MULTI-AGENT BASED AGRICULTURE EXPERT SYSTEM

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Abstract

An artificial intelligence-based system that supports the administration of many agent systems in the agricultural sector is known as a multi-agent based agriculture expert system. These technologies are built to track the entire agricultural production cycle and deliver high-quality, timely judgements. For doing this research data are gathered from the different literature and journal paper, and after that outcomes of the research are analyzed. To select appropriate actions and enhance their result they can analyses data from many sources including the condition of the soil, local weather, and other variables also. The device also helps farmers maintain control over their activities by promptly warning them of crucial conditions. In this way yield and production efficiency rise gradually. In conclusion, research on multi-agent-based agriculture expert systems has demonstrated that AI-driven intelligent agents and AI methodologies may boost decision-making in the agricultural industry with more accuracy and competence. It has given a general overview of the possibilities of these methods and brought attention to the need for more investigation into decision assistance tactics.

Keywords **-** Artificial Intelligence, farmers, local weather, soil condition, scheduling of fertigation, crop production, pest prevention.

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Introduction

This assignment has discussed a very crucial topic which is the multi-based agricultural system. A multiagent-based agriculture expert system is a sort of artificial intelligence system that makes decisions for the agricultural industry using the expertise of several agents. Its main goal is to exploit the collective knowledge of diverse agents who specialize in various areas of the agricultural sector, including horticulture, agronomy, agroforestry and many more. By making scientific suggestions on effective crop production, pest control, and pest prevention, these agents are able to benefit farmers and other agricultural stakeholders. The enhanced productivity resulting from this has the potential to significantly enhance the livelihoods of farmers and communities all around the world.

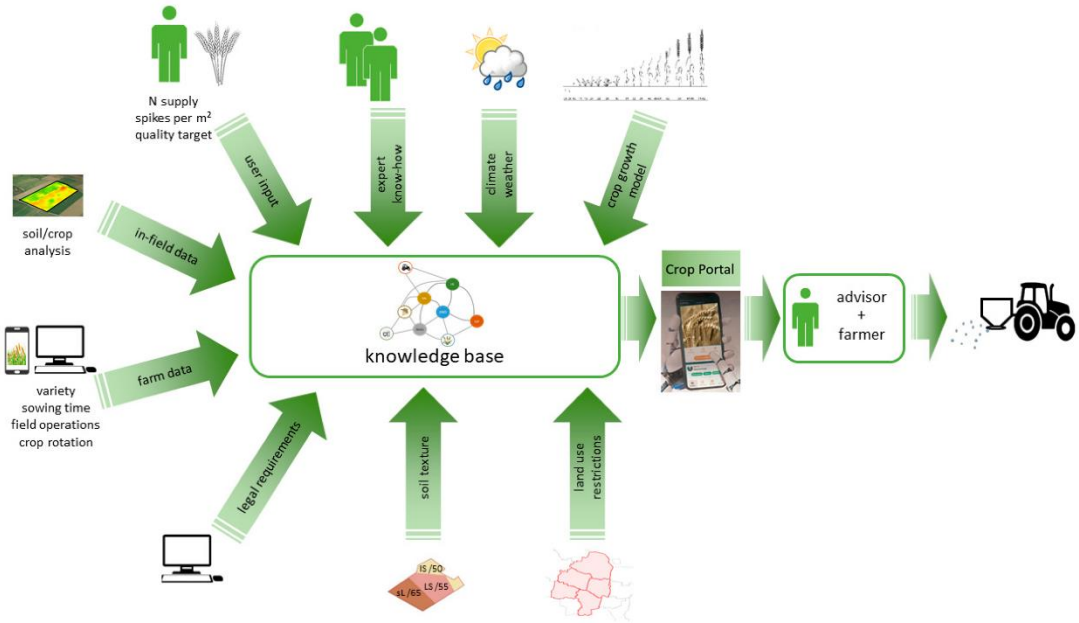

Figure 1: A digital advisor for crop management

(Source: https://www.mdpi.org)

Review of the literature

According to the study ”A multi-agent platform for remote monitoring and diagnostic in Precision Agriculture”, in order to enable remote monitoring and diagnosis of precision agriculture equipment, (Noulamo *et al*. 2020) employed a multi-agent platform. In two French farms, they tested and put the technology into use. The platform is made up of a number of agents, including monitoring, analysis, control, and coordination, which talk to one another and gather information from the equipment. The findings of this study show that the platform could quickly identify irregularities in agricultural machinery.***[Referred to appendix 1]***

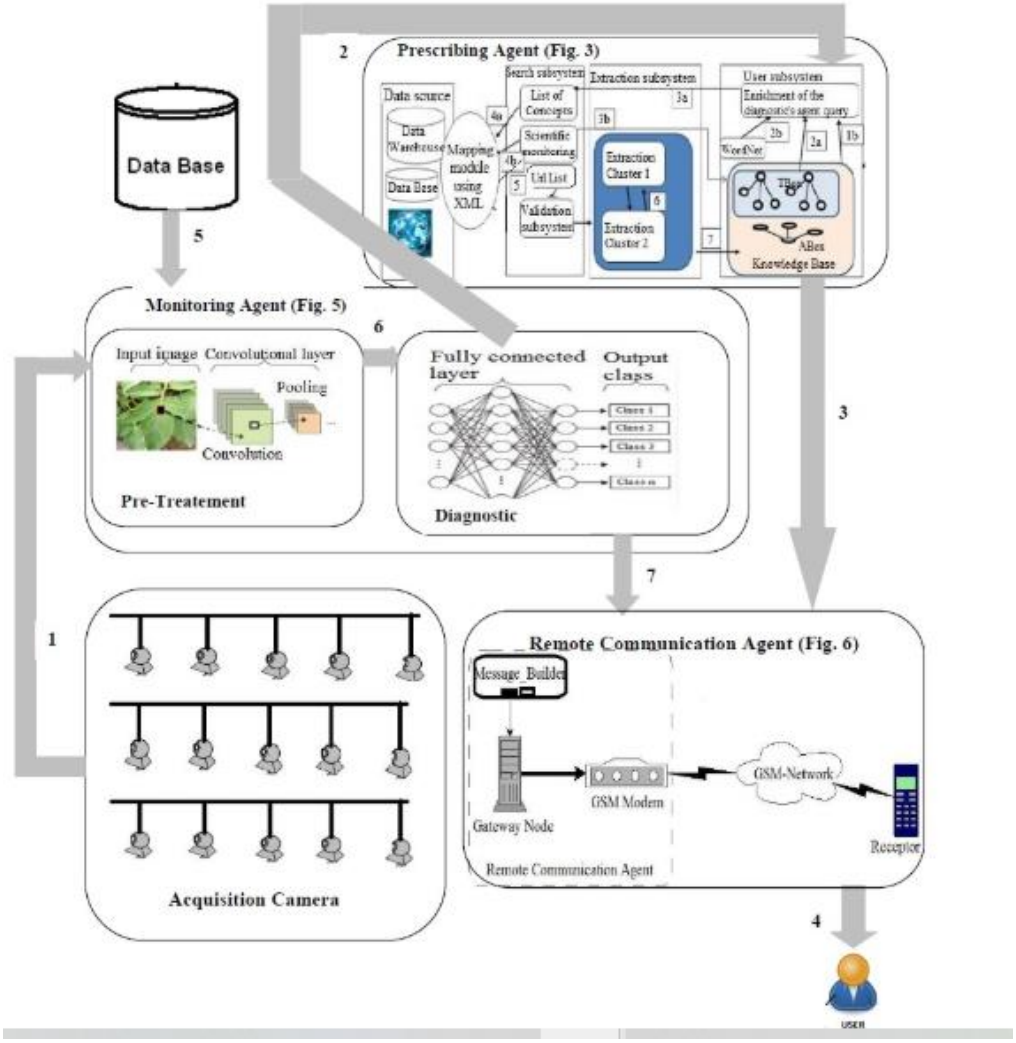

Figure 2: Multi-agent platform for remote monitoring and diagnostic in Precision Agriculture
(Source: Noulamo *et al*. 2020)

According to Simmonds, *et al*. (2020) this study from the "Journal of Water and Climate Change" investigates how multi-agent systems and agent-based modelling may be used for flood-related hydrological issues. In their conclusion, the authors propose that multi-agent systems offer a useful framework for controlling floods with less uncertainty and more forecast accuracy. They also demonstrate how the best flood mitigation strategies include combining agent-based models with optimization approaches (Simmonds, *et al*. 2020). The authors also go through the usefulness of using agent-based and multi-agent systems, including the potential for more effective and objective decision-making, the inclusion of real-time data, and the preservation of flexibility and agility. With these benefits in mind, the authors are able to employ agent-based and multi-agent systems to successfully simulate various flood control situations while giving recommendations on which approach should be applied in the given situation. The promise of agent-based modelling and multi-agent systems as instruments to handle flood-based hydrological issues and progress the creation of pertinent decision-making frameworks is highlighted by the authors as they draw to a close of their results.

In order to analyse interventions in the seed and breeding system for the use of organic carrot seed in Germany, Winter *et al*. (2021)

developed a multi-agent value chain model. The study's goal was to come up with potential tactics for expanding the selection of organic carrot cultivars on the German market. According to the investigation, just 3% of the entire carrot seed output was made up of organic types, and environmental sales were relatively low. The authors came to the conclusion that better legislation and public policies are necessary to maintain the production of organic carrot seeds, lower costs for stakeholders, and boost demand. Increased government funding for organic research and development, focused marketing, and the distribution of organic seed products are just a few of the initiatives they urged (Winter *et al*. 2021). The study demonstrated the potential for public policies to encourage the development and usage of organic carrot varieties in Germany and showed how focused policy interventions may have a major influence on the organic seed market.

According to Skobelev, *et al*. (2020), this study examines a multi-agent strategy for creating a digital twin of wheat. To provide a better understanding of the interactions between wheat plants, soil, and the environment, the authors created a multi-agent simulation system. The multi-agent system was able to forecast and increase the accuracy of data connected to the plants' growth over time, according to the outcome of the research (Skobelev, *et al*. 2020). The technology also demonstrated room for improvement in terms of accuracy. The study came to the conclusion that more accurate simulations of crop growth and more accurate simulations of crop growth and health can be achieved by combining several agents.

Materials and Methodology

For conducting this research the researcher use secondary research methodology. They use qualitative research methodology for gathering the information from the research. Data has been collected from published pieces of literature, articles, journals and books. During the information gathering time abstract screening occurs of the sorted journals and literature based on the keywords and research topic (Pérez-Pons, *et al*. 2021). After collecting the data, analysis occurs of the gathered data which is very much helpful for the success of the research.

For this research deductive research approach has been used. This approach has the possibility to demonstrate the causal relationship between the variables and concepts. This helps to measure the concept quantitatively. This approach helps to discuss the theory and the different literature that helps to gather the information from the previous researchers who did the research on this topic. The information are very helpful for the research from this it helps to know the burden of the research so the researcher is aware of the burden of the research.

Results and Discussion

After sorting the data it has been analyzed that this is a crucial topic for the research. An important addition to the field of agricultural automation and decision support systems is the study of "Multi-Agent based agriculture expert systems". The study assessed how intelligent agents powered by AI may be used to improve agricultural decision-making and knowledge. This study demonstrated that, in contrast to conventional knowledge-based approaches, the employment of AI-driven intelligent agents might offer improved decision accuracy, enhanced flexibility, and scalability (Aksyonov, *et al*. 2020). The study demonstrated that the application of AI and intelligent agents might increase decision-making precision and offer subject-matter knowledge.

The research assessed several approaches, including group problem-solving, simulation-based decision-making, and agent-specific decision-making, in the creation of the MAES system. When compared to current knowledge-based approaches, the research also shows that the MAES system may greatly increase decision-making accuracy and competence.

The study also demonstrated how simply the MAES system could be modified to suit various circumstances and applications. The outcomes gave a broad overview of how AI-driven

intelligent agents for decision-making and expert systems in agricultural applications may be used (Ntoukam, *et al*. 2019). A variety of consequences for the creation of the next intelligent systems for agricultural decision-making were disclosed by the study findings on Multi-Agent based agriculture expert systems. First, in order to make decisions easier, decision-makers should think about adopting AI-driven intelligent agents and AI methodologies. The study also emphasized the need of taking into account various decision-support mechanisms when creating AI-driven intelligent bots. The report also recommended that scientists investigate methods for developing and employing AI-driven bots that may be used in a variety of settings and applications. ***[Referred to appendix 2]***

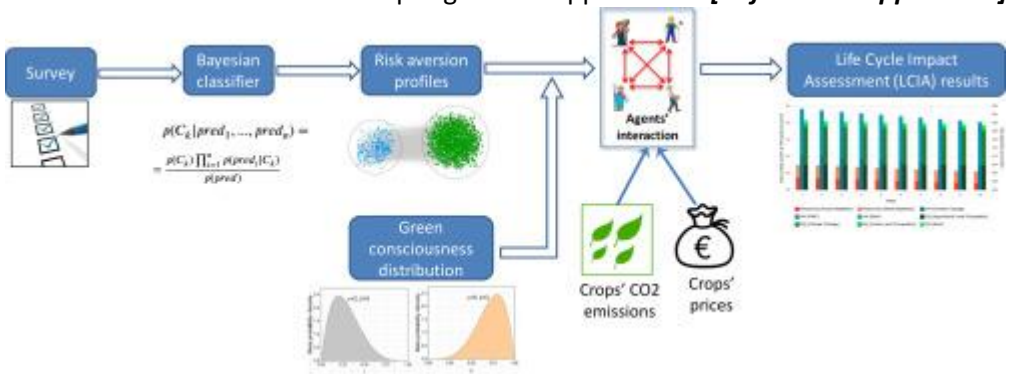

Figure 3: Multi-Agent based agriculture expert systems

(Source: https://ars.els-cdn.org)

Conclusion and future scope

After that, it has concluded a complicated decision-making system called a multi-agent based agricultural expert system integrates environmental information, data from physical sensors, and expert input to increase a farming system's production and yield. This kind of decision-making system is more effective than conventional agricultural decision-making systems because it can analyses a larger variety of factors. This kind of technology may also be used in many environments and settings, and it has the ability to gather a variety of data that can then be used to help local agriculture. A multi-agent based agricultural expert system may more correctly forecast the effects of changes to a farming system before the changes are executed by merging different data sources, AI techniques, and expert input. This kind of decision-making system has the potential to improve yields and expedite agricultural procedures. Additionally, higher yields are advantageous for both farmers and consumers. So that it summarized that it can be said that multi-agent based agriculture expert systems are a useful tool for enhancing efficiency, accuracy, and yield in agricultural decision-making.

Future Scope

There is a wide scope of "multi-agent based agriculture experts". In the future, these systems utilise artificial intelligence (AI) and advance techniques for advanced decision-making and resource management. Multi agents can be utilized to manage automated agricultural tasks in the future that are analysis of the soil, prediction of weather, crop surveillance for outbreak of disease, scheduling of fertigation etc. in the future these systems can be used in conjugated with smart products and advance service for precision farming. In the future, multi-agent-based agricultural expert systems assist farmers effectively in minimizing the risk of crop failure.

Recommendations

Farmers can benefit from timely, precise recommendations from a multi-agent based agricultural expert system to increase crop output. Autonomous agents in the system have access to a variety of data, including past weather patterns, market trends, and other

agricultural information. These agents may create knowledge and create rules using this data, which would aid farmers in making wise decisions. The system is adaptable to varied farming communities' demands, making it a useful tool for agricultural specialists.

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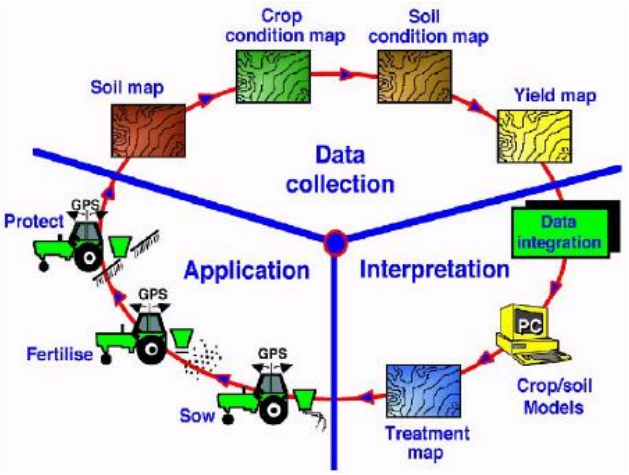
Appendices

Appendix 1: Precision agriculture cycle



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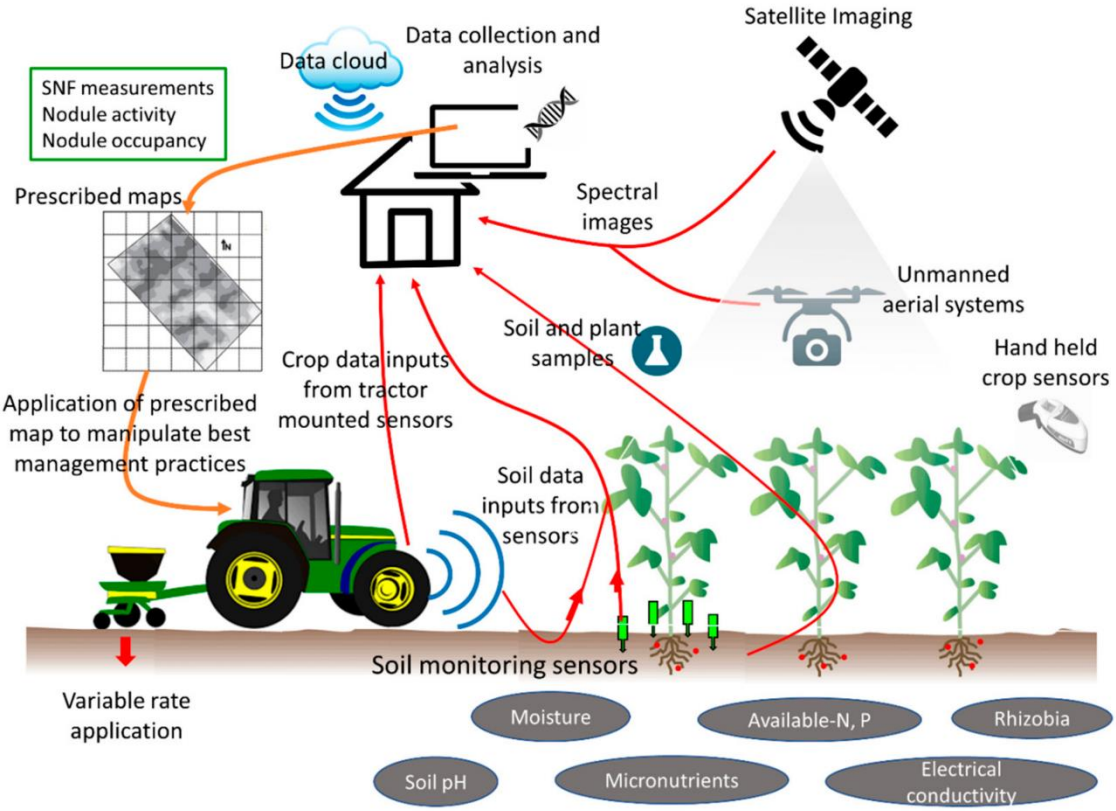
Appendix 2: Agronomy



(Source: pub.mdpi-res.org)