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Agri Finance Mate: Smart Agricultural Loan Calculator & Advisory Tool

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Abstract- *Many farmers struggle to understand how agricultural loans work and how much they need to repay. This paper presents, Agra Finance Mate, is an easy-to-use tool that helps farmers calculate important loan details like the amount they can borrow, the interest they will pay, and their monthly installments (EMIs). By entering basic details like the type of crop, land size, and income, farmers can quickly get useful financial information. This tool is designed to make the loan process clearer and easier, especially for farmers who may not have access to financial experts. It also supports better planning and helps build trust between farmers and banks. In this paper, we explain how we created Agri Finance Mate and how it can help improve the way farmers manage their finances.*

Keywords— Agri Finance Mate, Agriculture, Crop dvisory, EMI, Financial Literacy, Firebase, Government Schemes, Loan, Mobile App, Offline Mode, Subsidy, User Experience (UX), Web Application

I. INTRODUCTION

Agriculture is the backbone of many countries, especially developing countries. A significant population in many countries relies on agriculture as a source of livelihood. Though agriculture has much significance, this sector often faces numerous challenges, including inadequate access to credit, poor financial planning, and a shortage of tools required for effective budgeting and investment analysis. These issues obstruct the growth and sustainability of the farms, particularly for small landholders who operate on limited resources. To address these challenges, the use of technology in agricultural finance can be a suitable solution. The agricultural finance calculator is such a kind of innovation. It is a digital tool designed to assist farmers, agricultural businesses, and policymakers in making proper financial decisions. This calculator aims to simplify complex financial concepts such as cost estimation, loan repayment plans, profit forecasting, and investments by providing a user-friendly interface suitable for agricultural contexts.

This research paper mainly explores the development and impact of the agricultural finance calculator. The paper mainly highlights its role in improving financial literacy, enhancing access to credit and loans, and assisting suitable agricultural practices. By leveraging this tool, stakeholders in the agricultural sector can generate better financial revenue and ultimately contribute to food security and rural development. Altogether empowering the nation's growth.

Further, the paper is elaborated in different parts/sections, where I Section has the Introduction part, II Section has Literature Review, Section III comprised Methodology, Section IV contains research and discussion, Section V has Results, and Section VI contains conclusion.

II. LITERATURE REVIEW

Prior studies have concentrated on digital services, insurance, and microloans to help farmers. Personalized risk assessments and adaptable financial solutions are still lacking, though, which emphasizes the necessity of a comprehensive, data driven fetch platform designed specifically for smallholder farmers.[1] By enhancing irrigation infrastructure, which uses roughly 70% of water, water-saving agriculture helps to alleviate the agricultural water issue. To build these infrastructures and encourage sustainable farming, public funding is crucial.[2] In an effort to increase access to financial services, research focuses on streamlining farmer loan applications by utilizing machine learning models like logistic regression and random forest to predict loan

eligibility and algorithms like K-Nearest Neigh bur for tailored suggestions.[3][9][5]A study that used a variety of techniques to determine loan eligibility discovered that models such as Random Forest may achieve up to 95.55% accuracy. This suggests that applying such predictive algorithms can speed up and improve the reliability of the loan process, which is helpful for developing tools connected to loans. [4] Using soil and meteorological data, a unified system that combines machine learning and deep learning makes suggestions for crops and fertilizer and uses images to identify illnesses. Analysis to assist farmers in increasing their output. [6] Using RAG technology, another study created a web platform that helps farmers comprehend government scheme documentation in their own tongue while also offering agricultural guidance, yield prediction, and early disease detection. [7] A mobile expert system that provides work scheduling, crop advising, weather notifications, and financial tracking is presented in this study for Indian farmers. It assists farmers in making well informed decisions and increasing production by giving them up-to-date information about farm finances and initiatives. [8] Agri Finance Mate is an easy-to-use site that offers financial literacy, crop advise, application support, loan computation, and plan recommendations to help farmers. The system will make agricultural financing easier and provide farmers with timely, individualized financial solutions. [10] This study uses IoT and machine learning to improve crop advice and soil testing, which helps farmers increase yields and enable early disease detection for better crop health [11] This study uses the AODE algorithm to predict crops and recommend fertilizers, which helps farmers increase yields. [12] This study uses IoT soil fertilizer monitoring in conjunction with machine learning to provide precise crop recommendations, which helps farmers maximize fertilizer use and increase yields. [13] [15] Machine learning is also successfully applied in horticulture for crop prediction, disease detection, and yield optimization, which improves decision-making in modern farming. [14] While previous research has explored microloans, insurance, IoT-based soil testing, and crop recommendation systems, there is still a lack of a unified, personalized fintech platform tailored specifically for smallholder farmers. Most systems either focus on agriculture or finance separately, without integrating both. Additionally, many farmers struggle to understand financial and government-related information when it is available only in English. Therefore, there is a strong need for multilingual and locally relevant platforms. Our work addresses this gap by developing a data-driven system that provides financial tools, crop recommendations, and government scheme guidance in farmers' local language, helping them make better decisions and improve productivity.

III. METHODOLOGY/EXPERIMENTAL

The development of Agri Finance Mate was carried out in structured phases to ensure the platform meets the core needs of small-scale and semi-literate farmers. A modular design approach was adopted, targeting affordability, ease of use, and offline functionality.

A. System Overview

Agri Finance Mate is a mobile-first web application that provides an intuitive interface for calculating agricultural loan details, accessing subsidy schemes, and improving financial awareness among farmers. The development of Agri Finance Mate employed a modular and scalable architecture leveraging the Next.js framework, styled with Tailwind CSS, and powered by Firebase Realtime Database for backend operations. The application was designed with a mobile-first and offline-aware approach, considering the rural farming population with
Limited digital access

B. User Interface and Design

Mockups were designed using Figma and Canva, focusing on an icon-based, minimal interface. The app design avoids clutter and uses simple inputs to facilitate non-technical users. Color-coded buttons and large text were prioritized to ensure visibility and clarity on low-end devices.

Later on, User interface components were created using Tailwind CSS utility classes, ensuring responsiveness across devices. Minimalist design principles were followed, prioritizing large text, high contrast buttons, and icon-based navigation to aid farmers with limited digital experience.

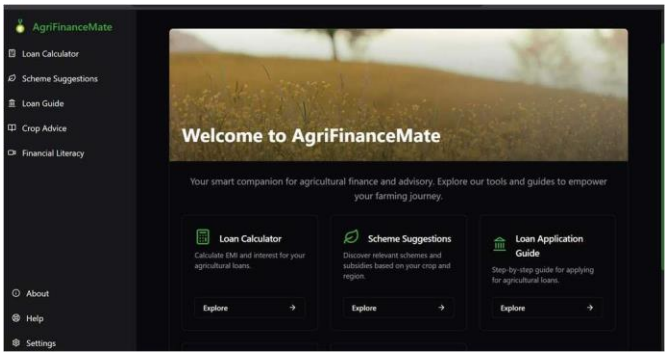

Figure 1: Home screen

C. Key Features and Functionalities

Agri Finance Mate isn't just about loan calculations, it is an overall advisory tool that helps fellow farmers not just learn the market prices but also get educated and gain awareness of various other opportunities in agriculture.

1) Loan Calculation Module

A reusable component was developed in /src/components/ to accept three inputs:

- Loan Amount
- Interest Rate (Annual)
- Loan Tenure (Years) A simple EMI formula was implemented in

TypeScript:

$$EMI = [P \times R \times (1 + R)^N] / [(1 + R)^N - 1]$$

The component outputs monthly EMI, total interest, and total repayment in real-time.

2) Scheme Advisory Logic

Users input their crop, region, and season, which are matched against a JSON-driven database of schemes hosted in Firebase. Matching logic is done via string comparison and optional risk categorization.

3) Financial Literacy Integration

A dedicated section fetches YouTube tutorial videos embedded directly into the site, explaining terms like EMI, credit score, and subsidy eligibility. These videos are embedded using <I frame> tags for seamless streaming.

4) Offline Access (PWA Setup) Using next-pwa and service worker configuration, the application caches key pages such as:

- Calculator
- Scheme list
- Literacy section

This ensures that users in low or no-connectivity zones can still access vital tools offline.

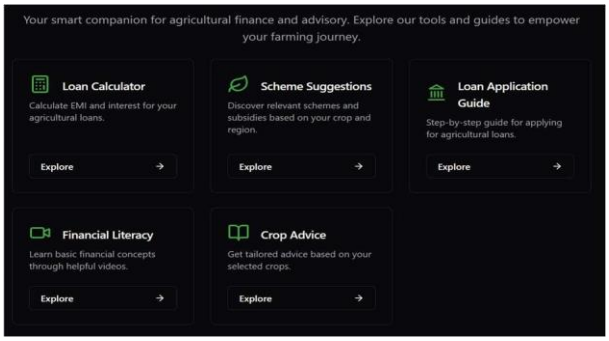

Figure 2: Function Select

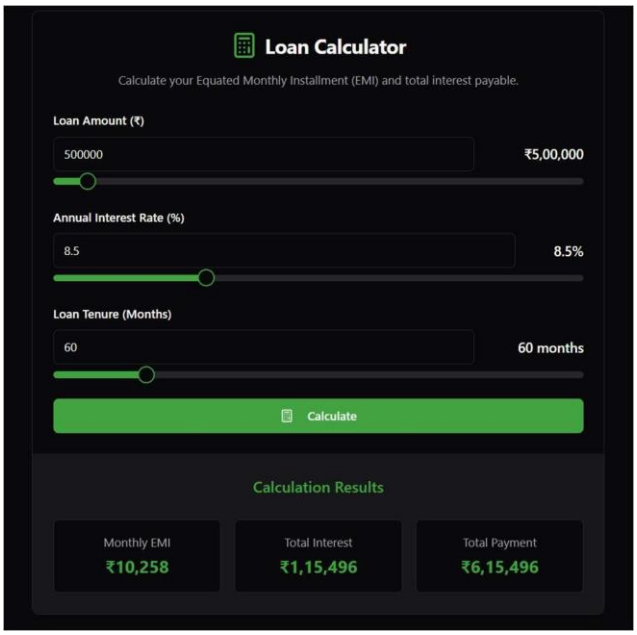

Figure 3: Loan calculator

D. System Architecture and Design

The Agri Finance Mate application follows a modular and client-server architecture optimized for rural accessibility and responsive design. The architecture integrates rontend interfaces, a Firebase backend, and a logic engine for EMI calculation and personalized advisory.

The system is broadly divided into three layers:

A. Presentation Layer (Frontend) This layer consists of the user interface developed using Next.js and Tailwind CSS. It includes input forms, result displays, navigation elements, and video embedding components. This layer handles user interaction and renders:

- Loan calculator
- Scheme suggestions

- Financial literacy section

B. Application Logic Layer Business logic is written in TypeScript components, which process:

- EMI calculations using mathematical formulas
- Input validation
- Advisory logic based on user's crop, region, and season

C. Data Layer (Firebase Backend) This layer uses Firebase Realtime Database to store:

- User preferences (if needed)
- Scheme data (manually added JSON or dynamic)
- Offline caching handled via PWA service workers

Firebase Authentication can be added optionally to manage individual user data securely.

D. Offline Capability

Offline access is enabled using PWA configuration and local storage caching to ensure uninterrupted access to calculators and guides, even in poor connectivity areas.

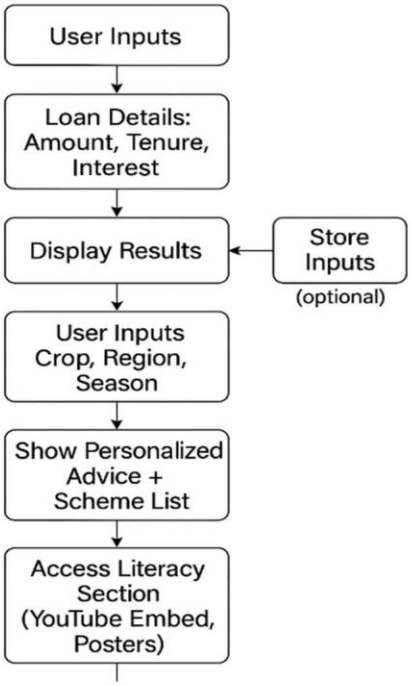

Figure 4: Execution Diagram

E. Pseudo Code

START

// ----------
// 1. LOAN CALCULATOR MODULE
// ----------

DISPLAY "Enter Loan Amount:"
INPUT loan Amount

DISPLAY "Enter Annual Interest Rate (%):"
INPUT interest Rate

DISPLAY "Enter Tenure (Years):"
INPUT tenure Years

CALL calculate EMI (loan Amount, interest Rate, Tenure Years)

FUNCTION calculates EMI (P, R_ percent, N_ years):
R = R_ percent / (12 * 100) // Monthly rate
N = N_ years * 12 // Months EMI = (P * R * (1 + R)^N) / ((1 + R)^N - 1) total Payment = EMI * N total Interest = total Payment - P
DISPLAY EMI, total Payment, total Interest
RETURN
END FUNCTION

// ----------
// 2. CROP & REGION BASED INPUTS
// ----------

DISPLAY "Enter Crop Type:"
INPUT crop Type

DISPLAY "Enter Region:"
INPUT region

DISPLAY "Enter Season:"
INPUT season

// ----------
// 3. SCHEME SUGGESTIONS MODULE
// ----------

Schemes List = FETCH_FROM_FIREBASE ("scheme Data")
Filtered Schemes = []

FOR each scheme IN schemes List: IF scheme. Crop == crop Type OR scheme. region == region:

```
    ADD scheme TO filtered Schemes
  END IF
END FOR

DISPLAY "Matching Government Schemes:"
DISPLAY filtered Schemes

// ---------------------------------
// 4. CROP ADVICE MODULE
// ---------------------------------

Crop Advice List                                    =
FETCH_FROM_FIREBASE ("crop Advice")

FOR each advice IN crop AdviceList:    IF advice.crop ==
cropType AND advice.season == season:
    DISPLAY "Advice for", cropType, ":", advice.tips
ENDS IF
END FOR

// ---------------------------------
// 5. LOAN APPLICATION GUIDE
// ---------------------------------

DISPLAY "Do you want help applying for a loan?
(Y/N)" INPUT guide Choice

IF guide Choice == "Y":
 DISPLAY "Step 1: Check eligibility"
 DISPLAY "Step 2: Gather required documents"
 DISPLAY "Step 3: Apply on official portal or visit office"
 DISPLAY "Step 4: Track application status"
END IF

// ---------------------------------
// 6. FINANCIAL LITERACY SECTION
// ---------------------------------

DISPLAY "Would you like to watch financial
Videos? (Y/N)"
INPUT learnChoice

IF learnChoice == "Y":    videoList = [      "What is EMI?",
    "How interest works",
    "Understanding credit score",
    "Loan safety tips"
  ]
  FOR each video IN videoList:
    EMBED_YOUTUBE (video)
  END FOR
END IF

// ---------------------------------
// 7. OFFLINE MODE SETUP (PWA)
// ---------------------------------

CACHE pages: [Loan Calculator, Literacy Videos,
Schemes, Advice]
DISPLAY "Offline mode enabled for future use"

END
```

IV. RESULTS AND DISCUSSIONS

The Agri Finance Mate platform was successfully developed and tested as a functional prototype. The application allows users to calculate agricultural loan repayment details, access government schemes, view crop-specific financial advice, and learn financial concepts through embedded videos. All modules performed as expected during internal testing.

The following modules were evaluated:

Module	Result
Loan Calculator Calculations	Accurate EMI, interest, and raiment o output with real-time
Scheme Suggestions	Successfully filters schemes by crop and region using dummy Firebase data
Loan Application Guide	Displays clear, user-friendly steps with no lag or errors
Financial Literacy	Embedded YouTube videos play correctly and are readable on mobile

Displays stored crop-specific tips Crop Advisory Based on user selection Calculator and static content Offline Mode remain accessible in no-internet conditions (via PWA)

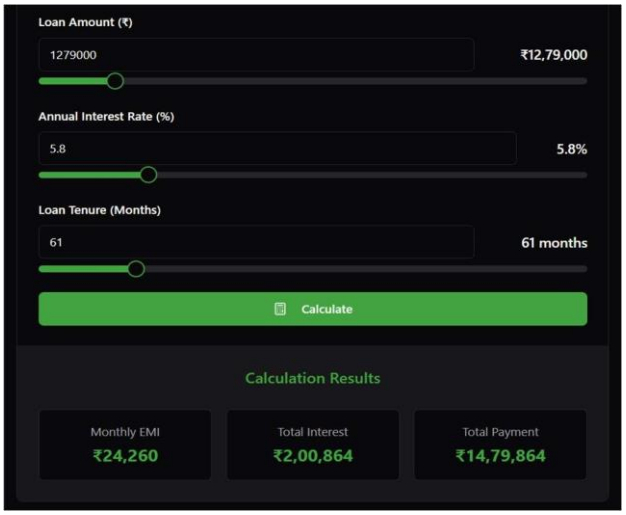

Figure 5: loan calculator

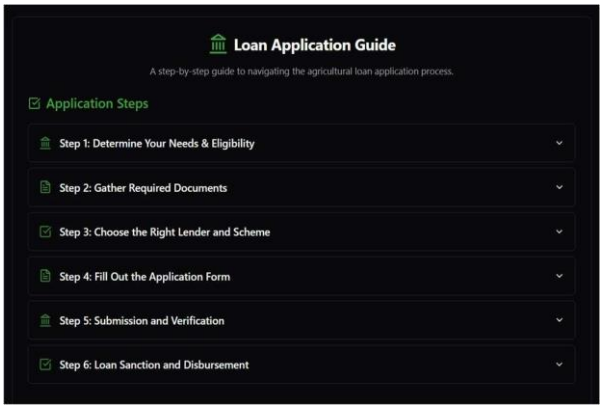

Figure 6: Guide

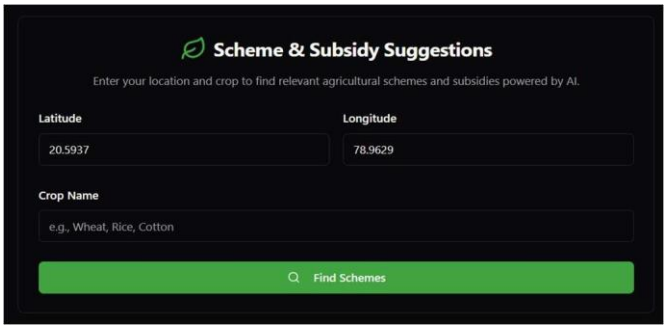

Figure 7: Scheme Information Tab

B. Performance Observations

- Responsiveness: UI performed well on both desktop and mobile browsers.
- Usability: All content is structured for semiliterate users using minimal text and icon based navigation.
- Accuracy: EMI logic matched real-world loan calculators with verified results.
- Offline support: Local caching was successful using service workers; scheme data and calculator remained available offline.

C. Limitations Identified

- Scheme data is static and manually entered; it does not yet fetch live updates.
- Financial literacy videos are limited to YouTube and require active connection for full stream (unless preloaded).
- Multi-language and voice assistant features are not yet implemented but are planned.
- Responsiveness is a little slower Difficulty in integrating live market trends and prices to provide real-time accurate information. Live weather updates to be Perfected

V. Future Scope

1. Expansion into Micro-Insurance:
Predictive modeling can be extended to crop insurance risk management, identifying potential climate risks, and suggesting coverage plans dynamically. Precision Farming through Data Fusion: Combine satellite imagery, drones, and soil/meteorological IoT data to offer hyper personalized advisories, detect pest outbreaks, and optimize resource usage (like water and fertilizers).

2. Integration with e-Marketplaces:
Connecting smart advisory systems to digital agri market platforms for better price realization and credit-based selling.

3. Holistic Agri- Fin tech Platforms:
Development of integrated platforms combining loan eligibility prediction, credit scoring, crop recommendation, and insurance guidance — tailored to farmer profiles using AI/ML and real time data from Iot sensors.

VI. CONCLUSION

The Agri Finance Mate project seeks to give address to those financial literacy issues that can be meaningful for farmers located in rural areas. Many farmers do not understand interest rates, how to repay loans, along with the true cost of borrowing. They do battle with all of the complexities of both loans and subsidies. This often results from debt cycles, loan rejection, or schemes' underutilization Agri Finance Mate offers up a solution by assisting you financially in such simple terms. It has

simple calculators that are still detailed, builds awareness, and grants scheme access. It also gives farmers advice about key money ideas like credit and EMI. The project seeks to help farmers with understanding various loan schemes and repayment plans, clearly visualize EMI, total interest, and repayment timelines, advise them based on crop type, region, and season, and give them awareness of and access to relevant agricultural subsidies and schemes through links. It also has an endeavor to try to increase financial literacy by way of educational content.

Agri Finance Mate's key features include Financial Literacy Videos along with an Offline Mode for areas with poor connectivity plus Crop Based Advice, a Loan Application Guide, Scheme & Subsidy Suggestions, also an EMI & Interest Calculator Future plans for Agri Finance Mate involve integrating with government schemes as well as subsidies, therefore it will implement AI-based loan prediction plus risk scoring to predict repayment capacity, suggest ideal loan amounts plus terms, then flag high-risk borrowing patterns. It also seeks data collection for policy making that lets governments track loan usage patterns, lets banks create flexible loan products, and lets NGOs target financial education campaigns. We plan for crop-specific financial matters later. Furthermore, we will have to add voice-based interfaces to regional languages because they are accessible, and we will have to fully deploy the program because we reach all farmers.

VII. ACKNOWLEDGMENT

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