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Development of a Knowledge Management System to Support Intelligent Rice Farming

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Abstract
Rice is a staple food worldwide. It is most common in Asia, Africa and Latin America. In Ghana, the annual rice consumption is about 1.5 million metric tons. However, about 60% of this demand is imported majorly from Asia. This high reliance on imported rice is one of the contributory factors that weaken Ghana's foreign exchange reserves. Hence, there is a need to encourage local rice production. However, the efforts by local farmers are thwarted by many challenges, including pest infestations, bird interference, insufficient technology for efficient fertiliser and herbicide applications, and the absence of reliable systems for predicting rainfall patterns. Additionally, inadequate access to modern agricultural extension services and the lack of advanced storage facilities exacerbate these difficulties. Although numerous intelligent agriculture systems exist that could address these issues in an environmentally sustainable manner, farmers in this region remain largely unaware of such technologies and persist with outdated and inefficient methods. This study sought to address these challenges by developing a customised Knowledge Management System (KMS) aimed at facilitating knowledge dissemination and supporting intelligent agricultural practices in rice farming. The research used a system prototyping methodology to produce a prototype KMS, which the System Usability Scale (SUS) evaluated for usability. The system achieved an average score of 70.025, surpassing the threshold for "Acceptability Usability," which denotes that the KMS meets the minimum standards for practical application. This result highlights the potential for the KMS to enhance agricultural practices and improve productivity within the community.

Keywords: *Knowledge Management System, Intelligent Agriculture, Rice Farming, System Evaluation. System Analysis, System Development.*

1. Introduction

The successful design and deployment of intelligent farming systems widely acknowledges the pivotal role of emerging technologies in data science, artificial intelligence, the Internet of Things (IoT), and mobile application development. These technologies serve as critical catalysts, driving advancements in the development of IoT-based farming systems and Knowledge Management System (KMS) that enhance agricultural efficiency and productivity.

KMS in agriculture facilitates the systematic collection, organisation, and distribution of information and expertise related to farming, and other agricultural practices [1][3]. This encompasses data on best practices for planting and harvesting, insights into weather and soil conditions, and research on emerging technologies and techniques. The primary objective of an agricultural KMS is to enhance farmers' efficiency and productivity while enabling more informed decision-making [4].

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Various platforms, such as farm implements, software applications, databases, websites, or mobile apps, can deploy such systems.

There are many applications and benefits of a well-developed and implemented KMS. A study by Wijaya and Suasih [5] established that KMS is the most important technology for achieving strategic goals, improving decision-making processes, and disseminating needed information to customers. Organisations can use KMS to support the training and orientation of their staff, provide better sales, and help managers or leaders arrive at critical decisions quickly.

According to Karlinsky-Shichor and Zviran [6], a well-implemented KMS can effectively manage and capture knowledge, ensure the accuracy and consistency of information, and enable the search and retrieval of existing knowledge. It also facilitates the dissemination of knowledge, data, and information to those who need it while supporting collaboration within and across teams.

This study aims to develop a comprehensive KMS designed to facilitate the dissemination of intelligent rice farming knowledge, with Afere (a rice-growing community in the Western North Region of Ghana) serving as the case study. The study specifically seeks to design and implement a robust KMS that enhances knowledge accessibility and supports informed decision-making in intelligent rice farming practices within the Afere community. Furthermore, the study systematically evaluates the developed system's usability, employing the System Usability Scale (SUS) to assess its effectiveness, user experience, and overall adoption potential.

a. Challenges of Implementing a KMS

Full-scale implementation of a KMS presents several challenges that must be addressed to ensure high success. A principal concern is the absence of a formal knowledge management strategy, essential for aligning the KMS with organisational goals [7]. Inadequate user awareness regarding available tools and methods can hinder the effective identification, collection, dissemination, and retention of knowledge [7][8]. Furthermore, insufficient communication channels and poor data quality can lead to inaccurate or incomplete information within the system [9]. Effective KMS governance is another critical factor, requiring a robust framework to manage knowledge and ensure proper use [10]. Other challenges include the lack of integration with business operations to maintain alignment with organisational objectives, as well as insufficient metrics for evaluating the KMS's effectiveness and guiding improvements [8][9].

2. Related Works

Intelligent agriculture represents the most advanced phase of agricultural production, integrating expert agricultural systems, comprehensive control mechanisms, and organic product traceability through Internet platforms and cloud computing [36][37]. This technological integration facilitates the digitalisation of agricultural information, the automation of production processes, and the intellectualisation of farm management, fostering a modern, sustainable agricultural system characterised by low carbon emissions, energy efficiency, and high productivity.

The emergence of intelligent farming, precision agriculture, and smart farming exemplifies a paradigm shift driven by modern information and communication technologies, aimed at optimising agricultural practices while minimising human labour requirements. These advancements mark the third wave of the modern agricultural revolution, following the mechanisation of agriculture and the Green Revolution, which introduced genetic modification [38][39][40]. As a result, intelligent agriculture is not merely an incremental improvement but a transformative shift that redefines traditional farming by applying cutting-edge science and technology such as the Internet of Things, Cloud Computing, KMS, specialised sensors etc.

The integration of KMS in agriculture has been the theme of many studies, highlighting both opportunities and challenges. Researches in India underscores the potential of KMS to support agricultural development and economic stability [11][12]. However, these studies emphasised that effective KMS implementation requires improved strategies and accessible knowledge platforms tailored to local agricultural needs. Similarly, [13] Saidu *et. al.* identified Information and Communication Technology (ICT) as a key enabler for agricultural innovation but noted significant barriers are limited ICT infrastructure and policy support in developing countries.

Further research by Alemu *et. al.* [14], stressed the importance of integrating both scientific and indigenous knowledge within KMS frameworks, advocating for a more inclusive approach to agricultural knowledge sharing. This aligns with Tiwari's [16] argument that leveraging recent ICT tools can enhance the accessibility and utility of agricultural knowledge, ultimately boosting productivity across value chains. Such frameworks must account for context-specific agricultural practices to be truly effective, as argued by Zecca and Rastorgueva [15] in their work on sustainable KM models for agriculture.

Studies have emphasised the social dimension of KMS in agriculture. Santoso *et. al.* [17] found that reliable KMS access facilitates knowledge-sharing among farmers, fostering stronger social ties and promoting sustainable practices. The need for tailored KMS that cater for local contexts is further echoed by Feo *et. al.* [18], who recommend digital repositories for storing innovative agricultural knowledge while acknowledging farmers' preference for traditional information channels.

Additionally, effective KMS implementation requires robust frameworks for data management and stakeholder engagement. Mendes *et. al.* [19] and Vangala & Mishra [20] suggested that participation in knowledge-sharing is influenced by socio-economic factors, and effective KMS should account for diverse professional communities. Integration of agriculture with modern ICT tools, as suggested by Akuku *et. al.* [21] and Gómez *et. al.* [22] can bridge the gap between traditional and digital agricultural practices, fostering innovation and sustainability in the sector.

2. Methodology

This section presents a rigorous research methodology, detailing the systematic processes and resources employed to achieve the study's objectives. It provides a comprehensive account of each stage of the research, ensuring methodological transparency and replicability.

a. System Development Methodology

A system development methodology refers to a structured process used to create or maintain a software system, involving a project management team and various stakeholders who define specific deliverables and artefacts [23][24]. There are numerous methodologies available, each with distinct advantages and drawbacks, including Agile, Waterfall, Scrum, Rapid Application Development, and Extreme Programming. These methodologies can be categorised into waterfall, iterative, or continuous approaches, with the Waterfall model following a linear sequence and iterative models allowing for ongoing adjustments during the system development processes [28].

For this study, the prototyping model was employed to develop a prototype KMS for rice farmers. This methodology involves creating a prototype, testing it, and refining it iteratively until a satisfactory outcome is reached, forming the basis for the final system [2]. The prototyping model was selected due to its benefits, such as fostering collaboration among team members, reducing costs, enhancing the quality of artefacts, and enabling early usability testing and user feedback.

The prototyping methodology was selected because it supports a more flexible and user-centric approach to system development. It allows for iterative adjustments based on stakeholder input, making it ideal for environments where requirements may evolve during the development process, ultimately ensuring that the final system aligns with user needs and expectations.

b. System Analysis and Software Development Tools

Tools for system analysis and software development play a fundamental role in the software development life cycle, supporting the design, development, testing, and maintenance of the software systems [23]. These tools are essential for managing high-quality software development, with system analysis tools aiding in understanding system requirements and identifying potential issues before development [25]. In parallel, software development tools facilitate important tasks such as coding, debugging, and testing [26]. Commonly used tools include Integrated Development Environments (IDEs), Unified Modelling Language (UML) tools, and Computer-Aided Software Engineering (CASE) tools, all of which help ensure effective software development [25].

The benefits of employing system analysis and software development tools extend beyond efficiency. Automating processes such as code generation and testing accelerates development, while system analysis tools enable a deeper understanding of existing workflows, aiding organisations in optimising operations [26]. These tools also enhance team collaboration by providing platforms for feedback, version control, and communication, leading to better coordination, faster problem-solving, and higher-quality software outcomes [23]. Early detection and resolution of potential defects is another key advantage, minimising errors in the final product and reducing costly rework [26].

Among the tools and techniques for system analysis are data flow diagrams, flowcharts, block diagrams, and entity-relationship diagrams. In this study, flowcharts, activity diagrams, and data flow diagrams were utilised for the planning, analysis, design, and deployment of the proposed KMS prototype tailored to support the dissemination of knowledge on intelligent rice farming. These visual tools facilitated a structured and clear understanding of system processes, contributing to the successful development of the prototype KMS.

For software development, a variety of tools are available, such as GUI Designers, Code Editors, and platforms like Flutter and GitHub. This study employed the Flutter platform, an open-source framework developed by Google, for creating a cross-platform mobile app prototype of the KMS. Flutter's use of the Dart programming language enhances development speed, producing high-performance applications compatible with multiple operating systems [27][29]. The choice of Firebase as a real-time database further supported the application’s requirements for efficient data management, synchronisation, scalability, and offline capabilities, essential for modern software development [30]

The adoption of system analysis and software development tools can significantly enhance software quality, development speed, and overall project success. These tools not only streamline processes and facilitate early problem identification but also foster collaboration and improve communication within development teams. However, careful consideration of project needs, cost factors, and scalability is essential when choosing specific tools and platforms. The effective application of these technologies contributes to the creation of reliable, user-friendly software solutions, as demonstrated in the development of the KMS prototype for rice farmers.

c. Overview of the Existing KMS at Afere

At Afere, rice farmers and other crop farmers currently do not have any official or formal KMS that supports the awareness creation and promotion of intelligent methods of farming. Instead, they rely on Agriculture Extension Officers (AEOs) who visit them occasionally to share new technologies and techniques to help improve their farming practices and farming business processes. The farmers would usually be informed ahead of time on the dates and times the AEOs would visit and the farmers would wait for the AEOs who would come from either the District, Regional or sometimes from the National Office of the Ministry of Food and Agriculture.

These AEOs act as a bridge between researchers, government, and farmers. They usually send notice of their visits ahead of time to inform the opinion leaders and leaders of the farmers. The AEOs then engage farmers in focus group discussions or open forum discussions on new farming technologies. Sometimes, one or two farms are chosen as a point of meeting to allow the AEOs to demonstrate and train the farmers on new technologies as shown in Figure 1.

d. Requirements Gathering for the Proposed KMS

Requirements gathering was an important phase in the design and development of the proposed KMS to support intelligent rice farming, with a primary focus on identifying key stakeholders.

The rice farmers at Afere were identified as the central stakeholders, and a mixed-method approach combining focus group discussions and close-ended questionnaires was employed to assess rice farmers' informational needs and expectations for the KMS. A total of 240 large and small-scale farmers participated in the survey, revealing a significant gender imbalance among respondents: 75% were male (180 respondents) and 25% were female (60 respondents) as shown in Table 1. This suggests that rice farming, a physically demanding activity, tends to involve more male participants, possibly due to the labour-intensive nature of the work.

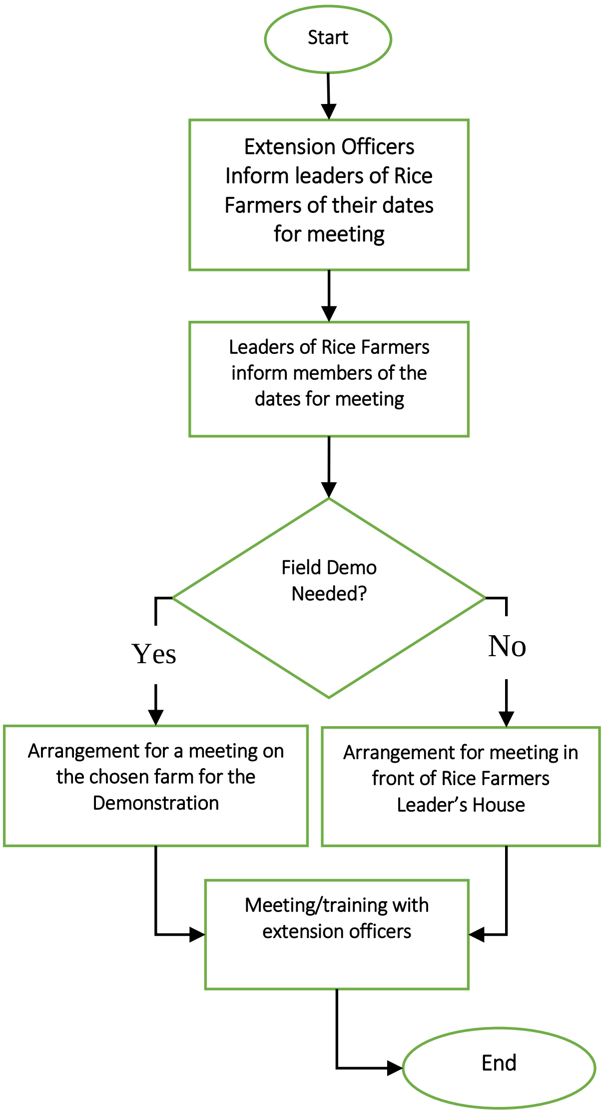

Figure 1: Flowchart Diagram of the Existing KMS

Table 1: Gender Distribution of the Respondents

Gender	Frequency	Percentage
Male	180	75
Female	60	25
Total	240	100

Source: Field survey at Afere (2023)

Table 2 analyses the respondents' age distribution, revealing a range from 21 to over 60 years. The majority of the respondents were concentrated in the younger age brackets: 20% were aged 30-39 years, 32.5% were aged 31-40 years, 33.33% fell between 41-50 years, and only 0.83% were above 60 years. This demographic analysis suggests that the rice farmers in Afere are predominantly young adults, indicating a workforce that is likely to be energetic and capable of managing the physical demands of daily rice farming activities.

Table 2: Age Distribution of the Respondents

Age Range (Years)	Frequency	Percentage
15-20	0	0.00
21-30	48	20.00
31-40	78	32.50
41-50	80	33.33
51-60	32	13.33
Above 60	2	0.83
Total	**240**	**100**

Source: Field survey at Afere (2023)

Table 3 shows the educational background of the respondents, showing that 8.75% had no formal education, 20.83% completed primary education, 33.33% reached Junior High School, 33.42% completed Senior High School, and 1.67% attained tertiary education. This analysis highlights that the majority of rice farmers in Afere possess at least a basic level of education, suggesting a fair level of literacy among them. However, a small fraction of the respondents, who reported having no formal education, can be classified as illiterate.

Table 3: Educational Level Distribution of the Respondents

Highest Level of Education	Frequency	Percentage
None	21	8.75
Primary	50	20.83
Junior High School	80	33.33
Senior High School	85	35.42
Tertiary	4	1.67
Total	**240**	**100**

Source: Field survey at Afere (2023)

The analysis of the collected data indicates that a substantial majority, 126 respondents (52.50%), strongly agreed that they have access to a smartphone, while only 15 respondents (6.25%) strongly disagreed with possessing and using a smartphone, as illustrated in Table 4.

Table 4: Access to Smartphone Distribution of the Respondents

Access to Smart Phone	Frequency	Percentage
Strongly Disagree	15	6.25
Disagree	9	3.75
Neutral	20	8.33
Agree	70	29.17
Strongly Agree	126	52.50
Total	**240**	**100**

Source: Field survey at Afere (2023)

In addition to the questionnaires, a focus group discussion was conducted to enrich the requirements-gathering process, targeting the informational needs and expectations of rice farmers concerning the proposed KMS for intelligent rice farming. This method proved effective for eliciting comprehensive requirements, as it involved assembling key stakeholders including rice farmers, extension officers, agricultural experts, and other relevant parties to engage in a detailed dialogue about their needs and desired functionalities for the KMS. The focus group approach allowed for a deeper understanding of stakeholder perspectives, facilitating a more user-centred design and development process for the KMS.

The features and functionalities of the proposed KMS were clarified and agreed upon in the focus group discussion. Five major questions were used to stimulate the focused group discussion, the questions were:

1. What are the main challenges you face in rice farming?
2. How do you currently source information on rice farming practices?
3. What information do you think is critical for successful rice farming?
4. What features or functionalities would you like to see in a KMS for rice farming?
5. What are your expectations of a KMS for rice farming?

By gathering insights from different stakeholders, the KMS can be designed to meet the specific needs of the rice farming community.

The focus group discussion provided a deeper understanding of the rice farmers' informational needs and expectations, leading to a consensus on the key features and functionalities of the proposed KMS. Stakeholders agreed that the KMS should be a mobile application with straightforward search and retrieval capabilities, a user-friendly graphical interface, and robust security and access controls. Additionally, there was a strong preference for data presentation in video format, ensuring that the KMS would be accessible and relevant to the rice farming community at Afere, effectively meeting their specific needs.

e. System Analysis and Design of the Proposed KMS

The system analysis and design process of the KMS was the next important phase aimed at developing an effective system to manage knowledge for the rice farming community at Afere. The initial step involved identifying the specific knowledge needs of the rice farmers through a comprehensive needs assessment, which helped determine the types of knowledge that were most important for the farmers and how this knowledge was currently managed. This assessment laid the groundwork for the system by pinpointing the core knowledge areas that the KMS needed to address, ensuring the system's relevance to the targeted users.

Once the knowledge needs were identified, the next step was to design the KMS architecture. This phase involved selecting appropriate KM tools and technologies, such as databases, search engines, and collaboration platforms, while also considering how to integrate the KMS with existing rice farming business processes. The development of the KMS software was carried out from scratch to align with the specific KM requirements of the Afere rice farmers, emphasising user-friendliness and accessibility to ensure ease of use for a broad audience. The system design phase included creating a Functional Model with a Use Case diagram, a Process Model with Flowchart and Activity diagrams, and a Database Model using a relational structure.

The KMS was structured around four key functional modules: the User Management Module, the Knowledge Repository Module, the Agriculture Knowledge Sharing Module, and the System Administration Module. To visually convey the functional model, a Use Case Diagram as shown in Figure 2 was employed, illustrating the interactions between the main actors; farmers and system administrators and the system. This diagram provided a clear depiction of processes, relationships, and system boundaries, serving as an important tool to ensure all stakeholders had a unified understanding of the system's operations before moving into the development and deployment phases.

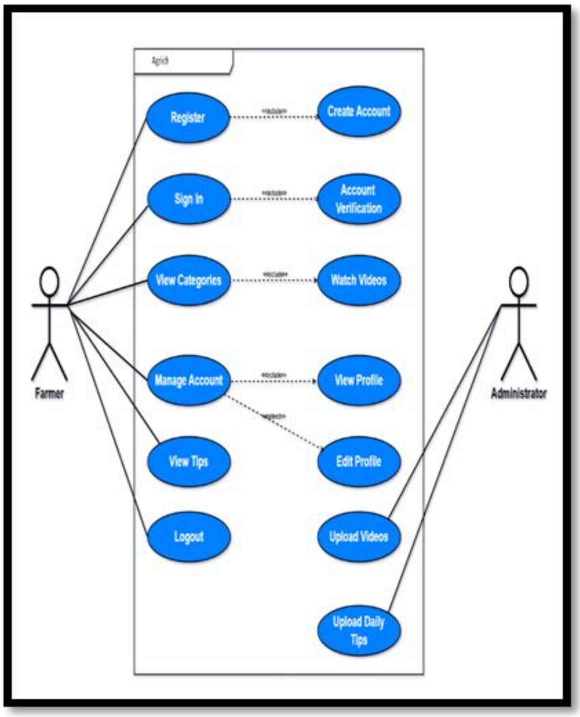

Figure 2: Use Case Diagram of Proposed KMS

The process model of the proposed KMS provides a detailed outline of the system's operational flow, illustrating how data would be managed and processed. It includes a flowchart and an activity diagram shown in Figures 3 and 4 that depict the key stages of the KMS, such as data input, processing, and output, offering a visual understanding of the system's workflow. These diagrams were crucial in identifying stakeholders, potential bottlenecks, and opportunities for improvement, thus serving as valuable tools for optimising the system's design. Generally, the process model plays an important role in effectively structuring and refining complex systems like the proposed KMS.

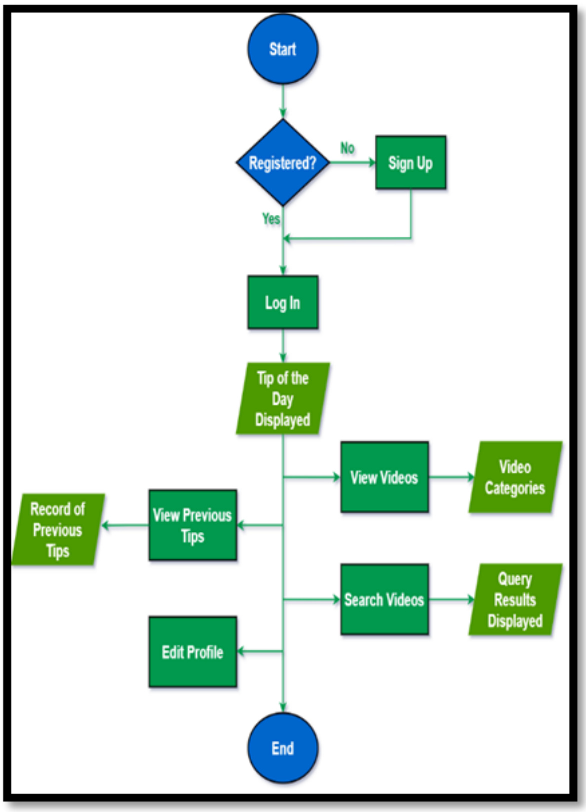

Figure 3: Flowchart of Proposed KMS

Designing the Database Model for the proposed KMS was another important phase in the system analysis and design process. The model included four key entities: Daily Tip, Category, User, and Technology Video with each representing distinct facets of agricultural knowledge relevant to intelligent rice farming. The Daily Tip entity focused on delivering regular advice to guide farmers on best practices, ensuring optimal timing and application of nutrients. Meanwhile, the Technology Video entity provided visual aids on pest treatment, disease management, and general farming techniques, enhancing the farmers' ability to protect and manage their crops effectively. The Category entity classified different intelligent farming technologies, while the User entity stored information on the registered farmers using the KMS. To ensure data accuracy and efficiency, the Database Model was normalised to the third normal form, eliminating redundancy and optimising data storage.

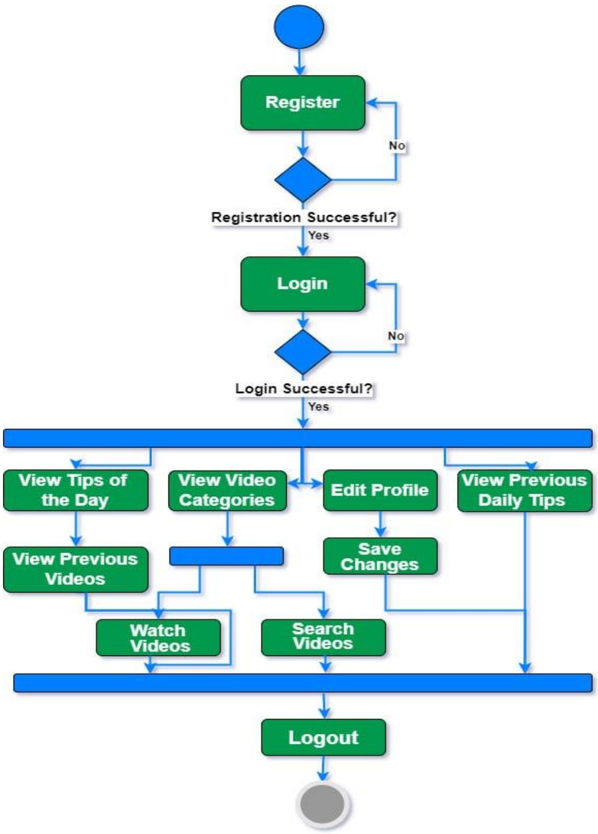

Figure 4: Activity Diagram of Proposed KMS

The relational database model shown in Figure 5 was essential in creating a user-centred KMS, addressing the practical needs of rice farmers. Through careful analysis of the data requirements, trends, and patterns in agricultural knowledge, the model facilitated the design of a system that was both efficient and functional. This approach ensured that the proposed KMS would be a robust tool, offering precise, targeted information to farmers, thereby supporting better decision-making and enhancing overall farm productivity.

The prototype KMS, Agrich 1.0, is a mobile application designed to support intelligent rice farming and operates seamlessly on both Android and iOS platforms. The name "Agrich," derived from "**agri**culture" and "te**ch**nology," emphasises its integration of modern technological tools into traditional farming practices. A significant feature of Agrich 1.0 is its streamlined user registration process, which requires users to provide a username, email, secure password, and a valid phone number. To ensure security and authenticity, a verification code is sent via SMS to the registered phone number, which users must enter to complete the registration process. This feature enhances the integrity of the system while making it accessible to farmers with varying levels of technical expertise.

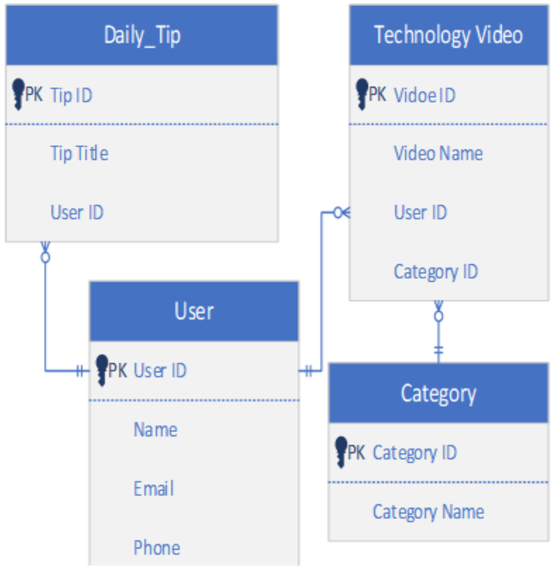

Figure 5: Database Model of the Proposed KMS

f. System Implementation

Firebase which is a cloud-based backend service provided by Google, was used to facilitate secure and reliable SMS verification services. The design of the prototype includes user-friendly interfaces that guide farmers through essential operations and interactions with the KMS, as illustrated in Figures 6 and 8. By combining intuitive design with robust functionality, Agrich 1.0 aims to empower rice farmers by streamlining processes and improving decision-making through the selection of a suitable intelligent technology. This innovative approach highlights the potential of mobile applications to revolutionise agriculture by making knowledge of advanced rice farming tools accessible to a broad audience.

After validation of the registration, the new user is required to log in using the login interface as shown in Figure 7. The registered user is required to use either the email address and the password or can sign in with just the phone number provided during the registration process. Provision for recovery of account in case of a missing or forgotten password was also provided as shown in figure 7.

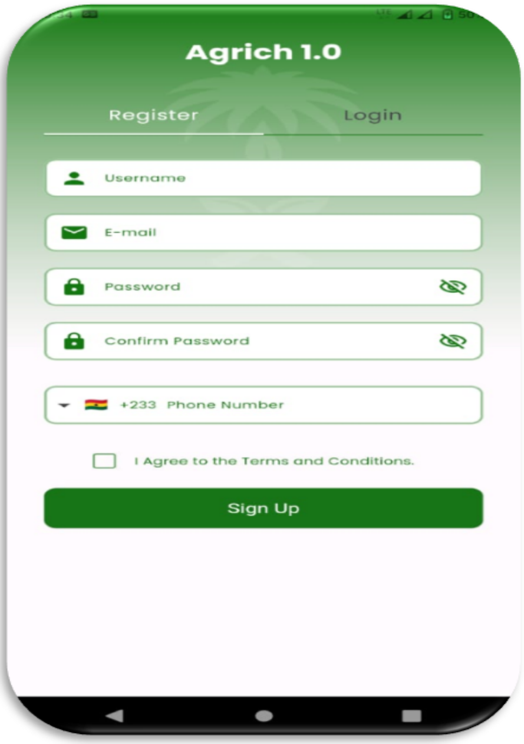

Figure 6: User Registration Interface

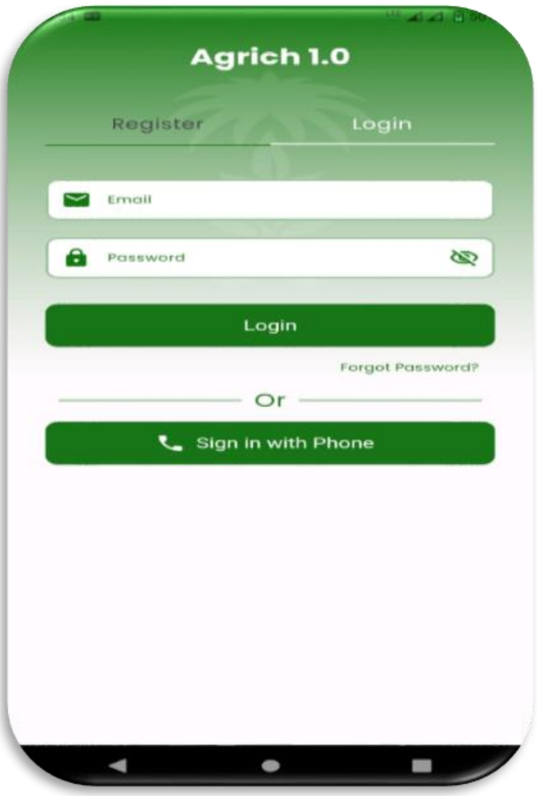

Figure 7: User Login Interface

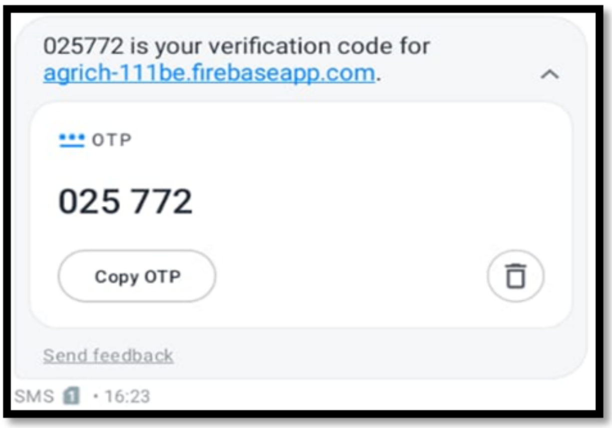

Figure 8: SMS for Account Verification

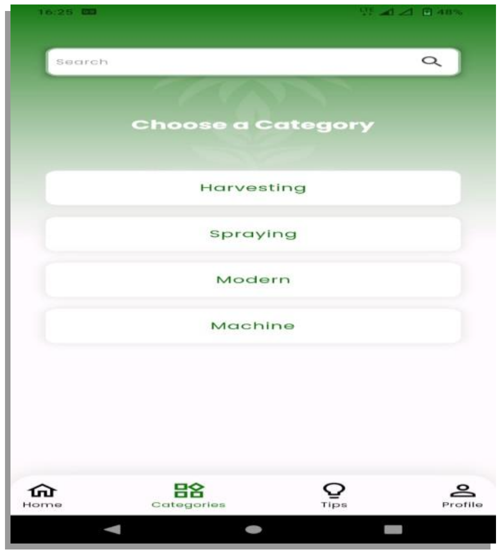

Figure: 9 Category Interface

An interface to manage the profile of users was also provided in the Prototype KMS. The user can update his/her details, upload a photo and generally manage the already created account as shown in Figure 11. The user can also log out of the system at that same interface.

The proposed KMS can also serve as a good knowledge resource for rice farmers because it provides them with daily tips on best rice farming practices. These tips are easily accessible on the home page interface of the KMS, making it simple for farmers to stay up-to-date on the latest information. Figure 12 shows how the proposed KMS system makes it easy for farmers to access these important daily tips and information on the home page interface of the KMS.

Figure:10 Harvesting Technologies Interface

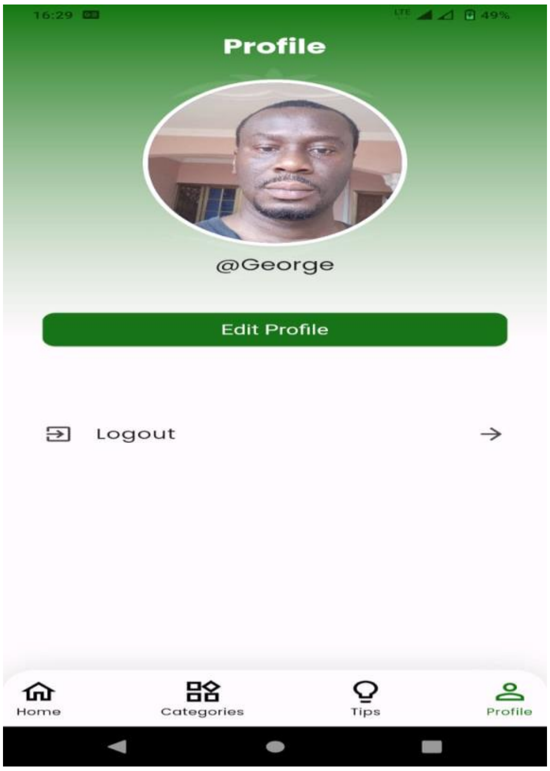

Figure 11: Profile Interface

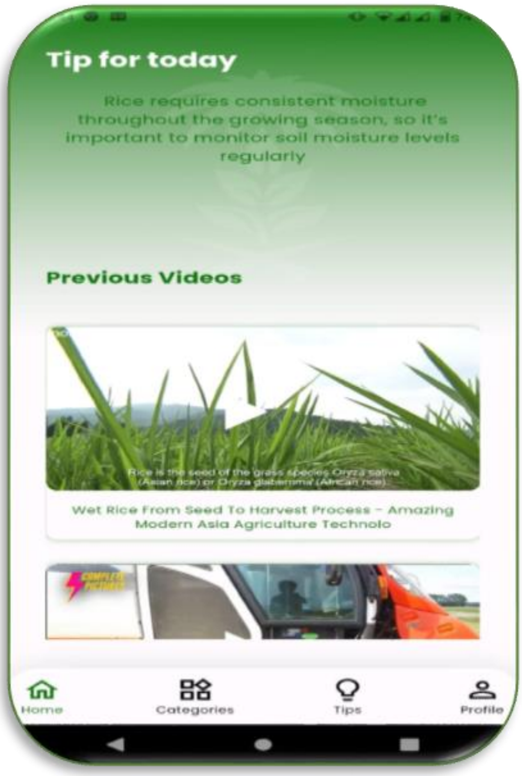

Figure 12: Tips of the Day Interface

g. Usability Evaluation of the KMS

The usability of the KMS was evaluated using the **System Usability Scale (SUS),** a standardised and widely adopted questionnaire for assessing users' perceived usability of a system. The SUS consists of 10 statements reflecting users' firsthand experiences with the system, and respondents rate their agreement or disagreement using a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). This method, endorsed by previous research [31][32], provides a reliable measure of system usability by capturing users' perceptions and summative evaluations of the system's performance. The SUS score represented by ***S*** is calculated by using the formula below:

$$S = 2.5 * \left(\sum_{i=1,3,5,7,9} (O_i - 1) + \sum_{i=2,4,6,8,10} (5 - E_i) \right)$$

Where $\mathbf{O_i}$ *- The response for the i*th *odd-numbered questions*
$\mathbf{E_i}$ *- The response for the i*th *even-numbered questions*

The SUS uses a constant factor of 2.5 to normalise raw usability scores to a range of 0 to 100, making the results easier to interpret and communicate [34]. Each question in the SUS evaluation is initially rated on a 5-point scale (1 to 5), but the scoring formula adjusts these ratings to a range of 0 to 4. The total raw score for the 10 questions thus ranges from 0 to 40, which is then multiplied by 2.5 to align with percentage-based metrics. A SUS score of 68 is considered the average usability benchmark, with scores above 68 indicating above-average usability and those below 68 reflecting below-average usability [33][35]. Full details of the general interpretation of SUS are shown in Table 5.

The SUS technique was chosen for this study due to its simplicity, reliability, and efficiency in evaluating user satisfaction with systems. It provides a quick yet robust method for assessing usability and is particularly effective with larger sample sizes, where its reliability is maximised [35]. By offering a standardised and widely recognised approach, the SUS ensures consistent usability assessment and facilitates comparisons across different systems and contexts.

Table 5: General Interpretation of SUS

S/N	Score Ranges	Interpretation of SUS Scores
1	0-69	Poor usability
2	70-79	Acceptable usability
3	80-89	Good usability
4	90-100	Excellent usability

Data collection for the usability evaluation was conducted over three days at Afere, with the assistance of two research assistants. A total of 102 respondents who had used the KMS were randomly selected and interviewed using the standard SUS questionnaire, which consists of 10 questions answered on a Likert scale. Each respondent was given only one opportunity to participate, and their responses were recorded and transferred to Microsoft Excel for analysis.
The interview sessions were aimed at gathering individual and collective experiences regarding the usability of the KMS. The data collected from the questionnaire were entered into MS Excel and coded. A random sample of 10% of the entered data was inspected to assess coding accuracy and consistency. The SUS score formula was implemented in MS Excel as shown in Table 6. The usability rating of the KMS was determined by calculating the average SUS score based on the total responses from all individual respondents.

3. Results and Discussion

The evaluation of the KMS using the SUS yielded a score of 70.025, positioning the prototype KMS within the "Acceptability Usability" category. This result signifies that the KMS meets the minimum threshold for user satisfaction and practical application, as defined by SUS guidelines according to [35] as shown in Table 6. The system's score surpasses the average SUS benchmark of 68, commonly regarded as an indicator of acceptable usability [33][35]. This achievement is particularly notable given the context of the KMS application in supporting intelligent rice farming practices. The design's emphasis on user-centric features, such as an intuitive interface, user-friendly information retrieval, and robust security measures, likely contributed to the positive reception by respondents. These attributes underscore the KMS's potential as a practical tool for enhancing farming practices and bridging the knowledge gap among rice farmers in resource-constrained settings.

The results of this study aligned with the findings of previous research, such as [33][35], which suggest that achieving a SUS score near or above 70 indicates satisfactory user experience and acceptance. The KMS's ability to meet these benchmarks demonstrates the feasibility of leveraging digital solutions to address challenges in traditional agricultural systems. However, the relatively marginal difference between the KMS score and the baseline of 70 warrants further scrutiny. The closeness of the score to the threshold may imply that certain aspects of the system's design, such as navigation efficiency or accessibility for less technologically inclined farmers, require refinement to enhance the overall user experience. This finding opens opportunities for iterative improvement. The evaluation also highlights the importance of sample size and respondent diversity in influencing usability scores. With 102 respondents, the sample size provides a robust dataset; however, potential biases related to user familiarity with technology, literacy levels, and prior experience with similar applications may have influenced the results.

Table 6: Responses of SUS Questionnaire Score and Results of Summing SUS Scores

REP	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	RAW SCORE (40)	FINAL SCORE (100)
Rep 1	4	2	3	4	4	1	3	4	3	4	22	55
Rep 2	2	4	3	4	2	2	4	1	5	2	23	57.5
Rep 3	5	2	5	2	5	1	4	1	5	2	36	90
Rep 4	3	4	3	5	2	4	5	2	3	4	17	42.5
Rep 5	5	1	4	2	5	2	4	2	4	1	34	85
Rep 6	1	3	2	4	2	3	5	1	5	1	23	57.5
Rep 7	3	5	4	5	4	4	4	2	4	3	20	50
Rep 8	1	5	4	3	1	4	5	2	5	2	20	50
Rep 9	1	3	5	5	2	3	2	2	4	1	20	50
Rep 10	1	5	3	4	4	5	5	4	4	3	16	40
Rep 11	1	2	1	5	2	1	3	4	4	1	18	45
Rep 12	1	3	4	4	4	3	4	1	4	4	22	55
...	...	...	...	...	...	...	...	...	...	...	...	...
Rep 98	5	2	5	2	3	2	5	4	4	2	30	75
Rep 99	2	1	4	1	5	1	5	5	5	5	28	70
Rep 100	5	4	5	2	3	2	5	4	4	1	29	72.5
Rep 101	5	1	5	1	5	1	5	5	5	5	32	80
Rep 102	3	2	5	2	3	2	5	4	4	2	28	70
Average Final Sus Score												**70.02475248**

For instance, respondents who are less experienced with mobile applications might have found certain functionalities challenging, slightly lowering the overall usability score.

Conversely, users familiar with digital tools might have rated the system more favourably, masking areas for improvement. These considerations suggest that future studies could benefit from a more stratified sampling approach, ensuring that feedback reflects the broader spectrum of potential end-users. Overall, the findings validate the system's viability while highlighting areas for optimisation to maximise its impact on intelligent agricultural practices for rice farmers [33][35].

4. Conclusion

This study has successfully demonstrated the feasibility of designing, developing, and implementing a customised KMS to enhance intelligent agricultural practices in rice farming. The evaluation of the prototype KMS was conducted using the System Usability Scale (SUS).

Findings from the TAM indicated a positive attitude towards The SUS results confirmed that the KMS achieved a satisfactory level of usability, indicating that it can effectively serve its intended purpose. Overall, the study not only underscores the potential of the KMS to facilitate knowledge dissemination and enhance decision-making among rice farmers but also emphasises the necessity for continuous refinement of the system to cater to the diverse needs of its users.

The research successfully achieved its objectives by designing and developing a Knowledge Management System (KMS) tailored to support intelligent rice farming practices in Afere and evaluating the usability of the developed system to ensure its effectiveness in meeting user needs.

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