture cycle. Increasing companies are functioning on robotics-innovation to advance drones, self-ruling tractor, automatic watering, robotic harvesters & seeding robot. At the present time, in huge part due to incredible latest developments in increasing technology, industry is observing a growing like never before. Greenhouse today are developing on a large scale, capital infused & urban centered. The aim is the farmer can practice artificial-intelligence to achieve the goals of a better-harvest by making better-choices in field.

References

1. S. M. Howden, J. F. Soussana, F. N. Tubiello, N. Chhetri, M. Dunlop, and H. Meinke, “Adapting agriculture to climate change,” *Proceedings of the National Academy of Sciences of the United States of America*. 2007, doi: 10.1073/pnas.0701890104.
2. H. M. G. Van Der Werf and J. Petit, “Evaluation of the environmental impact of agriculture at the farm level: A comparison and analysis of 12 indicator-based methods,” *Agric. Ecosyst. Environ.*, 2002, doi: 10.1016/S0167-8809(01)00354-1.

3. V. Seufert, N. Ramankutty, and J. A. Foley, "Comparing the yields of organic and conventional agriculture," *Nature*. 2012, doi: 10.1038/nature11069.
4. K. Otsuka, "Technology Transfer and Agricultural Development: A Comparative Study of Asia and Africa," 2019.
5. A. De Janvry and E. Sadoulet, "World poverty and the role of agricultural technology: Direct and indirect effects," *J. Dev. Stud.*, 2002, doi: 10.1080/00220380412331322401.
6. M. De Clercq, A. Vats, and A. Biel, "Agriculture 4.0 : the Future," *World Gov. Summit*, 2018.
7. J. Pretty, "Agricultural sustainability: Concepts, principles and evidence," *Philosophical Transactions of the Royal Society B: Biological Sciences*. 2008, doi: 10.1098/rstb.2007.2163.
8. N. Schaller, "The concept of agricultural sustainability," *Agric. Ecosyst. Environ.*, 1993, doi: 10.1016/0167-8809(93)90016-I.
9. A. Papageorgiou, "Sustainable development as a solution to agricultural competitiveness: The case of Greece in the era of European integration," *J. Cent. Eur. Agric.*, 2012, doi: 10.5513/JCEA01/13.3.1072.
10. D. Rigby and D. Cáceres, "Organic farming and the sustainability of agricultural systems," *Agric. Syst.*, 2001, doi: 10.1016/S0308-521X(00)00060-3.
11. Jim McClelland, "Top 5 tech innovations in agriculture," 2015. file:///C:/Users/admin/Desktop/Top five technology innovations in agriculture.html.