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Analysis of growers' perception of the use of an automated irrigation system

Análisis de la percepción de los productores acerca del uso de un sistema de riego automatizado

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ABSTRACT

This scientific article explores the perception of producers regarding the use of technology in automated irrigation systems in agriculture, focusing on a study conducted in the El Caraño district, Caquetá department, Colombia. The research emphasizes the importance of efficient automated irrigation systems in enhancing agricultural productivity and environmental sustainability. The study delves into the implementation of automated irrigation systems, their impact on operational efficiency, comparative benefits over traditional methods, challenges, limitations, effects on crop quality and yield, and recommendations for other producers interested in adopting this technology.

Keywords: Technology; Automated Irrigation; Producer Perception; Efficiency; Sustainability; Agriculture; Caquetá; Colombia.

RESUMEN

Este artículo científico analiza la percepción de los productores sobre el uso de la tecnología en sistemas de riego automatizado en la agricultura, centrándose en un estudio realizado en el corregimiento el Caraño, en el departamento de Caquetá, Colombia. Se destaca la importancia de la eficiencia del riego automatizado para mejorar la productividad agrícola y la sostenibilidad ambiental. Los sistemas de riego automatizado se basan en sensores y controladores para una gestión precisa del riego, optimizando el uso del agua y aumentando la productividad de los cultivos. La investigación se enfoca en aspectos como la implementación del sistema, el impacto en la eficiencia operativa, los beneficios comparativos con métodos tradicionales, desafíos y limitaciones, impacto en la calidad y rendimiento de los cultivos, y recomendaciones para otros productores interesados en adoptar esta tecnología.

Palabras clave: Tecnología; Riego Automatizado; Percepción de los Productores; Eficiencia; Sostenibilidad; Agricultura; Caquetá; Colombia.

INTRODUCTION

Irrigation is a fundamental practice in agriculture, especially in regions such as Caquetá, Colombia, where rainfall is not always sufficient to meet the needs of crops. In this context, searching for efficient and sustainable irrigation systems is imperative to guarantee food security and rural development.[1]

Traditional irrigation systems, such as surface irrigation, have significant limitations in terms of water efficiency, environmental impact, and production costs. Automated irrigation emerges as a viable alternative

to overcome these limitations and contribute to sustainable agriculture in Caquetá (International Water Management Institute.[21]

Automated irrigation systems (AIS) use sensors and controllers for precise irrigation management. These systems optimize water use, reduce production costs, and increase crop productivity. In addition, SRA can contribute to environmental protection by minimizing soil erosion, salinization, and agrochemical pollution.[23]

The adoption of new technologies always presents challenges, and the automated irrigation system is no exception. In the department of Caquetá, specifically, a series of barriers hinder their implementation and dissemination, which limits their potential impact on local agricultural production.

One of the main problems evident in this region is the lack of knowledge and information about this technology. Many local farmers and producers may not be aware of the benefits that an automated irrigation system can provide, such as water savings, resource optimization, and improved productivity. This lack of awareness can be attributed to the limited dissemination of information about these technologies.

Furthermore, limited economic resources also play a crucial role in adopting this technology. The initial investment required to install an automated irrigation system can be prohibitive for many small farmers, especially those with tight profit margins. Implementing this technology may seem unattainable for many local producers without adequate access to financing or government support programs.

Another essential aspect to consider is the lack of tangible evidence of this irrigation system's benefits in the Caquetá department. Although one producer has been identified in the village of Caraño who uses this system to grow lettuce, tomatoes, and peppers, his example has not yet been widely disseminated or replicated in the region. The absence of success stories and testimonies from other farmers who have adopted this technology can generate doubts and skepticism among the local farming community.

For this reason, the research question of the present investigation was: What are the determining factors for adopting an automated irrigation system?

Research into producers' perceptions of using automated irrigation systems in agriculture is fundamental to boosting water use efficiency, increasing crop productivity, and promoting environmental sustainability in the agricultural sector. By focusing on aspects such as system implementation, its impact on operational efficiency, comparative benefits with traditional methods, challenges, limitations, and the effect on crop quality and yield, this research provides a comprehensive and practical overview for producers interested in adopting this innovative technology. The findings of this study can benefit local producers in the village of El Caraño, in the department of Caquetá, Colombia, and have the potential to contribute to the advancement of more sustainable and efficient agricultural practices globally.

Location

The research was conducted in El Caraño's village, located in the Florencia department of Caquetá (Colombia). The city is located in the foothills of the Eastern Cordillera of Colombia at 1°36′51″N and 75°36′42″W, near the Hacha riverbed. Its average altitude is 242 meters above sea level, its annual rainfall is 3 500 mm, and its average temperature is 27 °C. It has an approximate area of 2 292 square kilometers and is part of the Colombian Amazon basin.[1,6]
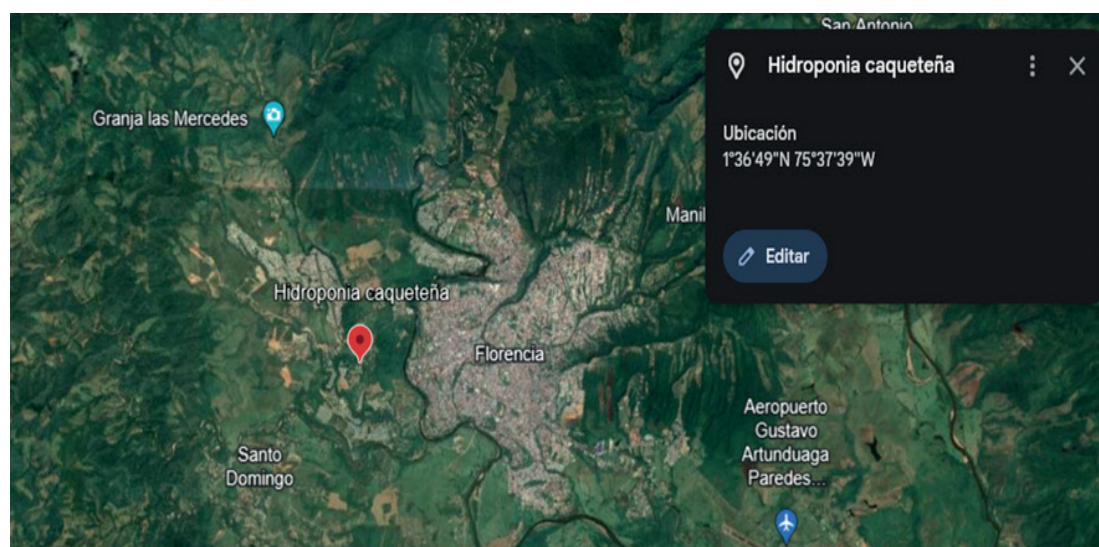

Figure 1. Location where the analysis will be carried out

Population and sample. The study or analysis was conducted on a lettuce producer in a rural area near the

municipal capital, specifically in El Caraño's village. This family has been growing different products for some years, mainly lettuce; an interview will be conducted with the producer about the process he has carried out with automated irrigation. This way, it will be possible to identify the motivations and processes followed using the computerized irrigation system.

Methodological approach

This manuscript is based on the historical hermeneutic research paradigm because it allows an analysis of the methodological traditions used in the population.[4]

The research carried out is explanatory because it allowed specifying the causes or effects by which, once the irrigation system has been used or implemented, it may or may not be accepted.[13]

The approach to this analysis was mixed because it focused on understanding the processes and the opinion of this producer on the results obtained with automated irrigation. In addition to this, the costs involved in its implementation were consulted, covering the qualitative and quantitative approaches, respectively.[29]

METHOD

An exhaustive analysis of the producers' perception of the use of the automated irrigation system was carried out to analyze the producers' perception of the use of the technology; an interview was conducted with a key actor in the process. During this conversation, essential aspects were addressed, such as the description and implementation of the system, the opinion on its impact on operational efficiency, the comparative benefits with traditional methods, the associated challenges and limitations, the impact on crop quality and yield, as well as recommendations for other producers interested in adopting this technology.

Data analysis and processing

The data obtained in the interview was processed using various analyses carried out in the Atlas. Ti program. To do this, the interviewee's narrative was transcribed into plain text and imported into the program. It began with an exploratory analysis that included the creation of a word cloud to identify the most relevant terms in the data. Subsequently, different codes were applied to organize the information more concisely. Network diagrams were produced as a deductive analysis of the interviewee's perception, culminating in the presentation of one in this document to visualize the concept of automation according to the interviewee. Finally, a Sankey diagram was used to obtain more detailed information on the coding of the text, completing the data processing with this inductive analysis.

RESULTS

Exploratory analysis of the perception of an irrigation system

At the first level of analysis, a superficial one, of the narrative of the interviewees about their perception of adopting an automated irrigation system, the most frequent words used were irrigate, use, system, technology, and quality.

From the outset, the frequency of words in the narrative shows the importance for producers of having permanent access to water, which is expressed by the word "irrigate." Likewise, they focus on the fact that this action is part of a system where not only the availability of the resource but also a series of events favor improving the quality of their crop and the final product.

In line with the producer's views, according to [25], the irrigation system is a fundamental element in agricultural production, as it allows producers to control and optimize the water supply to the plants. An efficient and well-designed irrigation system can significantly improve plant yield and productivity by ensuring the plant receives the right amount of water at the right time.

Now, from the dimension of quality, [24] ensures that this is what determines the value and acceptance of products in the market and that factors such as cleanliness, appearance, and the organoleptic properties of the crops are influenced by the irrigation system used; therefore, adds the author, an adequate irrigation system can help maintain the quality and freshness of products, which in turn increases their value and competitiveness.

In addition to this, the effective integration of elements such as the irrigation system, the quality of production, and the technology applied allows for the optimization of processes and the improvement of the quality of their products, with the subsequent increase in their competitiveness in the market.[17,24,25]

The producers also emphasized how strategic this technology is for their crops, which also favors agronomic performance and productivity. For [17], this factor is crucial in optimizing irrigation systems and improving production quality, as it allows producers to monitor, control, and adjust water use more efficiently.[17] This translates into greater efficiency in the use of resources, which in turn is reflected in higher productivity and plant performance.

Figure 2. Word cloud

Deductive analysis of the perception of an irrigation system

According to what was mentioned in the interview by the user of the technology, automation is understood as the process of implementing a technology or an automatic system, in this case, an irrigation system, where automation in agriculture, specifically in irrigation systems, has a direct impact on the improvement of agricultural production.[30] However, the interviewees recognized this technology's importance in ecologically and water saving because the sensors allow the necessary water to reach the crop, improving the production quality (figure 2).

Considering this, implementing an automated irrigation system for some producers is based on technology, automation, and system design. By using sensors and advanced control systems, the producer achieves optimal irrigation precision, adjusting the water supply to the exact needs of the plants.[19] This practice not only maximizes irrigation efficiency and reduces the waste of resources such as water but also sustainably increases agricultural production.

Irrigation automation integrates technology to optimize the use of resources, improve precision, and increase production, all while the producer prioritizes water saving and sustainability.[14,15,16] This approach benefits the producer by improving efficiency and productivity and contributes to the conservation of natural resources and the sustainable development of agriculture. In conclusion, adopting automated irrigation systems represents a significant step towards more efficient, sustainable, and productive agriculture. The combination of technology, efficiency, and sustainability in agricultural production through irrigation automation is key to meeting the current and future challenges of the agricultural sector
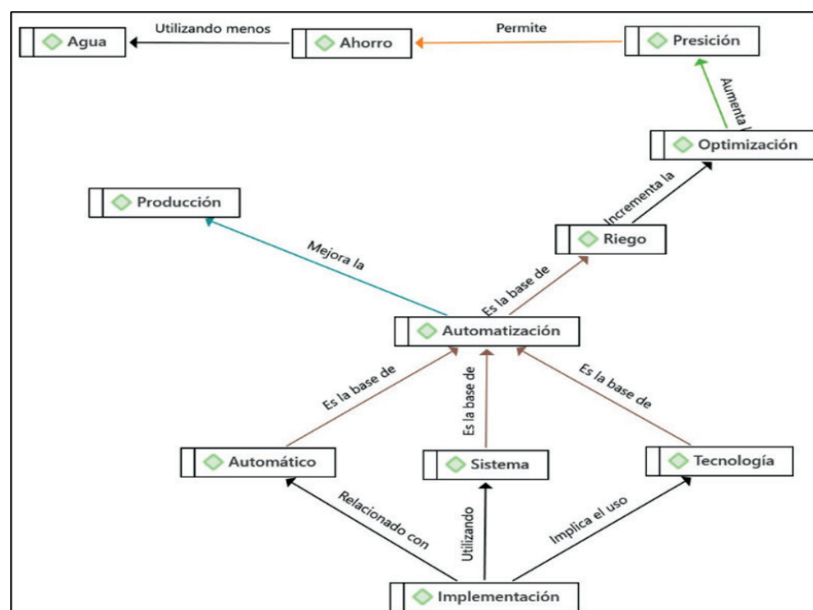

Figure 3. Network

Inductive analysis of the perception of an irrigation system

Considering the interviewee's narrative, implementing an automated irrigation system represents an

improvement in crop productivity levels, as constant and precise irrigation in cropping systems allows them to be efficient. However, when implementing this technology, various limitations arise that are crucial for consumer choice. Among these limitations are the economic resources for the implementation of the system and the financial and human resources for the maintenance and proper functioning of the technology.

In line with the above, [2] argues that the efficiency of the irrigation system, including automation and precision in water delivery, plays a crucial role in its adoption; this is why farmers tend to favor systems that are efficient in their use of water and energy, as this can increase the profitability and sustainability of their operations.

In addition, ease of use and access to technology are important considerations, as farmers may be reluctant to adopt systems they perceive as difficult to understand or maintain.[12] In this sense, the adoption of an irrigation system is influenced by farmers' ability to understand and properly manage the technology.

In the economic sphere, the initial installation and operating and maintenance costs are determining factors.[34] Farmers assess whether the return on investment justifies the initial outlay and whether the ongoing costs are sustainable in the long term. The availability of finance can also play a crucial role, as government programs or subsidy options can make adoption more attractive by reducing the initial cost.[22]
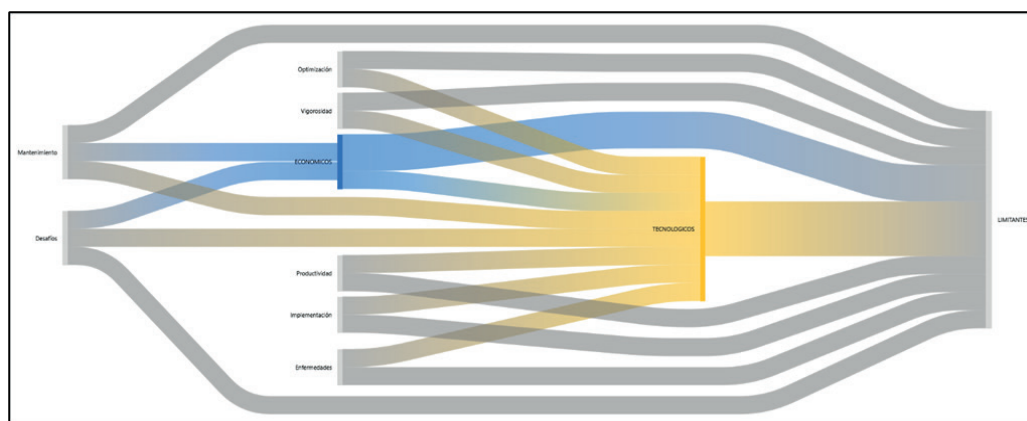

Figure 4. Sankey diagram

CONCLUSIONS

The positive perception of producers towards automated irrigation systems as a tool to improve quality, productivity, and sustainability in agriculture is evident. However, to achieve more widespread adoption, it is crucial to address challenges such as the need for economic and human resources for system maintenance and the availability of financing during implementation. Providing the necessary support so that producers can take full advantage of the benefits of this innovation in their agricultural practices is fundamental to boosting the adoption of automated irrigation technologies and promoting more efficient and sustainable agricultural practices.

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