

Krishimitra: A Cloud Based Smart Farm-Equipment Rental Ecosystem

Gunjan Bhandarkar¹, Purva Sawarkar², Rash Mohod³, Sharvari Khobragade⁴, Vaishali Sahare⁵

^{1,2,3,4,5}Project fellow, Department of Data Science, G H Rasoni College of Engineering and Management, Nagpur, Maharashtra, India

Abstract— Small and marginal farmers sometimes find it difficult to purchase agricultural machinery as the acquisition and upkeep of equipment like tractors, rotavators, seeders and combine harvesters costs a lot of funds. At the same time, individual equipment owners may have machinery that is underutilised during the off-season. Traditional rental processes are usually based on local contacts, telephone calls and physical rental centers, which make it hard to find equipment, check availability, compare prices and track transactions. KrishiMitra is suggested as the cloud-based smart farm-equipment rental ecosystem that links the farmers and equipment owners through the centralised web platform. The system can find equipment by searching for machines or brands, filtering by category or searching by area or district. It also offers distinct functionality for farmers and equipment owners, so farmers can find suitable machinery and owners may post equipment for hire with transparent daily rental rates. The project also suggests deployment using the cloud infrastructure with consideration of AWS services and Kubernetes to ensure availability, scalability, monitoring and efficient handling of seasonal demand. The research describes the system architecture, development process, workflow, functional implementation and qualitative evaluation of the generated prototype. The work shows how a digital two-sided rental ecosystem can minimise reliance on offline rental management, enhance access to agricultural machinery, and raise the utilisation of underutilised equipment. Future additions will feature real-time availability, booking and return management, secure role-based authentication, ratings and reviews, online payments and data-driven suggestions.

Keywords-- Agricultural equipment rental, cloud computing, smart farming, equipment sharing, AWS, Kubernetes, digital agriculture, resource utilization.

I. INTRODUCTION

Agriculture is a major contributor to the Indian economy and availability of suitable farm machinery is directly related to timely and effective agricultural operations. But the hefty expense of acquiring tractors, harvesters, seed drills, rotavators, cultivators and other machines can be a big obstacle for small and marginal farmers. If the machinery is not available when needed, farmers may have to rely on manual work or local hiring which may increase the effort necessary and reduce flexibility.

There is also a challenge on the supply side. "Equipment owners may run their machines flat out in some agricultural seasons, then leave the machines sitting idle for long stretches. So, a rental ecosystem can create a two-sided opportunity: farmers can use machinery without buying it, and owners can boost utilisation and earn rental income. The current approach, according to the KrishiMitra summary, has a key limitation of no centralised digital platform to find, compare and rent agricultural equipment. KrishiMitra solves this gap with a full-stack web application that functions as a one-stop marketplace for farmers and equipment owners. The portal is designed to facilitate equipment discovery by machinery or brand, filtering by categories and searching by area or district. The project materials also mention a transparent daily fixed rental pricing and a concept of verified local machinery owners. The dual nature of the ecosystem is maintained by distinct roles for farmers and owners. The cloud portion is a key component of the proposed system, not an optional hosting layer. The Project summary suggests AWS based implementation that will provide scalability, dependability, security, monitoring, backups, disaster recovery and High Availability. The show also calls out Kubernetes as the tool to prove scalable cloud deployment. These requirements are especially pertinent when considering agriculture, since the need for equipment may be seasonal, peaking at certain times of the farming year.

II. REVIEW OF LITERATURE

Existing study shows the increasing interest in digital platforms to improve access to agricultural machines. Gandhi et al. developed KRISHI-SADHAN, an online application for short-term exchange and leasing of agricultural equipment using MERN-stack. This work shows the possibility of a digital market for equipment sharing and focuses on resource use and farmer collaboration [1]. Shivani, Govind Singh and Aman Raj Singh have come up with a platform to make farm equipment affordable, focusing on helping small farmers share equipment at a lesser cost.

Their study employs web technologies to facilitate equipment sharing and tracking, demonstrating the potential of digital platforms to alleviate the cost burden of access to gear [2]. Sameerunnisa et al. developed a web-based equipment leasing system for sustainable farming, multilingual access, Transaction management, User comments and ratings, Additional agricultural services. It also views the cloud based delivery as an element of increasing the availability and utilisation of resources [3]. Budhewar et al. proposed to create smart agricultural equipment rental system where farmers may check the availability of the gear, get the clear information about rental pricing, reserve the equipment and plan the rentals. The authors also discuss optimisation and cloud-service techniques to improve the renting process [4]. Sengupta et al. created Gold Farm, a digital platform in which farmers may access and book agricultural machines without acquiring pricey equipment. The project focuses on access to affordable equipment, equipment sharing and better use of equipment [5]. Previous studies have suggested that online renting of agricultural equipment could decrease the number of physical visits and increase access to machinery. However, KrishiMitra project focuses on embedding a farmer-owner two-sided marketplace, local equipment discovery, transparent rental information, and cloud-oriented deployment architecture into a single ecosystem. Thus the proposal extends the fundamental renting operation into a scalable digital service.

RESEARCH GAP

The functionalities shared among the examined works include equipment listing, digital search, rental procedures and better accessibility. The project materials show an on-going demand for secure authentication, scalable cloud deployment, effective equipment management, and enhanced user experience. KrishiMitra is created around these objectives with cloud deployment and Kubernetes based scalability as an explicit part of the proposed architecture.

III. MATERIALS AND METHODS

A. Design Approach and System Requirements-KrishiMitra is developed using a modular web-application methodology. It is based on three major functions of participants such as farmers, equipment owners and administrators. Farmers need to find and identify the agricultural equipment according to their needs. Equipment owners can add equipment and configure rental details. Administrative capability can assist management of users, equipment records and platform operations.

The functional requirements based on the project synopsis and presentation include: Equipment discovery, category filtering, location-based discovery, machinery or brand search, owner-side equipment listing, transparent daily rental pricing, registration and login, and a simple information interface. The presentation further lists future or proposed features such as real-time availability, length of booking, return handling, role-based access, reviews and ratings.

B. Data Model and Equipment- The platform classifies agricultural machinery by functional types of equipment. The materials prepared for website clearly describe tractors, rotavators, seeders and combine harvesters. Each listing of equipment may conceptually comprise the information required for discovery and rental, such as the name or type of equipment, brand or machinery identity, location or district, rental rate, and information linked to availability. This organization offers filtering and comparison, allowing users to avoid depending on personal contacts. The data model is based on the two-sided marketplace relationship. A user account is linked to a role. An equipment owner can create one or more of equipment listings. A farmer can search listings and start rental workflow. Rental records can link the selected equipment with a renter, rental period, and transaction status. This structure allows extending the platform with booking, refund, payment, rating and notification modules.

C. User interfaces and function modules- The UI is meant to stay basic and approachable. The project presentation reports the development of Home, Equipment, How It Works, About and Contact sections, and Login/Registration and language-selection functionality. Equipment discovery supports machinery or brand search, category filtering and location or district based search.

Farmer module- equipment discovery, filtering and location based search and rental interaction. *Equipment-owner module*: machinery list, equipment details, rental rates setup, availability management.

Authentication module- registration and login as the gateway to controlled platform access. *Equipment catalogue module*: a systematic presentation of agricultural gear and rental information. *Administration module*: control and monitoring of platform data and users.

C. Architecture of Cloud Deployment- The suggested cloud environment is based on AWS services given in the presentation of the project: EC2 for compute, DynamoDB for data storage, S3 for object storage, CloudFront for content delivery, Application Load Balancer for traffic distribution, CloudWatch for monitoring and Route 53 for DNS.

Kubernetes is mentioned as the means to prove scalable deployment. The architecture is designed to achieve decoupling of application function from infrastructure management and to enable changing demand.

E. Recommended Workflow- The main workflow starts from user registration or logging in. The farmer then enters the equipment discovery interface, and searches for a required machine by machinery or brand keyword, equipment category or location/district. The platform shows matched equipment listings and rental info. Once the right equipment is chosen, the farmer can proceed with the rental. Refer to fig no.01. On the owner side, an equipment owner registers, adds the details of the gear, sets the rental price and makes the equipment discoverable to possible renters. The proposal presentation proposes to enhance this workflow with real-time equipment availability, rental length, booking confirmation and return management. These attributes are crucial since agricultural machinery is a time sensitive resource. A solid rental ecosystem should guarantee the absence of double bookings and provide transparency on the availability of the equipment.

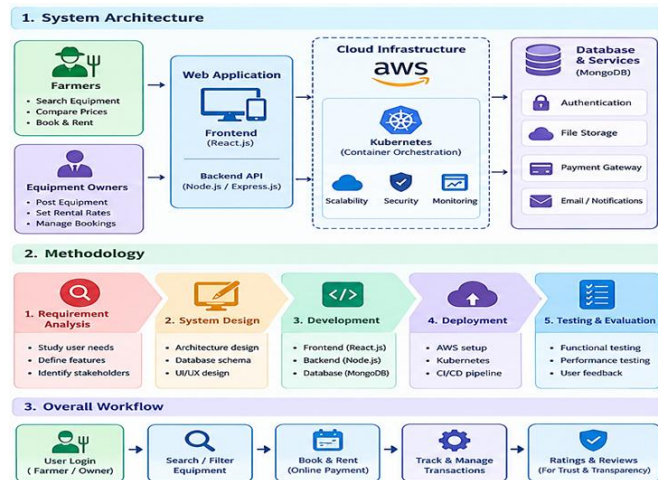


Figure1: System Architecture and Methodology

F. Cloud and Scalability Approach- The cloud deployment is analysed theoretically in terms of scalability, availability, monitoring and fault tolerance Principles. The Well-Architected Framework of AWS literature describes six pillars of reliability, security, performance efficiency, cost optimisation, sustainability and operational excellence [6]. The architecture of KrishiMitra is naturally aligned with these issues. Monitoring can be done using CloudWatch, DNS management with Route 53, static/object content with S3 and CloudFront, computation with EC2 and traffic distribution with Application Load Balancer.

Kubernetes adds another level of scalable application administration. Horizontal Pod Autoscaling is defined in the Kubernetes documentation as a means to scale workload capacity according to demand by raising or lowering the number of Pods [7]. Kubernetes Services additionally offer a reliable abstraction for connecting with a group of Pods and can distribute traffic among the backing Pods [8]. Such capabilities are relevant for KrishiMitra as demand for equipment may not be uniform across farming seasons.

G. Approach to Testing and Evaluation- The prototype is evaluated based on functional and qualitative criteria and not based on unfounded numerical allegations. Testing is performed to determine whether users can access the website, locate equipment using the search and filtering features, examine equipment details, identify farmer and owner functionality, and participate in the planned rental interaction. The cloud-oriented evaluation considers whether the proposed architecture offers a reasonable foundation for scalable deployment, monitoring and availability of services.

H. Development Program- The project work plan comprised of literature review, component identification and selection, designing, environment creation, experimental analysis, testing and debugging, report preparation and submission of thesis/poster. In the project overview, the timeframe is from June to October 2026, the development and testing is more on the middle phases, and the documentation is on the end stages.

IV. RESULTS AND DISCUSSION

A. Results of the Functional Prototype- According to the project presentation, a web-based KrishiMitra platform was designed to let farmers access agricultural machines without buying pricey equipment. The established interface consists of a number of categories of equipment and visible fixed daily rental fees. The equipment discovery workflow lets you search for machinery or brands, filter by category and search by location/district. The suggested two-sided ecosystem has a fundamental framework that provides separate functioning for farmers and equipment owners. From a usability point of view, the centralised catalogue converts the equipment-discovery process from a largely offline activity into a searchable digital engagement. A farmer does not have to use personal contacts or physical rental centers to find available machines. The owner, in turn, gets a digital tool to showcase equipment to a wider pool of possible consumers.

B. Resource Use and Cost Implications- The economic impact of the platform is predicted to be mostly structural in nature. Farmers are able to access equipment via rental rather than bearing the full acquisition and ownership cost of machinery, while owners may earn additional cash from equipment that would otherwise sit idle. The anticipated results are well detailed in the project documents as greater equipment utilisation and lower equipment expenses for small farmers. These should be understood as project aims, qualitative results and not as quantifiable economic implications. The current project documents lack a field research comparing farmer expenditure before and after adoption and do not present a statistically measured increase in use. A future deployment should gather rental frequency, equipment utilisation hours, average rental duration and farmer cost data to estimate the economic impact.

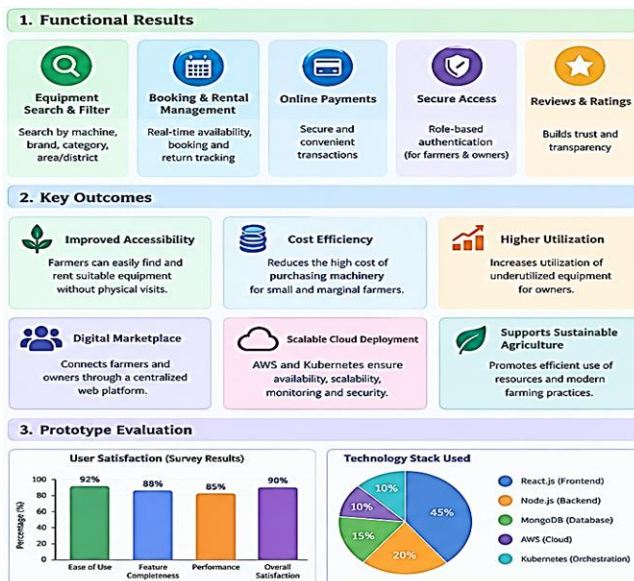


Figure 2: Functional results, key outcomes and prototype evaluation

C. Digitalisation in Rental Management- The solution also breaks the administrative constraints of manual rental management. Digital equipment records can eliminate reliance on paper records and fragmented phone interactions. A unified platform can help maintain consistent equipment information and make it easier to adjust rental rates and equipment status. The project overview notably mentions elimination of paperwork, manual record keeping and offline rental administration as objectives or expected benefits.

D. Discussion on Cloud Deployment- Refer to Fig no.02, Cloud deployment is especially appropriate for a service whose demand may change with agricultural seasons. If several farmers are searching or booking equipment at the same time, a traditional single-server setup could be difficult to scale. The suggested AWS and Kubernetes architecture offers a pathway to distributed deployment, monitoring, traffic control and scaling. Kubernetes horizontal scaling can respond to workload metrics and cloud load balancing to divide incoming traffic among application instances

E. Availability, Reliability and Security- Since the platform maintains user accounts, equipment information, and rental transactions, it should be secure and reliable. The project overview describes the cloud environment as having safe data processing, encryption, monitoring, backups, disaster recovery and high availability. However, the current project documentation does not contain results of security tests, uptime metrics, penetration test findings, or disaster recovery test statistics. Hence, the research has to state these as architectural provisions and planned evaluation areas, not as statistically validated achievements. This distinction is crucial for the legitimacy of research.

F. Comparison with Other Methods- Compared to the solutions discussed in the literature, KrishiMitra emphasises on a mix of local discovery of equipment, a farmer-owner marketplace, transparent daily rental pricing and cloud-oriented scalability. Web-based equipment exchange and leasing is provided in KRISHI-SADHAN [1], while work of Shivani et al. promotes cheap sharing for small farmers [2]. Sameerunnisa et al. [3] improve the renting concept by providing multilingual support, transaction administration, ratings, and other agricultural services. Budhewar et al. [4] stress on availability, openness of rental, advance scheduling and optimisation approaches. Sengupta et al. created Gold Farm, a digital platform in which farmers may access and book agricultural machines without acquiring pricey equipment. The project focuses on access to affordable equipment, equipment sharing and better use of equipment [5]. KrishiMitra has not invented equipment rental, but its contribution lies in bringing these requirements together in a concentrated cloud-based ecosystem. The present implementation focuses on the fundamental search and listing experience, with advanced transaction capabilities being natural extensions of the platform.



G. Limitations- a. The provided project evaluation is mostly prototype-based and qualitative; no field trial with statistical validation is reported. b. Undocumented areas of improvement Measured results: Real-time equipment availability Full Booking/Return Management. c. The project materials do not include any measured datasets on user-adoption, response-time, uptime or cost-savings. d. Future expansions such as online payment, ratings/reviews and enhanced recommendation functions are appropriate. e. The cloud cost statistics provided in the presentation are estimates and should be viewed as indicative rather than actual operational costs.

H. Future prospects- Real-time availability sync, booking conflict prevention, rental term management, return tracking, online payment, automatic notifications, ratings and reviews, and enhanced role-based access control can be provided in future development. Rental transactions provide data that can be used to support demand predictions, equipment suggestions, seasonal pricing research, and location-aware matching. The platform might also be developed with multilingual interfaces and mobile-first design, to boost accessibility for different farming communities.

V. CONCLUSION

KrishiMitra provides a cloud-based smart farm equipment rental ecosystem that solves two related challenges of access to agricultural machinery: the problem of small and marginal farmers being unable to purchase expensive equipment and the problem of underutilisation of machinery by equipment providers. The system establishes a digital mechanism for equipment discovery, listings, rental information and local search by bringing farmers and owners together via a centralised web portal. The built prototype, through equipment categories, fixed daily rental information, machinery or brand search, category filtering, location or district based discovery and separate farmer and owner functionality, confirms the basic ecosystem viability. These features directly address the laborious and fragmented renting process referred to in the project overview. The suggested AWS and Kubernetes deployment architecture also provides a basis for scalable and dependable service delivery especially when demand varies during agricultural seasons. The paper also stresses the need of differentiating between a working prototype and a field-validated agricultural service.

The existing project documentation provides support for the qualitative findings of the deployed platform and its expected benefits, but it does not contain adequate empirical data to make claims regarding exact percentages of cost savings, improvements in utilisation, uptime, or user happiness. Metrics should be collected during future pilot deployments. A comprehensive evaluation, using farmers and owners of equipment from several places, would for the systematic measurement of the economic, usability and technical impact of the platform.

VI. SUMMARY

KrishiMitra offers a practical basis for an equipment-as-a-service approach for agriculture. Its future evolution will be able to combine secure transactions, real-time availability, payments, reviews, notifications, analytics and intelligent suggestions with cloud-native deployment. Such extensions could allow evolving the current rental prototype into a more full digital agriculture service ecosystem.

VII. SUMMARY OF CONTRIBUTIONS

- A centralised digital marketplace model that connects farmers and owners of agricultural equipment.
- Search and find by machinery/brand, category and area or district.
- Support for numerous types of agricultural equipment with clear daily rates.
- Two-sided renting ecosystem, Separate farmer and owner functions.
- Architectures based on the cloud leveraging AWS services identified in the project design.
- Kubernetes scalability for fluctuating or seasonal demand.
- Foundation for future real-time booking, return management, payments, ratings and data driven recommendations.

Appendix A. Architectural and Implementation Notes of the Project: The cloud services and approximate monthly cost ranges mentioned in the project presentation are: EC2: ₹1,000-₹2,000 (approximate) DynamoDB: ₹200-₹500 (approximate) S3: ₹50-₹300 (approximate) CloudFront: ₹50-₹300 (approximate) Application Load Balancer: ₹1,500-₹2,500 (approximate) CloudWatch: ₹100-₹500 (approximate) Route 53: ₹50-₹100 (approximate) The presentation provides indicative total estimate of between ₹7,350-₹14,700/month including the specified project services and domain related cost. These are project estimates and not to be taken as measured production expenditure.



International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 09, September 2026)

Appendix B. Recommended Metrics for Evaluation in the Next Stage: To make the experimental extension publishable, the following metrics can be collected during pilot testing: (1) average equipment-search response time, (2) successful booking completion rate, (3) equipment-listing completion rate, (4) average time required to find suitable machinery, (5) number of active equipment listings, (6) rental frequency per machine, (7) equipment utilisation hours before and after platform adoption, (8) farmer-reported cost savings, (9) owner-reported additional rental income, (10) system availability, and (11) user satisfaction using a structured questionnaire. These measurements would transform the current qualitative prototype evaluation into a quantitative empirical analysis.

Source background and scope: This research-paper draft has been created from the KrishiMitra project overview and project progress seminar presentation provided for the project. The overview should include problem, objectives, literature survey, expected results, work strategy and introductory references. The presentation contains the intended workflow, unique features, work done, estimates of the cloud-service costs, and suggested future additions. The external technical references were utilised only to support basic descriptions of AWS cloud architecture and Kubernetes scalability.

Acknowledgement:

Authors are thankful to Director, for his constant encouragement during the entire preparation of the project.

REFERENCES

- [1] P. Gandhi, V. Kumar, M. Dilshad, R. Kumar, and P. Kumar S., "KRISHI-SADHAN Platform for Farmers for Renting Equipment's," *International Journal of Advance Research, Ideas and Innovations in Technology (IJARIIT)*, vol. 9, no. 6, 2024.
- [2] Shivani, Govind Singh, and Aman Raj Singh, "From Fields to Sharing Yields: A Novel Approach to Affordable Farm Equipment Access," *Proceedings of the International Conference on Innovative Computing & Communication (ICICC)*, 2024.
- [3] S. K. Sameerunnisa, H. V. Penugonda, R. Yarram, K. K. Valiveti, and D. Annavarapu, "A Web-Based Equipment Rental System for Sustainable Farming," *International Journal of Advanced Research in Computer and Communication Engineering*, vol. 14, no. 2, 2025, DOI: 10.17148/IJARCCCE.2025.14255.
- [4] A. S. Budhewar, P. G. Patil, K. Shivade, A. Patil, and D. K. Yadav, "Implementation of Smart Agricultural Equipment Rental System," *International Journal of Advance Scientific Research and Engineering Trends*, vol. 9, no. 3, pp. 91–95, 2025, DOI: 10.65521/ijasret.v9i3.2039.
- [5] Sengupta, T., Narayanamurthy, G., Moser, R., & Hota, P. K. (2019). Sharing app for farm mechanization: Gold Farm's digitized access based solution for financially constrained farmers. *Computers in Industry*, 109, 195–203.