



## OPERATION RESEARCH IN AGRICULTURE

**Abhishek Purohit, Lalitha Manogna Kasturi, Sahil Nath Kohli  
Vihaan Kenia, Mukesh Udeshi**

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### ABSTRACT

*This paper is the analysis of 25 research papers combined on the topic of Agriculture. The paper aims to showcase how Operations research in agriculture and various other factors play a key role in the development of the Agricultural Industry*

**KEYWORDS:** Agriculture, artificial intelligence, electric tractor, forestry, multi-robot, operational costs, ploughing, agricultural exports, agricultural vehicle, automation, autonomous vehicles, business survey, China, covid 19, decision tree classifications, GSNN data, international trade, machine learning, mixed reality, Mr, pandemic, situational awareness, tractors, vehicle operation mode, wearable headset, agricultural robot, machine vision, smart agriculture, vision navigation.

### REVIEW METHODOLOGY

The literature selected in this work was from Jstor, Science Direct, and Research Gate databases. The keywords used to find the particular papers mainly include the terms “operational research in agriculture”, “operation research”, artificial intelligence”. These terms were used in the same ways in the said databases to obtain the research papers. The publishing time of the selected literature in this work is from 1958, 1965, 1977, 1980, 1982, 1992, 2012, 2013, 2014, 2019, 2020, 2021, and 2022. Finally, we have chosen 25 research papers from various publications and provided insights based on the bibliometric analysis in the coming part of the paper.

### LITERATURE REVIEW

The literature review comprises the summaries of the chosen 25 research papers based on agriculture.

All the chosen papers revolve around the use of agriculture in the modern world in various ways and how agriculture is a whole all around the world.

All the papers taken oversee how agriculture is helping various categories and what all technological changes happened over the past years

The various key points are:

- Studies were done on the Growth Rates of peas and the study was done for all the months during the season and different kinds of varieties
- Methods of research have been both analytical and synthetic, Different agricultural methods may be compared by operating them side-by-side on different small- holdings on the experimental farms.
- The Growth Rates of peas and the study was done for all the months during the season and different kinds of varieties. After the study was done on planting

program was devised to analyse and read the maturity of peas in succession at a daily rate (Within the capacity of the harvesting and processing departments). So that the crop could be harvested in prime condition.

- Specialties of operation research, which include sequencing, scheduling, and queuing, could become important in large-scale agriculture. Potential applications of operations research in farm management are probably far greater than we realize.
- Operational research in the agricultural industry and introduces a selected bibliography. One of the opportunities is INVENTORY CONTROL, REPLACEMENT MODELS, RESOURCE ALLOCATION, SEQUENTIAL DECISIONS, UNCERTAIN EXPECTATIONS, And MODEL BUILDING.
- The role in encouraging change by making greater contact with agriculture specialists, university departments, and colleges to encourage them in agriculture.
- Aspect is related to quality standardization, in which some degree of successful activities is being observed at the moment. . The promotion of trustful relationships with local partners is crucial to minimizing environmental risks and providing substantial feedback to newly introduced business models.
- Agricultural market analysis will remain a vibrant research field. Demands for stronger vertical coordination in the food system as a means of satisfying increasingly diverse consumer preferences are changing the landscape facing food supply chain



participants, Advances in econometric methodologies and computing power give contemporary researchers great advantages over their predecessors, but these tools must be used wisely

- Good prospects for OR in the agricultural sector because of increasing competition for natural resources, the importance of sustainability and viable ecosystem services, and producer and industrial integration. New opportunities for OR may involve: better predictive modelling of the natural resources system's bio-economic behaviour; better predictive modelling of the decision-making behaviour of actors in the natural resources system; multiple stakeholder decision analysis, optimization in a more complex business environment with more opportunities as well as legal constraints; and the conversion of increasingly abundant data into real-time, robust and relevant managerial information.
- AR system is to be used in an agricultural multi-robot system of two robots to improve the situational awareness of a human supervisor, The implementation required the real-time communication system from both robots to the AR system and in addition, an external camera system was required to measure the orientation of the headset in the tractor frame.
- Agricultural cooperatives have played an important role in the process of agricultural modernization development characteristics of national agricultural cooperatives from the perspective of supply chain integration, focused on summarizing the operation mode and development experience of these national agricultural cooperatives in the agricultural product supply chain and innovated production and operation methods for agricultural cooperatives in the supply chain environment
- The impact of COVID-19 pandemic on agricultural exports, over exports during the pandemic, grain and oil exports still held strong and even increased, implying the essential Demand for staple food the agricultural industry faces various challenges such as lack of effective irrigation systems, weeds, and issues with plant monitoring due to crop height and extreme weather conditions. But the performance can be increased with the aid of technology and thus these problems can be solved. It can be improved with different AI-driven techniques like remote
- Development and application of algorithms for automatically detecting the operation mode of agricultural vehicles (e.g., for the automatic adjustment of tire inflation during transport on the road or operational field work) based on GNSS data collected with two different GNSS receivers that differ concerning model and correct data sources (EGNOS and RTK).
- When evaluating the analysed papers, the main conclusion is that current research does not solve the challenges of multi-robots in agriculture swarm

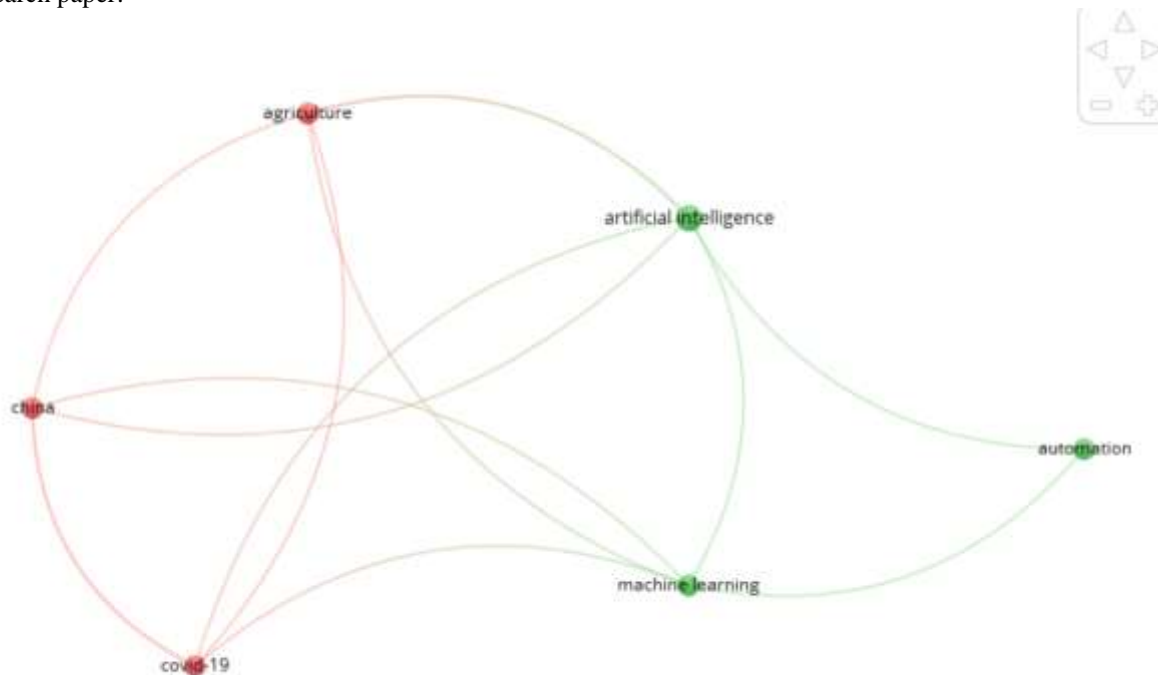
configuration. Instead, it presents obstacles that must be overcome to fulfil the multi-mission defined by agricultural mechanization operations. In this way, these challenges are suggested as objects for future research focused on implementing swarm robots in agricultural fields aiming at mechanized operations. Therefore, this initiative can constitute a roadmap for inter-institutional and trans-disciplinary research bringing together the scientific community dedicated to robotics. It will be able to implement innovative and essential research so that this proposal goes off the record and becomes one carried out in the agricultural world.

- The study found that the monocular camera has the most applications in agricultural robot navigation, However,
- When faced with complex environments, such as curved paths and uneven terrain, a lot of studies choose depth sensors since depth information can help robots accurately perceive complex environments. Among depth sensors, the structured light camera is the most widely used. Because it is complicated for the stereo camera to obtain depth information, and the tof camera has strict distance and sunlight limitations. At present, some tof cameras are equipped with strong infrared light sources have appeared, which may make more researchers choose the tof camera.
- There is rising academic interest in AI usage in sustainable agriculture, drastically improving from 2019 to 2020. China, the USA, and Australia are leaders in producing top works of literature and authors in the domain. By analysing the results, it can be determined that there is huge potential for the application of AI to attain sustainability, especially in predicting the yield, crop protection, climate control, crop genetic control, and produce supply-chain, wherein the prominent researchers and institutions need to collaborate further and form more networks to bring radical progress in the field.
- Agricultural Routing Planning (ARP) is the process of determining the best route for agricultural machinery in the field. The objective function and limitations were shown in a variety of ways. Among the objectives include minimization of each machine's total finish time, optimization of each vehicle's input cost, task time, and capacity utilization, and minimization of each machine's non-working distance to cover a field. ARP's overall goal is to reduce the cost of machines used to perform agricultural tasks in the field. The common method used to solve the ARP is Clarke-Wright, Genetic Algorithm, and Tabu Search. A hybrid algorithm is also a promising approach to solving ARP. ARP has recently been used in a variety of applications, including orchard fields, vineyard areas, biomass areas, and sugarcane farms.

### TECHNIQUES OF OPERATION RESEARCH USED

Operation techniques used	Titles of the research paper	Author	Year
LINEAR PROGRAMMING PROBLEMS	Artificial intelligence solutions enabling sustainable agriculture: A bibliometric analysis	Bhagat; Naz ; Magda	2022
TRANSPORTATION	Operations Research for Agricultural Pest Management And other 24 papers as well	Feldman; Curry	1982
RESOURCE ALLOCATION	Application of Operations Research in Farm Operations and Agricultural Marketing And other 24 papers as well.	Snyder; Snodgrass, French;	1958

**BIBLIOGRAPHIC ANALYSIS :** The following figure represents the connection of the main keywords from all the collected research paper.



**Figure 1: Interlinking of all the research papers collected.**

In Figure 1, agriculture is interlinked between AI, China, machine learning, covid 19 which shows that over the years agriculture is closely being related to all particular areas.

Automation is available only in machine learning and AI. There is a low dependency on automation in agriculture as a lot of manual work goes into this.

China being one of the largest countries in the world, here represents how agriculture, AI, and machine learning have helped their growth in agriculture but similarly also shows that it has been impacted by COVID-19.

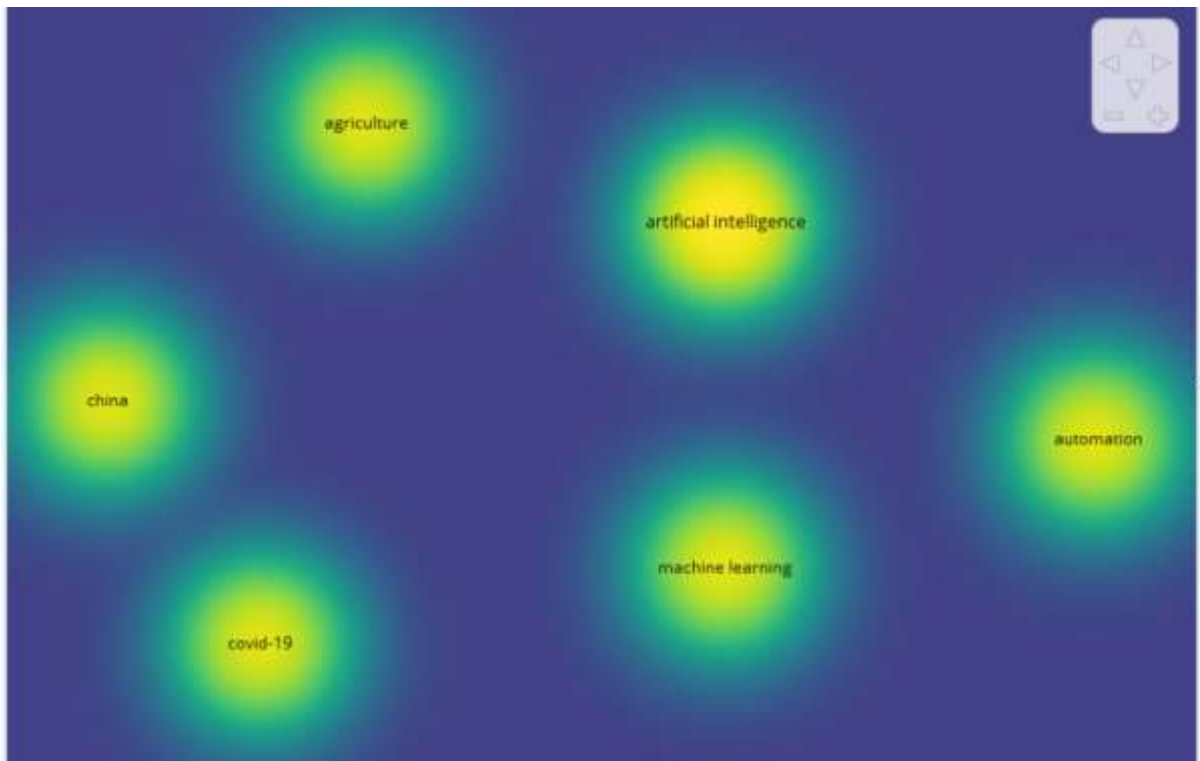


Figure 2: Weightage of the chosen research papers.

Figure 2 explains the weightage of the papers in the particular paper, there is a high density of Artificial Intelligence when compared to all the other categories which indicates that there

has been the use of AI in modern-day agriculture and the other categories as well.

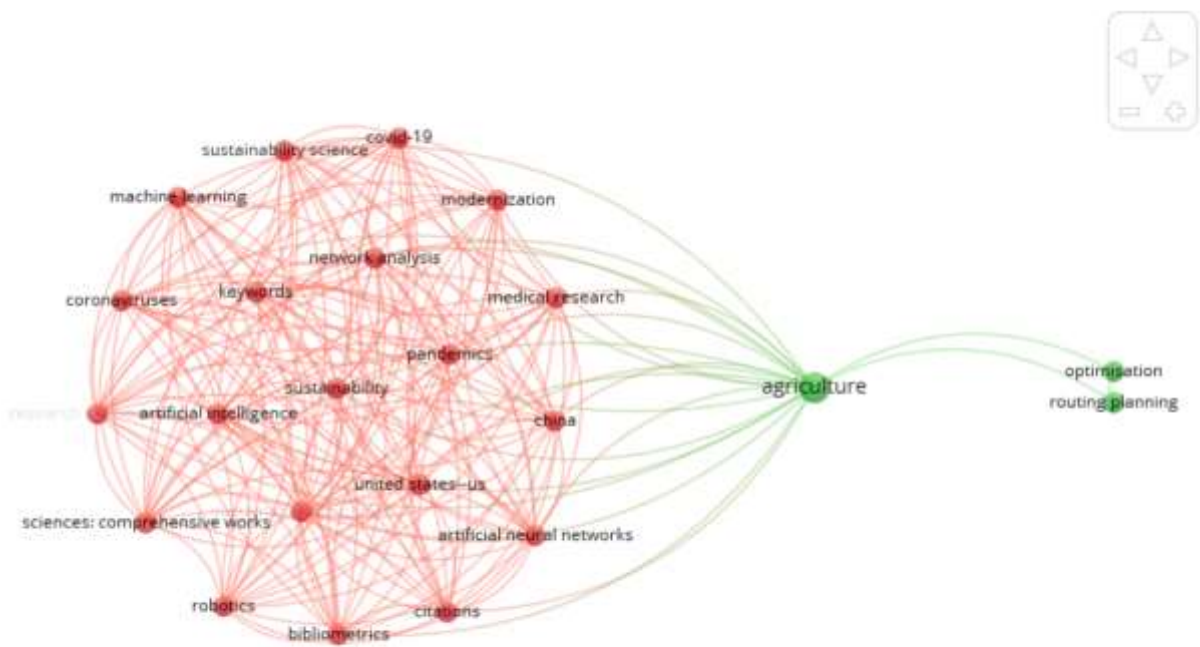
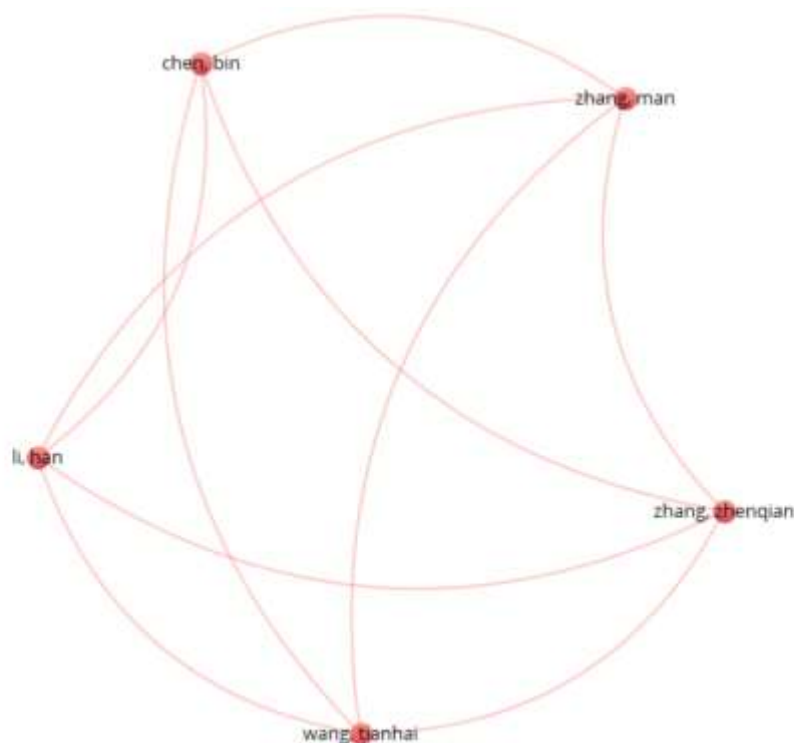


Figure 3: Interlinking of all the keywords.

These are the connections between 7 papers chosen at random to give an idea of how well connected they are.

Figure 3 represents how agriculture is interlinked with every aspect of the keywords. Including optimization and routing planning



**Figure 4: interconnection of the papers between authors.**

Figure 4 represents the authors that are connected in the flow, and these are the main authors who contributed to the study of Operation Research in Agriculture.

## CONCLUSION

Through this research paper, we analysed how agriculture is interconnected with every aspect taken into consideration. Through this research paper and with the help of some graphs related to operation research (OR), we can say that agriculture plays an important role in every phase of modern life. During COVID-19, agricultural research helped the country/farmers to know how much should be saved and produced during the crisis to feed the entire country.

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