Bridging the Gap in Agricultural Sharing Economy: A Systematic Review for Evaluating Information Systems for Machinery Efficiency

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Abstract: The sharing economy is rapidly transforming various industries, including agriculture, where there is growing demand for systems that facilitate machinery rental and sales. Agricultural machinery is often expensive and is used primarily during specific periods, such as harvests. This limited utilization leads to high depreciation costs, imposing substantial and scalable financial burdens on owners. This study investigates how a sharing economy model can improve the efficiency of agricultural machinery use. By allowing equipment owners to maximize utilization and providing small-scale farmers with affordable access to machinery, such a model reduces the need for significant upfront investments. We conducted a qualitative analysis to evaluate the effectiveness of current information systems that support this approach. The methodology involved exploring grey literature to identify relevant tools, defining evaluation criteria, and conducting a qualitative assessment of existing platforms. Among 14 evaluated platforms, we rated only four as acceptable, with only one achieving a good rating. None fully met all the criteria, revealing a gap between user needs and the solutions currently available in the market. This study highlights the inadequacies in existing platforms and offers valuable insights for advancing the sharing economy in agriculture. By identifying specific needs and challenges, the findings provide a foundation for future research and the development of more effective technologies and practices in this domain.

1 INTRODUCTION

With the pursuit of more efficient and sustainable food production, it has become necessary to optimize agricultural processes. Emerging technologies are already part of the reality in this field, as demonstrated by Albiero *et al.* (2020). However, access to innovations from previous generations, such as autonomous machines, is still limited (Sordi and Vaz, 2020). Furthermore, Neves et al. (2009) emphasize that there is a limiting economic factor associated with the idleness of this machinery in certain properties.

In this scenario, the sharing economy emerges as a promising solution. According to Hamari et al. (2015), it is a recent phenomenon that promotes the direct transfer of goods and services between people, supported by digital technologies. The authors link this reality to ICT (Information and Communication Technologies) informatization, highlighting its core aspects. Key traits are: online collaboration, involving decentralized digital content creation and use; social commerce, enabling peer-to-peer interactions for buying and selling via social networks; and online sharing, covering information exchange and service offerings through ICTs.

As pointed out by Zanchett *et al.* (2018), the development of agricultural activities requires the use of high-cost machine and equipment for acquisition and maintenance. Furthermore, the use of these technologies is limited to harvest periods, remaining idle for most of the time. This results in high depreciation costs, which can translate into a scalable expense over time for the owners.

Given this, the authors emphasize that one way to improve the scenario of efficiency in the use of

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agricultural machinery could be the sharing economy model (Belk, 2014). This model allows owners to maximize the use of their equipment, while users can meet their needs with a lower investment than would be required to acquire the machinery. In other words, the sharing economy, by enabling the rental or sale of machinery, allows owners to maximize the use of their equipment and enables farmers with fewer resources to access essential technologies with a smaller investment. Despite advances in informatization, there are still significant gaps in meeting the needs of users in this market.

Furthermore, this study is based on the Diffusion of Innovations Theory (Rogers, 2003) to understand the factors that influence the adoption of innovative tools in the agricultural context. According to this theory, the adoption of an innovation depends on factors such as the perception of its relative advantage, compatibility with the values and needs of users, simplicity of use, and observability of its benefits. In the agricultural sector, the theory provides a useful framework for analyzing the challenges and opportunities associated with the dissemination of sharing economy platforms. Works such as those by Moore and Benbasat emphasize the importance of adapting innovative functionalities to the specific needs of users to facilitate their adoption.

Given the scenario presented, this study aims to raise and conduct a qualitative analysis of sharing economy platforms focused on advertising the rental and sale of agricultural machinery. In other words, the present study seeks to qualitatively analyze sharing economy platforms focused on the rental and sale of agricultural machinery. Through a search in the gray literature, we identified fourteen (14) tools, each with distinct business models and specific functionalities. Then, we conducted a brainstorming process to define relevant criteria, which were weighted using the planning poker method. With these criteria established, we carried out a qualitative evaluation of the platforms, assigning scores based on the weighted sum of the criteria by the quality of implementation of each tool. This work aims not only to highlight the strengths and weaknesses of these platforms but also to inspire the development of more effective technological solutions aligned with the sector's demands.

The remainder of the study is structured as follows: Section 2 presents related works. Next, Section 3 describes the methods used to achieve the objectives of this study. Section 4 presents the tools found, the evaluation results, and the analysis of the obtained findings. Then, in Section 6, we describe the threats to the validity of this study. Finally, Section 9 provides the concluding remarks on the article and potential future work on the topic.

2 RELATED WORK

This section aims to discuss related works in research or the development of platforms that are related to the sharing economy applied to the context of agricultural machinery.

Zanchett et al. (2018) investigated the existing agricultural machinery and equipment sharing software on the market. To do so, they conducted an exploratory study addressing the topic qualitatively. Through a search based on a systematic mapping, the systems were listed and evaluated. In the end, the authors developed a description of the listed applications, specifying their basic features, strengths, differentiators, and weaknesses.

Nunes (2023) carries out the software engineering process for the production and validation of prototypes of an agricultural machinery rental application. To do so, the author first specifies the system requirements. Based on what was generated, the system prototypes are developed. Finally, the author validates the artifacts, including a usability evaluation variation intended for prototypes.

Furthermore, this work can also serve as a relevant reference for future research and developments in the field of the sharing economy applied to the agricultural context. By conducting the qualitative analysis of existing platforms, our research contributes to an understanding of the needs and challenges in this domain. In this way, we hope that the results presented here can complement and inspire new studies aimed at advancing practices and technologies in this sector.

The study aimed to develop AgroShare (Da Silva et al., 2024), a platform for sharing and trading agricultural resources, addressing inefficiencies and financial constraints among small-scale farmers. It offers features like resource listings, messaging, and rental agreements. A usability test confirmed its user-friendly interface and practical functionality but highlighted areas for improvement, such as search workflows and advanced recommendations. The study concluded that AgroShare promotes sustainable and inclusive farming practices while offering insights for enhancing digital agricultural tools.

These works contribute in distinct and significant ways to the understanding and development of our work. In Table 1, a summary of the main characteristics addressed by each of these references can be seen.

Table 1: Comparison of Related Works.

Reference	Main Objective	Methodology	Results and Conclusions
Zanchett *et al.* (2018)	Investigation of agricultural machinery sharing software	Exploratory study, systematic mapping	Identification of positive and negative aspects of the analyzed systems
Nunes (2023)	Development and validation of prototypes for agricultural machinery rental apps	Software engineering, requirements specification, prototyping	Creation of prototypes with good usability acceptance by users
Da Silva *et al.* (2024)	AgroShare is a platform for sharing and trading agricultural resources addressing small-scale farmers	Usability test with 47 participants to evaluate user-friendly interface and practical functionality	Promotes sustainable and inclusive farming practices while offering insights for enhancing digital agricultural tools
Our Study	Qualitative analysis of sharing economy platforms applied to the agricultural context	Qualitative study, comparative analysis of platforms	Identification of the sector's current needs and suggestions for future research

3 METHODOLOGY

According to Garousi et al. (2019), gray literature refers to documents and materials not formally published through traditional academic channels, such as peer-reviewed articles and books. It includes a wide range of sources, such as technical reports, working papers, theses, specialized websites, and dissertations. These sources often contain valuable information that is not available through conventional academic methods and can provide important data on current practices, recent developments, and emerging techniques. The decision to prioritize gray literature was driven by the limited availability of peer-reviewed academic research specifically focused on sharing economy platforms for agricultural machinery. Additionally, gray literature, such as technical reports and industry websites, often provides more practical insights into platform functionalities.

Research Objectives: Consisted the first step, which aimed to collect information about platforms for agricultural machinery ads and map their functionalities. The goal was to identify which of these platforms could be converted into features for a software. Additionally, the aim was to discover which platforms are currently being used by farmers. Thus, Figure 1 formalizes the research method through the following Research Questions (RQ):

```
RQ1.  What advertising platforms for
   agricultural machinery exist?
RQ2.  What are the features of the
       found platforms?
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Figure 1: Research Questions.

3.1 Search and Selection of Tools

For the search of the software, we developed a string that was submitted to the Google search engine. We composed the string of the following elements: **(i)** the general theme, addressing agriculture and related terms such as "agro" and "farm"; **(ii)** the subtopic, focused on machinery, including terms like "machinery" and "equipment"; **(iii)** the objective, covering sharing economy and transactions, with words like "rent", "used", and "purchase"; **(iv)** keywords related to solutions, such as "platform", "system", "software", and "website".

Figure 2 shown the string used in the search.

```
(agro OR farm OR agricultura OR rural
   OR agrícola OR agronegócio) AND
 (machine OR machinery OR tractor OR
máquina OR máquinas OR maquinário OR
  equipamento) AND (rent OR rental OR
      used OR buy OR announcement OR
 aluguel OR alugar OR usado OR comprar
 OR loja OR anúncio) AND (platform OR
 plataforma OR sistema OR software OR
           site OR portal)
```

Figure 2: Search String of the Research.

After submitting the search string to the search engine, we conducted an initial screening by reviewing the tool descriptions and key functionalities available on their landing pages. This assessment aimed to quickly identify whether each tool aligned with the study's scope and objectives. Based on this initial analysis, we selected the most suitable tools for a more detailed evaluation, focusing on those that met the established criteria.

3.2 Evaluation Criteria

The evaluation criteria were established during a brainstorming session among three evaluators (co-authors), focusing on the functionalities we considered essential for an agricultural machinery rental system. To assign weights to these criteria, we used the Planning Poker technique, a collaborative methodology that promotes the active participation of the evaluators to reach a consensus.

Each evaluator suggested a value from 1 to 5 for each criterion, where one (1) represents low priority and five (5) represents high priority. If the proposed values were too divergent, the evaluators discussed the differences until reaching a consensus on the most appropriate weight. As described by Grenning, J. (2002), Planning Poker is an efficient technique that facilitates collaboration and decision-making by structuring the team estimation process. Table 2 shows the criteria raised with their weights.

Table 2: Criteria and Assigned Weights.

ID	Criteria	Weight
a	Machine Rental	5
b	Service Rental	5
c	Filtered Search Interface	5
d	Platform Internal Chat	4
e	Filtering Based on Technical Specifications	4
f	Rental History and Other Reports	4
g	Rating and Review System for Ads	4
h	Price Alert	3
i	Price and Feature Comparison	3
j	Machine Purchase	3
k	Filtering Based on Geographic and Financial Conditions	3
l	Stores	3
m	Proximity Search	2
n	Wish List	2
o	Location Map	2

3.3 Qualitative Evaluation

This study used a modified four-point Likert scale (Likert, 1932) to assess the functionality of the website, avoiding neutral responses, as recommended by Clason and Dormody (1994) (Clason and Dormody, 1994).

Instead of "agree" or "disagree", evaluators assigned qualitative scores: "not implemented", "partially implemented", "implemented," and "fully implemented". This adaptation enabled a more precise evaluation of usability and technical functionality.

Multiplication factors were defined to reflect the quality of implementation, ensuring a fair and measurable evaluation. They capture the gradation from

absent to ideal implementations, rewarding superior systems with higher scores. Table 3 presents the implementation levels and their respective factors.

The score ranges were established based on the weighted sum of the products between the criteria and their respective maximum implementation weights. To calculate the maximum possible score, we used the following formula:

$$\text{Score} = ((5 \times 3) + (4 \times 4) + (3 \times 5) + (2 \times 3)) \times 1.5 = 78 \tag{1}$$

This value represents the ideal performance across all criteria, considering the implementation highest level. From this maximum score, we created five classification ranges for the evaluated systems: **(i)** Inadequate, score from 0 to 15.6; **(ii)** Mediocre, from 15.7 to 31.2; **(iii)** Acceptable, from 31.3 to 46.8; **(iv)** Good, from 46.9 to 62.4; **(v)** Ideal, from 62.5 to 78.

4 RESULTS

Throughout this section, we present the results of our research obtained through the application of the methodology's procedures. Initially, we present the tools found through the search in the gray literature. Next, we show the results of the qualitative evaluation conducted on the identified platforms, using the criteria and implementation levels previously established.

4.1 Tools Found

This section presents the platforms identified from the search in the gray literature. Table 4 lists the tools found, detailing their business model, corresponding URL, and the region of operation. Figure 3 shows the distribution of tools by business model, with the majority of 11 (78.6%) tools focused on Purchases.
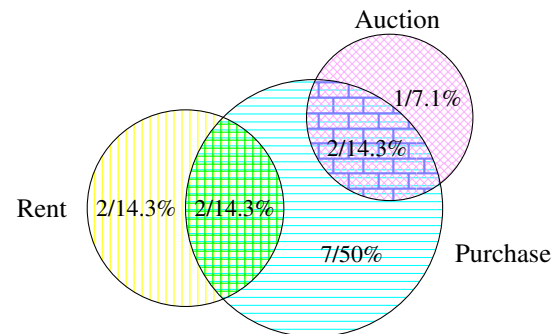

Figure 3: Distribution of Business Models.

Table 3: Implementation Levels.

Level	Description	Factor
⊗	The system does not provide the functionality or feature evaluated by the criterion	0x
⊘	The system has the evaluated functionality, but it is implemented in a limited or unsatisfactory way	0.5x
⊙	The system adequately implements the functionality	1x
⋆	The system provides the functionality in an excellent manner	1.5x

Legend: ⊗: Not Implemented | ⊘: Partially Implemented | ⊙: Implemented | ⋆: Fully Implemented

Table 4: List of Advertising Platforms for Agricultural Machinery.

Tools	🤝	Site	Region
Agrofy	🔍🛒	agrofy.com.br	🇧🇷
AgroLiga	🔍🛒	agroliga.com.br	🇧🇷
Agriaffaires	🔍🛒	agriaffaires.com.br	🌐
Alluagro	🔍	alluagro.com.br	🇧🇷
E-agro	🛒	e-agro.com.br	🇧🇷
E-FARM	🛒	e-farm.com	🇪🇺
Iron Planet	🧑‍💼🛒	ironplanet.com	🌐
MachineFinder	🛒	machinefinder.com	🇺🇸
Machinery Pete	🧑‍💼	machinerypete.com	🇺🇸
Machinio	🛒	machinio.com.br	🌐
Mascus	🛒	mascus.com.br	🌐
MFrural	🛒	mfrural.com.br	🇧🇷
Tractor House	🧑‍💼🛒	tractorhouse.com	🇺🇸🇨🇦🇲🇽
Tractor Zoom	🛒	tractorzoom.com	🇺🇸

Legend: 🤝 Business Model | 🔍 Rent | 🛒 Purchase | 🧑‍💼 Auction

4.2 Evaluation of the Tools

We evaluated each tool based on the criteria (Table 2). The score assigned reflects the overall performance of the platform concerning these criteria. The aim is to highlight the strengths and weaknesses of each tool, providing a clear view of its effectiveness in the context of the shared economy for agricultural machinery. Table 5 presents the final view of the qualitative evaluation, which results from the grouping and discussion of the evaluations among three team members.

5 ANALYSIS OF THE RESULTS

In this section, we analyze the results of the platform evaluation, addressing the following aspects: **(i)** a general comparison of the performance of the evaluated platforms; **(ii)** the overall implementation of the most important criteria; **(iii)** the least met criteria.

5.1 General Comparison of Platforms

Platform performance varied significantly. Agriaffaires scored highest (49.5), excelling in most criteria, while AgroLiga and Mascus had the lowest scores (13), with poor implementation.

Most platforms scored between 20 and 30 points. Agrofy (38.5) and Tractor House (35) performed well, standing out despite ranking below the top plat-

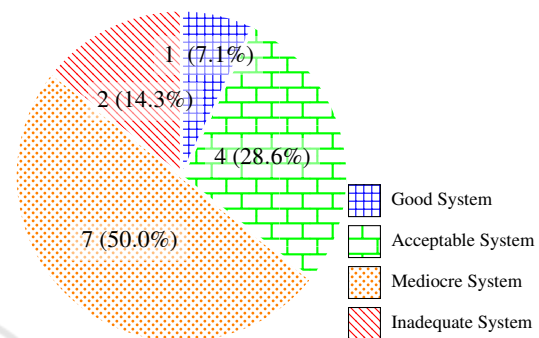form. Figure 4 shows a pie chart of the classification distribution.

Figure 4: Distribution of Platform Ratings.

5.2 Implementation of Key Criteria

Criterion a (machine rental) was implemented by only four platforms (Agrofy, AgroLiga, Afriaffaires, and Alluagro). In contrast, criterion c (filter-based search) showed consistent adoption across platforms, making it one of the most important. Criterion e (filtering by technical specifications) also had good adherence, as it is a key search mechanism.

However, key criteria such as b (service rental), d (internal chat), f (rental history and reports), and g (ad evaluation and comments) were rarely implemented. Their absence or inadequate implementation limits user experience and platform effectiveness. Figure 5 presents a chart on the implementation of these criteria (a to g), weighted between 4 and 5 points.

5.3 Least Addressed Criteria

The least addressed criteria by the evaluated platforms were: **(i)** the rental of services, with only two implementations; **(ii)** the internal chat feature, with no implementations; **(iii)** the rental history and reporting mechanism, with no implementations; **(iv)** and the feedback and comment system, with only two implementations. This highlights significant gaps in user experience and platform efficiency.

Table 5: Evaluation of Advertising Platforms for Agricultural Machinery.

Tools	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	Score
Agrofy	★	⊘	★	⊗	⊙	⊗	⊗	⊗	⊗	★	⊙	★	⊙	★	⊗	38.5
AgroLiga	★	⊗	⊘	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊙	⊗	⊗	⊗	⊗	13.0
Agriaffaires	★	⊗	★	⊗	★	⊗	⊗	★	★	★	★	⊘	★	★	★	49.5
Alluagro	★	⊙	⊙	⊗	⊘	⊗	⊙	⊗	⊗	⊗	⊙	⊘	⊙	⊗	⊗	30.0
E-agro	⊗	⊗	★	⊗	★	⊗	⊗	⊗	⊗	★	⊘	⊗	⊘	⊗	⊗	25.0
E-FARM	⊗	⊗	★	⊗	★	⊗	⊗	⊗	★	★	★	⊗	★	⊗	★	33.0
Iron Planet	⊗	⊗	★	⊗	⊘	⊗	⊗	⊗	⊙	★	★	⊗	⊙	★	★	29.5
MachineFinder	⊗	⊗	⊙	⊗	⊙	⊗	⊗	⊗	⊗	⊙	⊙	⊙	★	★	⊙	26.0
Machinery Pete	⊗	⊗	⊙	⊗	⊙	⊗	⊗	⊗	⊗	⊙	⊙	★	⊙	★	⊗	24.5
Machinio	⊗	⊗	★	⊗	★	⊗	★	⊘	⊗	★	★	⊗	⊗	⊗	⊗	30.0
Mascus	⊗	⊗	★	⊗	★	⊗	⊗	⊗	⊗	★	★	⊙	⊗	⊙	⊗	27.5
MFrural	⊗	⊗	⊘	⊗	⊗	⊗	⊗	⊗	⊗	★	⊘	★	⊗	⊗	⊗	13.0
Tractor House	⊗	⊗	★	⊗	★	⊗	⊗	⊘	⊙	★	★	⊙	⊙	★	⊗	35.0
Tractor Zoom	⊗	⊗	⊙	⊗	★	⊗	⊗	⊗	⊗	⊙	★	★	★	★	★	32.0

Legend: ⊗: Not Implemented | ⊘: Partially Implemented | ⊙: Implemented | ★: Fully Implemented
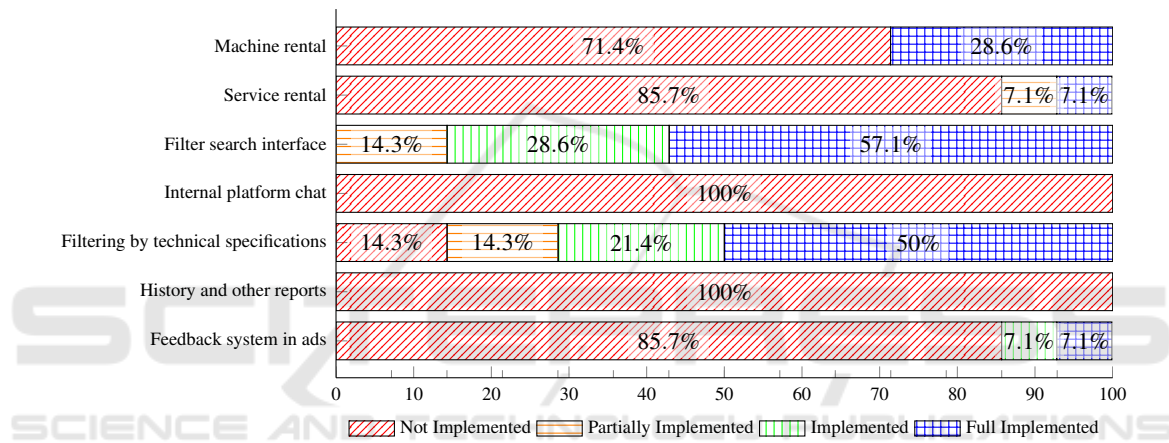

Figure 5: Implementation of the main criteria.

5.4 Discussion on the Platforms

In general, platforms such as AgriAffaires and Agrofy stood out for implementing most of the criteria adequately, although there is still room for improvement, especially in usability. Features like geographic filters, integration with interactive maps, and detailed ad rating systems are limited, and if improved, they could optimize the user experience and the efficiency in searching and comparing products. Thus, in response to the research questions of the study, we can highlight the following points (Figures 6 and 7).

6 THREATS TO VALIDITY

This section aims to present the threats to the validity of the study and the procedures used to mitigate them, following the postulates of Wohlin (2012) and Verdacchia *et al.* (2023): **Construct Validity**: One identified threat is the risk of not capturing all rele-

> **RQ1.** What are the existing platforms for agricultural machinery listings?
> The study identified fourteen (14) platforms focused on the rental, buying/selling, and auctioning of agricultural machinery, including Agrofy, Agriaffaires, and Tractor House. These platforms have distinct business models and varying levels of functionality implementation.

Figure 6: Answer to RQ1.

vant platforms in the search mechanism. Since the study focused on gray literature, there is a possibility that some tools were excluded due to not being visible in the channels investigated. To mitigate this threat, we developed a search string to be as comprehensive as possible within its limitations.

Internal Validity: (i) The perceived threat is related to the possibility of biased evaluation criteria. Since the group's future work is likely to involve developing a system similar to the ones analyzed, there

> **RQ2.** What are the features of the found platforms?
>
> The most implemented features were the search interface with filters and filtering based on technical specifications. However, functionalities such as service rental, rental history, internal chat, and ad evaluation systems were found to be insufficiently explored or absent among the evaluated platforms.

Figure 7: Answer to RQ2.

may have been some subjectivity in the development of the criteria. To mitigate this threat, the Planning Poker method was used during the assignment of weights to help the reduction of individual bias; (ii) Another threat relates to the possibility that criteria may have been evaluated incorrectly in some platforms. Considering the possibility that we may have overlooked some functionality due to usability issues or been excessively strict or lenient in certain evaluations. To mitigate this threat, we conducted four evaluations: three individual and one joint. In the joint evaluation, all criteria were thoroughly reviewed and validated, ensuring greater accuracy and consistency.

Conclusion Validity: The main threat to our study refers to the possibility of biased data analysis, where the evaluation may vary depending on the platform. To reduce this, we structured the analysis by considering general points of inflection, ensuring all platforms faced equal criteria.

7 MAIN CONTRIBUTIONS

The study presents several significant contributions, both to the agricultural sector and to the field of IS.

Identification of Gaps in Existing Systems: The study identified that many platforms do not fully meet the needs of users. For IS, this emphasizes the need for user-centered designs (people) and more robust requirements models for specific demands.

Application of the Diffusion of Innovations Theory: The use of the Diffusion of Innovations Theory helped to understand the challenges of adopting platforms in the agricultural sector. The theory provides a framework for analyzing the adoption of technologies and surpass cultural and economic barriers.

Proposal of Criteria for New Solutions: Criteria were suggested for developing platforms, including features such as advanced search, interactive maps, and evaluation systems. This provides practical guidelines for requirements engineering in IS, creating systems more aligned.

Exploration of Grey Literature as a Data Source: The use of grey literature allowed for the identification of tools that are underdocumented in academic sources, broadening the view of the agricultural platform market. This approach complements traditional literature reviews in IS by including emerging data and practical trends.

8 RESEARCH PERSPECTIVES

The results of this study reveal a series of gaps and opportunities that can guide future research in the sharing economy for the agricultural sector.

Development of Essential Features: The analysis showed low or absent implementation of key features like service rental, chat systems, rental history, and feedback mechanisms. Future research should explore their development to enhance user experience and platform efficiency.

Focus on Usability and Accessibility: Although some platforms, such as Agriaffaires and Agrofy, have stood out for implementing important criteria, the overall usability of the tools remains a challenge. Future studies could explore user-centered methodologies to assess and redesign interfaces, including testing with real users in the agricultural sector, to ensure accessibility and ease of use, especially for farmers with low technology familiarity.

Exploration of Hybrid Models: The analysis identified that the evaluated platforms have different business approaches (such as rental, buy/sell, and auction), but few integrate multiple models efficiently. Future research could explore the development of hybrid platforms that combine rental, buy/sell, and service functionalities, maximizing the reach.

Agricultural Machinery and Equipment API Service: An emerging opportunity identified from the analysis of this study is the creation of an API (Application Programming Interface) service focused on agricultural machinery and equipment. The API service could centralize information on rental, buying/selling, location, and technical specifications of agricultural equipment, making this information accessible to developers and users of other platforms. The API could also include relevant data such as average prices, regional availability, and technical characteristics of the equipment.

9 FINAL REMARKS

In this study, we conducted a qualitative analysis of platforms focused on the rental and sale of agricul-

tural machinery. However, the results revealed that, although some platforms have advanced in the implementation of essential functionalities, there are still significant gaps, especially in terms of usability and critical features.

The use of grey literature as a methodological basis proved to be an effective strategy for identifying relevant tools, but it also revealed limitations in accessing complete and detailed information about the existing platforms. Future studies could expand this approach to include complementary data collection methods, such as user interviews and in-depth analysis of successful cases.

Applying Diffusion of Innovations Theory clarified adoption challenges for the platforms. Compatibility, complexity, and observability emerged as key factors. Many platforms struggled, especially with agricultural compatibility, underscoring the need for better adoption strategies.

As noted in the abstract, the work highlights collaborative efforts linking equipment owners to small and medium producers. These initiatives can reshape technology access, fostering inclusion, sustainability, and competitiveness. Future advancements should address gaps identified, offering tools to meet evolving market demands.

DATA AVAILABILITY

We are committed to promoting transparency and reproducibility in research. In line with this commitment, we provide all the data supporting the findings of our study, which is openly available on Zenodo at https://doi.org/10.5281/zenodo.14176810.

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