Revolutionizing Agriculture through Digital Platform: Examining the Economic Viability of a Web Portal for Equipment Lending and Income Generation in Off-Seasons

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***Abstract*: This research paper presents a case study on the application of information technology in agriculture, and how it can help to transform the lives of poor farmers in developing countries. In particular, we will focus on how a multilingual web portal called Krish-e-Hal has been created as an alternative solution to increase farmer incomes during the off-season, when no crops are grown and hunger becomes a problem. This portal allows farmers to lend and buy farming machinery and equipment, and it can be used easily by any farmer in any part of the country. India has a unique cropping pattern, with different parts of the state experiencing sowing season or off-season at any given time, and this pattern is being utilised in our portal to help farmers to generate an alternate source of income by lending their expensive modern farming equipment in the off-season. Our solution is beneficial for poor farmers in debt trap**

***Index Terms*— Rental portal, Sustainable agriculture, Farmer equipment rental, Equipment sharing, Increasing farmers income, Web portal, Student innovation**

I. INTRODUCTION

In India, agriculture and farming serve as the primary occupation for a majority of the population comprising 14% of the Indian GDP. According to recent economic reports, approximately 40-42% of the workforce is engaged in farming activities. Despite being the world's largest producer of wheat and rice, Indian farmers struggle to earn enough income to provide three meals a day for their families. The average monthly income of a farmer is around ₹10000, which is insufficient in today's world. Over 50% of farmers' families spend more than they earn and subsequently fall into debt traps set by wealthy landlords. Farmers have limited alternative income sources if they are unable to profit from farming. Their earnings frequently fall short when compared to those employed in other sectors.

This paper seeks to examine methods for boosting farmers' incomes by reducing upfront costs such as significant machinery and equipment costs. Any potential cost reductions could greatly influence farming's economic viability on a larger scale. Following an in-depth analysis, our team has proposed an alternative solution aimed at boosting farmers' income during seasons when no crops are sown or.

II. PROBLEM IDENTIFICATION

Global agricultural industry is notable, with significant growth attributed to the introduction of farming machinery. Despite this, traditional farming methods have been used by generations of farmers in India. Many farmers are reluctant to make the substantial financial commitment required for mechanization. Insufficient mechanization in agriculture continues to be a pressing issue in numerous developing countries, primarily due to inadequate capital investments from farmers who often cannot afford the essential equipment or perceive no return on their investments. The outcomes of this lack of mechanization are evident in the sluggish growth and decreased efficiency within the agricultural sector.

In recent years, an increasing number of farmers entertain the idea of investing in mechanization to boost their crop yield and minimize labour expenses but are forced to obtain loans from banks to finance expensive machinery, which significantly contributes to the high suicide rate among them, with 80% of cases linked to debt. The destruction of crops during floods and rainy seasons causes severe financial strain on farmers, making it challenging for them to repay their loans. A potential solution is if farmers were able to rent equipment for short durations instead of purchasing them outright, thereby reducing production costs and burden of repayment.

The following information table and charts reveals that 562 farmers were categorized into three groups: small, medium, and large. Among the 377 smallholder farmers, 179 expressed interest in obtaining a loan, with 128 of them requiring the loan for machinery rental. Within the medium category, 53 farmers possess credit, and 28 of them need it for renting equipment. Studies and assessments indicate that the majority of farmers require credit to purchase or lease equipment, thereby lowering their initial investment costs.

Table 1: Depicting the various reasons and interest in renting machinery

Analysis of various farmer category and whether they availed loan or not and their wish to hire machinery				
Farmer's category	***If loan availed***	***Reason for loan availed***	***Count***	***Interest in hiring machinery***
Small=377	Yes=179 No=198	Plantation, Fertilization, Machinery, Land Dev. Education Not Availed Loan	10 127 42 0 198	Yes=179 No=197
Medium=179	Yes=53 No=126	Plantation, Fertilization, Machinery, Land Dev. Education Not Availed Loan	0 28 25 0 126	Yes=51 No=121
Large=6	Yes=4 No=2	Plantation, Fertilization, Machinery, Land Dev. Education Not Availed Loan	0 4 0 0 2	Yes=2 No=4

Figure 1: Graphs to represent study result

III. Problem Statement

During off-seasons, it's common for farmers to have idle equipment and machinery. Our goal was to create a platform allowing farmers to rent out their farming equipment at lower rates during these periods. By utilizing a straightforward aggregation platform alongside call centre support for booking equipment, farmers can generate additional income

IV. Problem Solution

As a country where farming occurs year-round, India's regions experience varying seasons with differing tool requirements from season to season. This seasonal pattern sometimes creates a situation where one region's off-season coincides with another region's sowing period. Utilizing this pattern to our advantage allows for the lending of unused farming equipment from one region to another at minimal cost, enabling farmer's access to essential machinery without burdening them with purchasing it outright.

We have developed Krish-e-Hal, an online platform aimed at assisting farmers in renting and sharing agriculture equipment. Farmers in need of tools can easily visit our platform and rent the necessary equipment. Additionally, if a farmer possesses idle tools or equipment, they can share or list it on our platform, allowing other farmers and workers to borrow said equipment. Consequently, this will enable the lender to earn extra income while simultaneously reducing the financial burden on smaller farmers due to loans and debts.

The rental market for farm machinery, particularly expensive ones, can enhance farm mechanization in several ways:

• By increasing investment incentives for capital goods. The returns on these investments are likely to rise with the presence of an agricultural machinery rental market since machine owners with excess capacity can now generate income by leasing their services.

• By providing accessibility to less wealthy farmers who cannot afford farm machinery. These farmers can still experience and afford farm automation by renting the equipment. Thus, establishing a rental market for agricultural tools benefits both well-off and economically disadvantaged farmers. In essence, agricultural machinery lease markets can function similarly to other factor markets such as water markets and land lease markets.

• By elevating agricultural production and efficiency. The agricultural machinery rental market can help farmers effectively adapt to changing environments such as limited pastures for raising draft animals, frequent flooding, and insufficient electricity supply. Due to these challenges, even maintaining a single cow can prove difficult; smallholders often resort to using oxen or progressively employing plows or tractors as alternatives.

V. DESIGN AND IMPLEMENTATION

V.I Software Requirement Specifications

i. Functional Requirements

The portal comprises several features. These include:

- **Registration and Authentication:** Users can sign up to the platform by furnishing fundamental details such as name, contact information, and location. The portal also incorporates secure authentication techniques, including passwords and two-factor authentication, for protecting user data.
- **Tool Listings:** Farmers and tool proprietors can establish listings for their tools, specifying information like tool type, location, accessibility, and rental fees. Listings creation and management are convenient with options to modify or remove listings when necessary.
- **Searching and Filtering:** Renters can look for tools according to parameters like tool kind, area, availability, and cost. The portal also offers filtering capabilities to aid renters in refining their search results and finding suitable tools according to specific needs.
- **Booking Management:** Renters can reserve tools through the platform by choosing their desired tool, rental duration, and delivery alternative. Farmers and tool owners get notified of new reservations and can oversee bookings via the portal.
- **Payment Processing:** The platform employs a secure payment processing mechanism for renters to make payments for their tool rentals using credit or debit cards or other electronic payment options. Additionally, the platform handles payment disbursement to farmers or tool proprietors after deducting any applicable fees.
- **Chat Support:** The portal integrates chat support functionality for users to raise queries, receive assistance with issues, or acquire support from customer service representatives or fellow users. This feature is user-friendly, accessible through both the website and mobile application.
- **IVR System:** An Interactive Voice Response (IVR) system is incorporated in the portal that allows users to book tools telephonically by following a series of voice cues. The system accommodates users with limited literacy or technical abilities.
- **Multilingual Support**: The portal caters to a diverse user base with support for multiple languages, enabling users to engage with the platform in their preferred dialect. Additionally, translation services or language support are available

ii. Non Functional Requirements

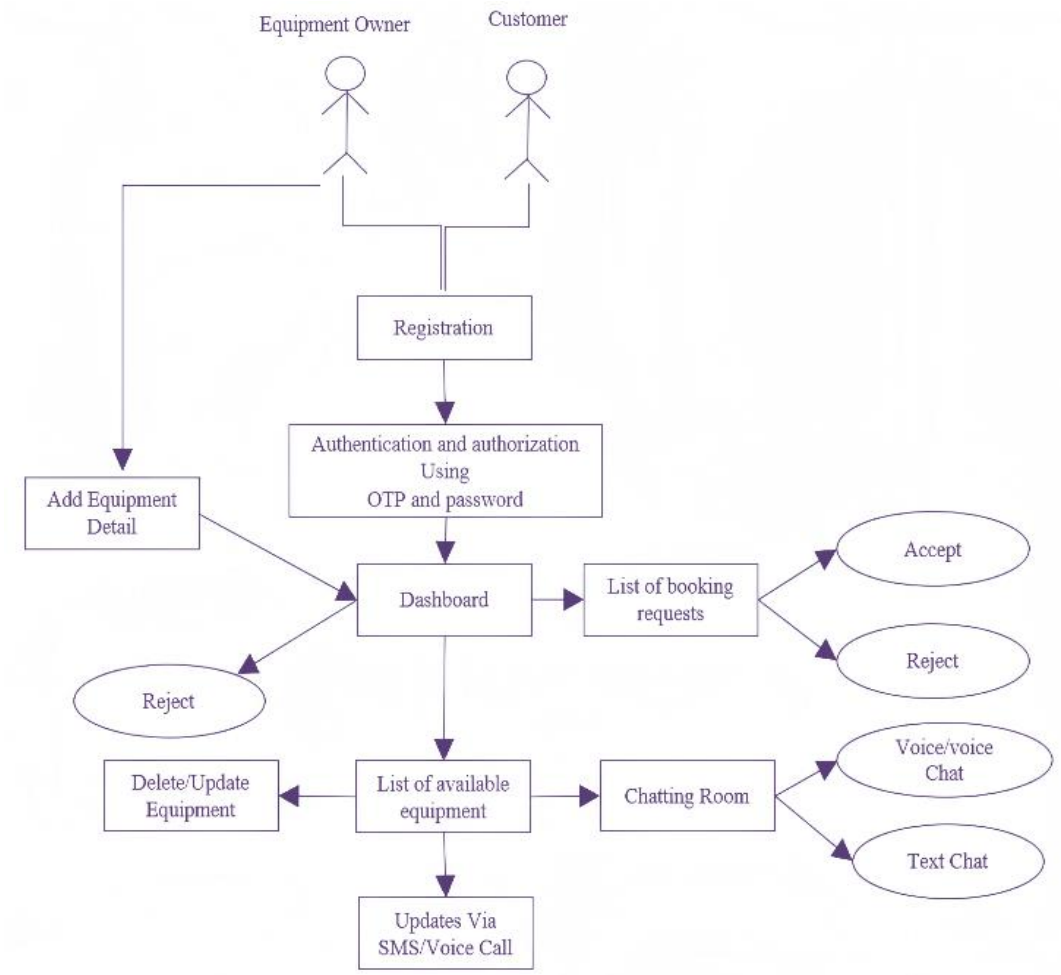
The various non- functional requirements for the system are:

- **Availability**: The system is available 24/7 with an as minimum downtime as possible.
- **Ability to handle stress:** The system will be able to handle a high volume of concurrent users at any period of day.
- **Secured:** The system is highly secured and protect sensitive user data of users specially the payment details.
- **Accessible:** The system is accessible from all the user devices whether mobile or stationary.
- **Understandable:** The system is easy to use and understand for farmers with a lesser literacy rate.
- **Fast Response:** The system is very fast and have a response time of less than 2 seconds to any query
- **Scalable:** The system should be scalable, and should be able to handle increasing number of farmers over time.

V.II: Flow Diagram

The diagram below illustrates the process within our web portal. Upon a user's initial visit to the site, they can view available equipment for rent; however, they must register and verify their identity before booking or listing items for rent. Login authentication is managed by Firebase, with OTP and email-password options for accessing the portal. After registering and logging in, the user arrives at the main dashboard displaying equipment details and images. By clicking on an image or a "get details" button, users can access additional information regarding specific equipment and book directly from that page. The home page offers links and features that users can explore and utilize, including a chat system for resolving inquiries via an AI Chabot or text chat. Users wishing to lend tools can find an "Add Product" button on the navigation bar, which directs them to a form requesting necessary information for creating a listing. Once they complete the form and submit it by clicking "Add Product," their item appears on the main dashboard. Admins oversee these actions and have the authority to remove any listings deemed inappropriate.

Figure 2: Flow diagram of portal



V.III Use Case Diagram

Actors:

Farmer/user: The "Farmer" actor is the primary user of the tool-sharing portal, and they have several key responsibilities and abilities within the system. These include:

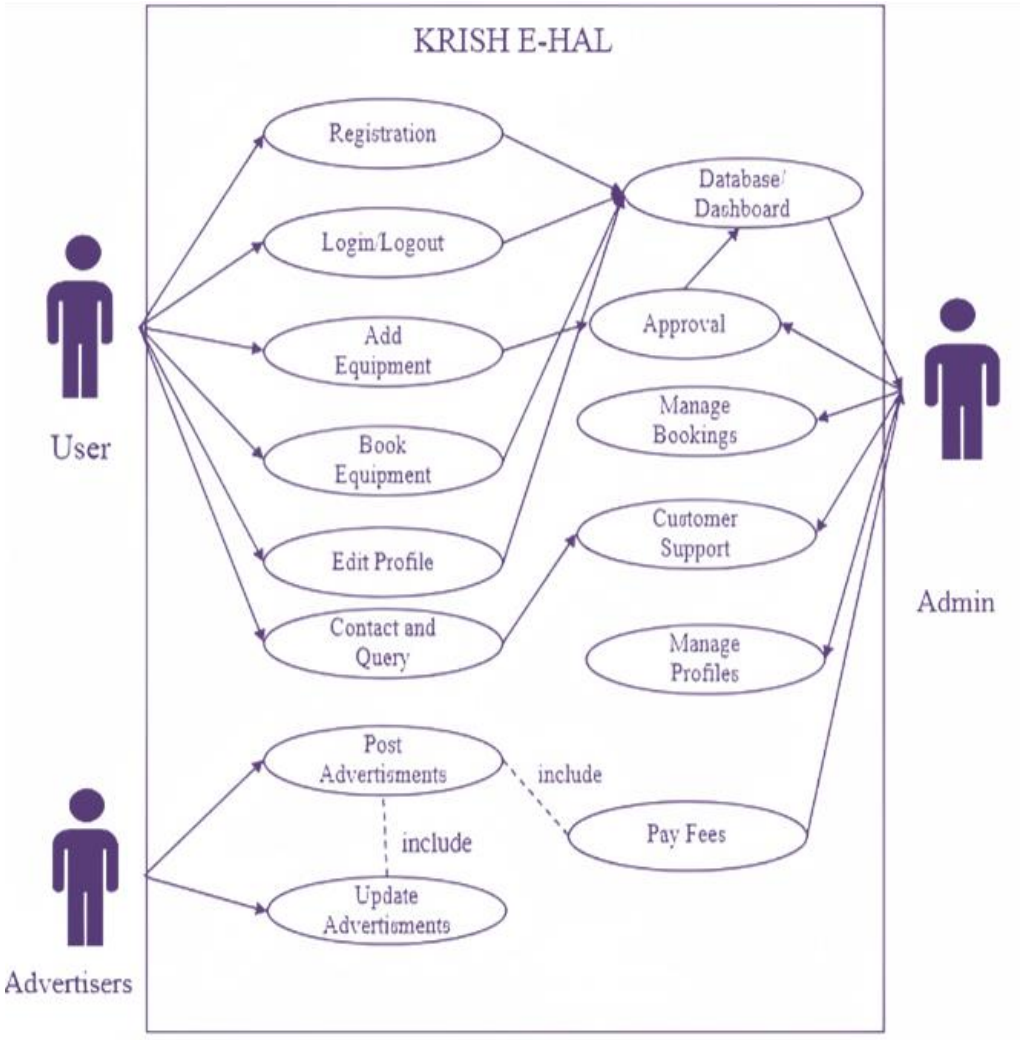
1. Listing Equipment
2. Searching for Equipment
3. Renting Equipment
4. Communicating with other Farmers

Administrator: The "Administrator" actor is responsible for managing and moderating the tool-sharing portal. They have several key responsibilities and abilities within the system, which include:

1. Removing and approving Equipment Listings
2. Handling Issues and Complaints
3. Managing Transactions:
4. Approving and posting advertisements:

Advertisers: The advertiser actor can play an important role in generating revenue for the tool-sharing portal.

Figure 3: Use case diagram of portal



V.IV TECHNOLOGY USED

The technology stack used to develop our equipment and machinery renting web platform includes React.js and Tailwind CSS for front-end development, and Firebase for back-end development. Firebase provided a variety of tools and services for our platform, including authentication, real-time database, hosting, and storage.

To support multilingual functionality, we utilized the Google Translate API to enable users to switch between multiple languages on the platform. We also implemented the Razorpay API for payment processing, which allowed for seamless and secure transactions.

Additionally, we integrated Twilio's API to provide chat support and an IVR system for users to book tools through a phone call. Overall, this technology stack enabled us to create a dynamic, user-friendly, and functional platform for farmers to lend their tools and generate extra income during the off-season.

VI. OUTCOME

After conducting a comprehensive analysis of the obstacles faced by small and medium-sized farmers in India, we discovered that many of them find it difficult to afford the essential farming machinery needed to ease their work and enhance efficiency. To address this issue, we developed Krish-e-Hal, an innovative platform enabling farmers to rent and share equipment at reasonable prices.

We utilized cutting-edge research and technology in constructing the platform, making sure that it is user-friendly, secure, and reliable. Farmers can effortlessly sign up on our platform and explore available equipment for rent. Moreover, they can list their idle or unutilized machinery on the platform, generating additional income while assisting fellow farmers who may not

Farmers can access an extensive array of machinery such as tractors, threshers, and various other farming instruments via Krish-e-Hal. This dramatically simplifies their lives and contributes to elevating their economic standing. Our platform is specifically engineered to create a rental ecosystem that advantages all farmers throughout the nation.

In short, Krish-e-Hal is a transformative platform addressing the financial have the means to invest in new equipment struggles faced by India's small and medium scale farmers. It enables them to easily and affordably rent and share farming equipment, subsequently improving their agricultural practices and overall living standards.

VII. RELATED WORKS

A paper titled 'Metaheuristic and Machine Learning-Based Smart Engine for Renting and Sharing of Agriculture Equipment' by Manik Rakhra, Ramandeep Singh, Tarun Kumar Lohani, and Mohammad Shabaz surveyed 562 farmers and identified financial struggles stemming from the high cost of new machinery. In response, an Internet-based mobile app was developed to facilitate advertisement, reservation, rental, and sharing of agricultural equipment. This e-marketplace empowers farmers to grow their businesses and enhance their knowledge.

Similarly, a paper named 'Efficient Farming – Hiring Equipment for Farmers' by B. Jothi Jahnavi, R. Monica, and N. Supriya tackled this issue by creating a mobile app that concentrates on renting tractors and other machines. The app features market rate information for equipment and was developed with JetBrains' IntelliJ IDEA software. The aim is to provide a free renting service for users.

Another paper, 'Agri-Equipments Rental System' by Bhuvan S, Purushotham G.K, Manoj A, Chandan A.M, Chandraprabha K.S., aimed at simplifying agricultural machinery rental. The app allows users to check equipment availability and offers advanced booking and tracking capabilities for rented items. The project's goal is to minimize manual labor, save time, and promote a sustainable environment.

Furthermore, the research paper 'Farm equipment rental system' by Anuradha A., Bhavana J. Musale, Mrunali T. Nanaware3, and Priti R. aimed at developing a portal to enable farmers to loan their machinery during off-seasons. With user-friendly design at its core, the portal enhances profits while reducing time and effort for farmers. Additionally, it serves as an information hub for future use.

A research paper titled 'AGRARYANS: Farm Equipment Rental System/Based on Agriculture' by Chella Ashok Kumar and Dr. M. Saravanamuthu delves into the idea of machinery leasing and the role of E-commerce platforms in connecting farmers with suppliers. The paper puts forth a proposal for offering affordable rental services to farmers, thus creating an additional income source during off-season periods.

In recent times, several major corporations have attempted to tackle similar challenges. For instance, 'Mahindra & Mahindra Limited' introduced the Krish-e application in 2020, which delivers various services to farmers through its mobile app. These services encompass farm consultancy, crop diversification methods, and personalized guidance. One aspect of this application is the 'Krish-e Rental Partner App,' which enables larger partners to rent out heavy machinery via the platform.

The case study titled 'The benefits and challenges of machinery sharing among small-scale fruit and vegetable growers' by Georgeanne Artz and Linda Naeve focuses on the benefits and challenges faced by growers during the first year in machinery-sharing arrangements. The study examines the sharing and lending opportunities amongst farmers who want to scale up their business but are unable to do so due to capacity and manufacturing scaling problems, and are hesitant or unable to make high investments upfront. After various questionnaires and meetings, it concludes that most people were satisfied and quite happy with the impact that the lending of tools had on their yield and profitability. Some of the benefits highlighted by the group included reduced upfront costs for purchasing expensive machinery early on in the business cycle. In addition to this, there were savings in labour costs due to the use of machines, which increased productivity while reducing effort.

The paper 'Web based form equipment rental system for agriculture' by Nagendra Raju, Dr T Manikumar, and Dr N Naveenkumar focuses on the development of a system that allows farmers to purchase equipment on an hourly lease basis. The system aims to build an e-commerce store of tools, providing a time-saving and quick purchase option for farmers. The system is built using HTML and CSS in the frontend and Python Django in the backend. However, upon doing a literature review of the research paper, it is unclear to what extent the system is able to solve the stated problem. The project seems to be very basic and static, providing very limited functionalities to the farmers.

Implementing Machine Learning for Smart Farming to Forecast Farmers' Interest in Hiring Equipment is a research paper that focuses on the significance of tool renting and sharing in the workplace. The study examines rental and sharing equipment as two approaches that might be used to enable farmers to borrow equipment at a cheaper cost than they would otherwise have to pay for it. The research highlights the difficulties confronting agriculture in terms of farmer education, land ownership, awareness, mobile phone use, debt burden, loan source, and interest in renting equipment. The research found that farmers lack awareness of current technology, which is extensively used in agricultural operations worldwide. Another barrier is the financial status of farmers, especially small and marginal farms.

The publication 'Agri-Equipments Rental System' authored by Bhuvan S, Purushotham G.K, Manoj A, Chandan A.M, Chandraprabha K.S focuses on the agricultural equipment rental system in India. Organizations exist to help those farmers in need of these tools by renting out equipment owned by the organization at a liable cost. Previously, farmers had to travel to obtain all necessary equipment, resulting in a time-consuming and expensive activity. This paper describes the digitization of the process of renting agricultural equipment for farmers, focusing on developing an application that farmers can use to rent and check the availability of equipment. Farmers are also able to reserve equipment in advance, and this application helps to keep track of equipment on rent.

A paper entitled 'Tractor Hiring Application for Farmers' created by Krunal Bagaitkar, Khoshant Lande, Anklesha Welekar, Aman Yadav, Anshul Tambe and Amruta Chopade, discussed the development of a mobile app called the Tractor Hiring Application for Farmers. This app aims to assist farmers who are facing issues such as the inability to rent tractors and other farming equipment at reasonable rates. Additionally, farmers may not always know the costs involved in renting tractors and other agricultural machines, making them vulnerable to exploitation by tractor owners who may charge extra fees. As a solution, this Android application has been introduced. The application also features two different languages, English and Hindi, making it easier for farmers to use. Therefore, this application serves as an interface between farmers seeking to hire or to rent out equipment.

VIII. ENHANCEMENTS ADDED

We are delighted to introduce the newest development in our project in this research paper, which emphasizes the enhancements made to our cutting-edge equipment and machinery rental web platform for farmers.

Our versatile platform addresses all the limitations that existed in earlier versions developed with a focus on ecommerce but without accounting for farmers' literacy levels. Our project sets itself apart by offering multilingual support, chat assistance, voice recognition capabilities, filtering and sorting options, as well as a visually appealing, simple, easy to understand and user-friendly interface.

Our platform is designed to be user-friendly and intuitive, enabling farmers to swiftly list their tools and allowing potential renters to effortlessly discover the equipment they require. The chat support function ensures effective communication between farmers and renters to negotiate prices amongst themselves, while voice recognition assistance allows those with literacy challenges to easily navigate the platform.

Moreover, our platform also includes an extra IVR system feature that allows tools to be booked through a phone call, similar to booking an LPG connection. This feature is especially helpful for farmers who have limited access to smartphones or the internet, but still want to take advantage of the benefits of our platform.

By including this feature, we ensure that every farmer has equal access to our platform and can enjoy its benefits. Our goal is to create an inclusive and accessible platform that is designed to meet the unique needs of farmers, and the IVR system feature is a step in that direction.

We are confident that our platform will transform the way farmers rent out their tools and contribute to a more resourceful and sustainable agriculture sector. We take pride in developing a solution that caters specifically to the requirements of farmers while ensuring accessibility, convenience, and mutual benefit for all involved.

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IX. CONCLUSION

We have concluded, after studying various sources and research papers, that farmers need modern equipment to increase production and profit but without high upfront costs. To bridge the gap in the farming industry, we have created a web application called 'Krish-e-hal', which allows farmers to share and rent equipment. This platform not only enables farmers to save money but also provides an opportunity to increase their income.

'Krish-e-hal' has several special features, such as multi-language support to cater to farmers from different states and mobile verification for enhanced security. Farming can be expensive, especially when purchasing equipment and other necessary resources. Our platform helps resolve this issue by renting out equipment at a lower cost, increasing profitability and reducing the time and effort needed by farmers. It also ensures that all important information is saved for future use. In addition, we have developed and launched an Internet-based mobile application that can be used to advertise, reserve, rent, and share agricultural equipment. The main aim of this application is to ensure farmer business stability.

X. FUTURE SCOPE OF WORK

The future prospects of our equipment and machinery rental web platform are immense, with the potential to revolutionize the lives of millions of farmers worldwide. By facilitating equipment lending during idle periods, farmers can generate supplementary income and enhance their financial stability

Moving forward, we aim to implement a fully automated, artificial intelligence-based delivery management system to assist farmers in streamlining their delivery processes. Utilizing AI algorithms, this system will optimize delivery routes and minimize delivery times, yielding faster and more efficient service. Moreover, we plan to refine the booking system for a more seamless experience in listing tools for farmers and sourcing the necessary tools for renters.

Additionally, our development roadmap includes improving non-functional aspects of the platform through enhanced security measures and expedited loading times.

Another future work that we wish to implement is a sophisticated artificially intelligent tool recommendation system that will improve user experience by showing the tools that are more suitable for them in their region and according to the weather and season.

This tool recommendation system will use AI algorithms and data analytics to suggest the most suitable tools for the farmers, based on their geographical location, crop type, weather conditions, and other relevant factors. By providing personalized recommendations, we can help farmers choose the right tools for their specific needs and improve their overall efficiency and productivity.

The implementation of a sophisticated artificially intelligent tool recommendation system will be a significant enhancement to our platform, leading to a more personalized and efficient user experience for both farmers and renters.

In summary, our equipment and machinery rental web platform hold the potential to significantly impact millions of farmers by providing opportunities for additional income and financial improvement. The future scope of our platform is extensive, as we continually enhance its features and user experience. Ultimately, our goal is to make this platform readily available to farmers across the globe—contributing to a more efficient and sustainable agricultural sector.

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