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## Krushak Setu: A Digital Scheme Recommendation Portal for Farmers of Maharashtra

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**ABSTACT:** Agriculture drives India's economic growth, necessitating farmer welfare through improved infrastructure, insurance, irrigation, and financial inclusion. However, limited awareness, language barriers, and unstructured data hinder access to government schemes. This paper proposes a bilingual (Marathi and English) web-based platform featuring data visualization, insightful analytics, and an AI-powered chatbot. The solution aims to simplify access to relevant schemes, enhance understanding, and empower farmers with accurate, timely information, ultimately improving scheme utilization and fostering agricultural development.

KEYWORDS: Farmer schemes, Scheme analytics, Bilingual interface, AI chatbot, schemes accessibility.

## I. INTRODUCTION

A. Background

Agriculture is the backbone of India's economy, employing over half of its workforce and contributing significantly to its GDP [3]. However, the sector faces numerous challenges, including low productivity, fragmented landholdings, climate uncertainties, and limited access to modern technology and markets. To improve farmer's welfare and productivity, the government of India regularly introduces welfare schemes related to credit, insurance, subsidies, technology adoption, and capacity building. However, most farmers remain unaware of these schemes or find them difficult to understand due to complex eligibility criteria and lack of accessible information.

Technological solutions can bridge this gap. By leveraging modern technologies like AI assisted chatbot, and multilingual user interfaces, it is possible to simplify the process of discovering and applying for schemes. A digital platform customized for farmers can help overcome these barriers by centralizing scheme information and offering predictive recommendations.

## B. Problem Statement

Although many digital portals exist, most are static, poorly structured, and available only in English. Farmers often have to depend on intermediaries or government officers for scheme-related help. This leads to misinformation, delays, or loss of opportunities. The absence of predictive analytics, user-centric design, and conversational interfaces further limits the usability of these platforms for rural populations. 55.6 % of the farmers are aware of the available govt. schemes in the study area. Out of these, the source of awareness for the majority of the farmers is television, followed by newspapers. They mention their busy schedule and lack of formal education stands as a hurdle in understanding the government schemes. Proper education and training are required to avail the benefits of the welfare schemes and the overall development of the farmers. [4]

## C. Objective

Sharama [5] concluded that middle-aged farmers should participate along with young farmers. Awareness among the farmers and knowledge of the complete procedure should be clearly explained by the disseminating agencies, which may influence farmers positively to participate. The primary objective of this research is to design and implement an accessible and intelligent platform that bridges the information gap between farmers and agricultural welfare schemes. This includes the development of a centralized digital portal that consolidates information about various schemes,



making them easily searchable and filterable. The system is intended to empower farmers by providing them with access to critical scheme information in both Marathi and English, thereby overcoming language barriers that often hinder participation. A significant focus is also placed on incorporating an analytics engine that can interpret user behaviour and agricultural context to provide personalized scheme recommendations based on eligibility, location, and seasonal requirements. Furthermore, the platform integrates a conversational AI-assisted chatbot. This chatbot will help farmers query about schemes, understand eligibility, and even guide them through application steps.

## **II. LITERATURE REVIEW**

## A. Government Efforts and Existing Platform

Numerous initiatives have been launched by both the central and state governments in India to support farmers. Flagship schemes such as PM-KISAN (Pradhan Mantri Kisan Samman Nidhi), PMFBY (Pradhan Mantri Fasal Bima Yojana), and the Kisan Credit Card Scheme aim to provide direct benefits like financial aid, insurance coverage, and accessible credit. While these initiatives are commendable, their digital outreach remains limited. Existing portals and mobile applications like Kisan Suvidha and the Agri Market Mobile App offer basic information but lack advanced features such as personalized recommendations, real-time updates, and interactive support. Additionally, these platforms often require digital literacy and comfort with English, limiting their accessibility for a majority of rural farmers.

## B. Importance of Multilingual Accessibility

The agricultural community in India is linguistically diverse, with many farmers speaking only regional languages. According to a 2021 NITI Aayog report, more than 65% of rural users prefer content in their native languages. Multilingual digital interfaces have been shown to significantly improve engagement, trust, and retention among rural populations. Implementing bilingual or multilingual content, especially in Marathi and English, enables broader inclusion.

## C. Application of AI Chatbots in Public Services

Chatbots are becoming an essential tool in digital public service delivery. Their ability to provide 24/7 support, handle multiple queries simultaneously, and offer consistent and accurate responses makes them ideal for sectors like healthcare, finance, and governance. However, various applications in the agriculture domain is still emerging. For farmers, a chatbot can simplify access to complex government data, clarify eligibility criteria, and guide them through application processes.

## D. Real-Time Agricultural Data Services

Access to real-time market data and weather information is vital for farmers making day-to-day decisions. Various studies have emphasized that timely access to mandi prices can help farmers secure better deals and reduce exploitation by intermediaries. Likewise, accurate weather forecasts contribute to better planning of sowing, irrigation, and harvesting schedules. Platforms like IMD (India Meteorological Department), A market, and third-party APIs provide reliable data that can be integrated into digital farmer support tools. Furthermore, static agricultural content like best practices for crop care, pest management, and fertilizer usage remains essential for continuous learning and informed decision-making at the grassroots level.

## E. Gaps in existing research and Challenges

## Gaps in Existing Research:

- Standardizing unstructured government scheme data
- Ensuring translation accuracy in domain-specific contexts
- Maintaining conversational relevance in chatbot interactions across dialects
- Creating scalable systems for real-time updates and analytics

## **III. METHODOLOGY**

The Krushak Setu portal begins with a carefully designed user registration and on boarding process, intended to capture authentic and relevant farmer information. The front-end of the portal is built using React.js, chosen for its component-driven architecture and fast rendering capabilities, ensuring a seamless and efficient user experience. During sign up,

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users are required to input basic credentials such as email and password, followed by mandatory verification of their Farmer ID or Kisan ID. This ID is cross-validated with records stored securely in Firebase Firestore, a scalable NoSQL cloud database that enables real-time validations. Only after successful ID verification can the user move forward to the detailed profiling form, developed using HTML, CSS, and JavaScript to maintain compatibility with academic project guidelines while ensuring lightweight performance. This form collects critical agricultural details like land size, soil type, farming type (e.g., Horticulture, Traditional), caste category, annual income, and number of family members. These inputs create the data backbone for intelligent personalization across the portal.

A. System Architecture

- The application is divided into multiple functional components front-end, database, authentication services, and external APIs each of which handles a specific set of tasks in isolation, thereby promoting maintainability and clarity in the system's operations.
- At the core of the front-end lies React.js, which powers the entire user interface. The use of a componentbased architecture allows each section — such as Dashboard, Schemes, Weather, Crop Info, and FAQ — to be treated as an independent module.
- The dashboard itself acts as the central navigation hub, built with custom HTML and CSS for layout structuring, and enhanced with JavaScript for dynamic interactions.
- All user data, scheme records, and static content like crop information are stored in Firebase Firestore, a scalable NoSQL cloud database.
- Firebase Authentication handles user signup and login, verifying credentials through email and password, while also validating Farmer ID/Kisan ID entries against stored values in Firestore.
- The application integrates external APIs to fetch live data. The OpenWeatherMap API is used in the Weather module to retrieve current conditions and 5-day forecasts based on the user's geolocation.
- Meanwhile, the chatbot "Bhuvi" is seamlessly embedded into all pages post-login using the Tawk.to API, allowing real-time assistance without requiring back-end processing.



## B. Implementation

## 1. Dashboard

Upon successful registration, users are seamlessly redirected to the Dashboard, the heart of the Krushak Setu portal. Designed using React.js modular architecture, the dashboard features six navigational cards — each serving as an access point to a specific module: Recommended Schemes, All Schemes, Crop Info, Weather, Market, and FAQ. These cards are lazy-loaded using React Router v6, meaning that the module's internal logic is only initialized when the user interacts with the respective card, resulting in optimized load times and a smoother interface. The overall layout is constructed with plain CSS and grid systems to ensure a clean, mobile-friendly, and visually appealing interface that aligns with academic expectations. Every card is visually enhanced with intuitive icons and labels for easy recognition and navigation.



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## 2. Recommended Scheme

The Recommended Schemes module forms a pivotal part of the system's personalized assistance offering. Here, government schemes are manually entered into Firestore and labeled with metadata such as eligible soil types, land size range, income brackets, and caste eligibility. This dynamic matching mechanism ensures users are not overwhelmed with irrelevant schemes and receive only targeted, actionable recommendations to enhance their farming ventures.

## 3. Weather

The Weather module is a utility section that integrates the OpenWeatherMap API, allowing farmers to view live weather conditions and a 5-day forecast for their current city or any searched location. On visiting the Weather module, the app attempts to fetch the user's geolocation using browser APIs and requests weather data for that exact latitude and longitude. If permission is denied, users can manually search by city name. The fetched weather details — such as temperature, humidity, wind speed, and rain probability — are displayed using responsive, mobile-friendly cards built with JavaScript and CSS. This feature empowers farmers to make timely decisions about sowing, irrigation, harvesting, and pest control based on actual weather trends.

## 4. Crop Info

The Crop Info module is crafted as a rich, static information hub where different crops are showcased by category and season. Every crop is encapsulated within a clickable card that highlights its ideal soil type, growing season, water requirements, and general care tips. The crop data is manually stored in Firestore collections and retrieved using optimized queries to reduce read operations and improve performance. Card designs use flex-box layouts for smooth, responsive scrolling, making it easy for farmers to search for and browse crops relevant to their specific needs.

## 5. AI Chatbot Assistant

Lastly, the portal integrates Bhuvi, a real-time Chatbot embedded using the external service Tawk.to. After login, Bhuvi is available on every page to assist users with queries, offer navigation help, and answer basic questions related to schemes and trade. Since Tawk.to handles all hosting, message routing, and AI-based responses, no custom back-end service is required. This integration helps maintain the portal's lightweight structure while offering dynamic support. Serves as the back-end framework for handling user requests and processing data.

## C. Technologies Used

Each of the technologies listed in Table I play a critical role in the development and operation:

• **React Js:** React.js is used as the primary front-end framework due to its component-based architecture and fast rendering capabilities. Each feature of the app, whether it's Scheme Filtering or Weather Forecasting, is



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developed as a separate reusable component. React virtual DOM enhances performance and allows dynamic data updates without full-page reloads. Routing is managed using React Router v6, ensuring seamless transitions between modules.

- HTML & CSS: The fundamental technologies for designing and styling web applications. HTML determines the layout of the pages, while CSS improves its design, responsiveness, and look.
- JavaScript: Adds interactivity to the portal, handling user input, animations, and API calls to bridge the frontend and back-end.
- Flask: A Python web framework for back-end development that generates real-time market data.
- **Restful APIs:** Enables instantaneous data exchange and request processing between back-end (Flask) and front-end (React Js).
- Authentication Mechanisms: Firebase Authentication provides a secure and scalable login system.
- Firebase Firestore: Firestore acts as the central cloud NoSQL database, offering real-time data storage and syncing. It stores all essential records such as user profiles, scheme metadata, crop info. Firestore collections are structured to support complex queries, enabling personalized recommendations and filtered search results without a dedicated back-end server.

ReactJS	React.js is used as the primary front-end framework due to its component- based architecture and fast rendering capabilities.
HTML, CSS, JavaScript	Enhances the web app design, styling and interactivity.
Flask	Serves as the back-end framework for generating real-time market data.
Firebase Firestore	Firestore acts as the central cloud NoSQL database, offering real-time data storage and syncing.
Restful APIs	Facilitates seamless communication between the front-end and back-end.
Authentication Mechanisms	Firebase Authentication provides a secure and scalable login system.

## TABLE -1

## D. Expected Outcomes

- Centralized access to all government schemes relevant to farmers of Maharashtra.
- Real-time updates on crop prices from mandi/markets.
- Live weather alerts to help plan farming activities like sowing, irrigation, and harvesting.
- AI-assisted chatbot (Marathi & English) for 24/7 scheme and farming help.
- Easy discovery of relevant schemes based on user profile (landholding, crop type, etc.).
- Increased scheme awareness and registrations due to simplified information.
- Support for digital literacy and self-service among rural users.
- Reduction in intermediaries, dependency and misinformation.
- Empowerment of rural communities through technology-driven services

## **IV. CHALLENGES AND SOLUTIONS**

• During the development of Krushak Setu, several technical and design-related challenges emerged. These were critical in shaping the implementation strategy and ensuring that the final application remained lightweight, secure, and user-friendly, especially considering its intended audience includes rural farmers with limited digital exposure.

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- One of the initial challenges was validating the authenticity of users during registration. Farmers were expected to input either a Farmer ID or Kisan ID, which needed to be checked against existing records. The challenge was maintaining a secure verification flow without over complicating the process. This was addressed by storing a list of verified IDs in Firestore, and using Firebase Authentication for login security. Only when a valid ID is matched, can the user proceed to the full registration form thus minimizing unauthorized access without needing biometric tools.
- Another major hurdle was handling scheme personalization logic without overwhelming the front-end with conditional checks. The filtering of schemes based on caste, soil type, land size, and income had the potential to become complex and inefficient if not handled properly. To solve this, the development team implemented a structured tagging system within Firestore. Each scheme entry had multiple tags corresponding to eligibility fields. On login, React queries were constructed dynamically based on the user's stored profile data, fetching only the matching results. This eliminated the need for front-end based heavy filtering and reduced rendering delays.
- The weather module, which relies on OpenWeatherMap API, occasionally faced reliability issues due to poor internet connectivity in rural test zones. If the API fails, it could disrupt the user experience. To manage this, error-handling logic was added to detect network failures and display fallback messages like "Weather unavailable check connection," rather than leaving blank screens.
- The chatbot integration using Tawk.to raised concerns around consistency across routes and rendering on different screens. Since it loads via external script, it requires careful placement within the app's routing hierarchy. The solution involved loading the Tawk.to script only once post-login and attaching it to the React root component, ensuring that it persists across modules without multiple reloads or visual glitches.
- Lastly, one of the broader challenges was ensuring that the application remained light and mobile-optimized. Since many farmers would access the platform via basic Android browsers or low-speed networks, performance was a priority. The team solved this by avoiding bulky CSS frameworks like Tailwind, manually optimizing images, using conditional component rendering, and implementing lazy loading where possible.

## V. RESULTS AND DISCUSSION

A. Overall Platform Usability & Responsiveness

- The Progressive Web App (PWA) was tested across desktop and mobile browsers to ensure platform independence.
- Tests included varied network conditions (4G, 3G, low-signal areas) common in rural and semi-urban Maharashtra.
- Maintained a lightweight, fast-loading experience even on entry-level Android devices and browsers.
- All routes were optimized using React code-splitting to reduce initial load time and data usage.

elcome, shubhamatugade070! se a module below to access information and resources		
Recommended Schemes	All Schemes	ر Crop Info
View government schemes tailored for your farm profile	Browse all available agricultural schemes	Explore detailed information about various crops
کے۔ Weather	۱۱ Market	⑦ FAQ
Get real-time weather updates for informed decisions	Access market prices and trends for better sales	Find answers to common questions

## B. Scheme Personalization Engine

- Personalization logic filtered schemes based on:
  - Caste category, soil type, landholding size, and annual income.
- Successfully matched user profiles to eligible schemes stored in Firestore.

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- Achieved 90–95% accuracy across a range of dummy test profiles, validating the tag-based metadata system and dynamic Firestore queries.
- Users could view:
  - o "Recommended Schemes" tailored to their profile.
  - o "All Schemes" to explore opportunities beyond their default eligibility.

a Krushak Setu	🙆 Dashboard ල් V	Veather	@ FAQ S
ecommended Schemes			
vernment schemes tailored based on your farm profile and eligibility			
Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) Direct income support of 10,000 per year to eligible farmer families, payable in three equal	i installements of ¥2,000,		Recommended
Eligibility	Benefits		
All landholding farmer families with cultivable land.	Financial assistance for agricultural expenses.		
Application Process	Deadline		
Online application through PM-KISAN portal or Common Service Centers.	Ongoing		
Income Support All Farmers Direct Benefit Transfor			
	L	earn More	Apply Now
Soil Health Card Scheme			Recommended
Provides information on soil nutrient status and recommendations on appropriate dosage	of nutrients for improving soil health and fertility.		
Eliaibility	Benefits		
All farmers regardless of land size.	Optimized fertilizer use, increased yield, and reduced cultivation costs.		
Application Process	Deadline		
Register at nearest Krishi Vigyan Kendra or Agriculture Department office.	Ongoing		

## C. Weather Module

- Integrated with OpenWeatherMap API to fetch:
  - Current weather conditions.
    - o 5-day forecasts.
  - Metrics like temperature, humidity, wind speed, and weather summary.
  - Tested across 10 cities, using both live geolocation and manual city search.
- API response times were consistent under 1.5 seconds on average.
- Built-in error handling gracefully displays fallback messages like "Weather unavailable check connection" during network issues, preserving the user experience.

learch for a city				Q 50
owai attered Clouds				<b>a</b> 31
Numidity 54%	🔶 Fe	rels Like 3°C	Wind Speed 6.35 m/s	
-Day Forecast				
Fri, Apr 25	Sat, Apr 26	Sun, Apr 27	Mon, Apr 28	Tue, Apr 29
			•	•
31%	28°C	28°C	27°C	28°C

D. Crop Info Module

- Provided static, structured crop information categorized by:
  - Farming type (e.g., cereal, pulses, vegetables).
    - o Season (Kharif, Rabi, Zaid).
- Designed for clarity with minimalistic, readable cards.
- Static design ensures no external API dependency, resulting in fast loading and low data usage especially beneficial in poor connectivity zones.
- Test users appreciated the clarity and accessibility of crop content.

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## E. Market Module

- Displayed real-time commodity prices fetched from manually uploaded APMC data.
- Data was shown in a scrollable, responsive table format, optimized for mobile viewing.
- Focused on user clarity and ease of access.

Aarket Insig	hts			3 May 2025
elect APMC Locati	ion: Mumbai APMC, Vashi			
Commodity	Category	Current Price	Last Week Price	Change
Wheat	Coreals	₹ 1351 per quintal	₹ 1396 per quintal	-47(-3.36%)
Rice	Cereals	₹ 1272 per quintal	₹ 1302 per quintal	-30(-2.30%)
Aaize	Cereals	₹ 1984 per quintal	₹ 1995 per quintal	-11(-0.55%)
Dnion	Vegetables	₹ 1335 per quintal	₹ 1330 per quintal	+6(0.38%)
Potato	Vegetables	₹ 1028 per quintal	₹ 937 per quintal	+91(9.71%)
omato	Vegetables	₹ 1568 per quintal	₹ 1495 per quintal	+73(4.88%)
Mango	Fruits	₹ 1814 per quintal	₹ 1889 per quintal	-75(-3.97%)
3anana	Fruits	₹ 1094 per quintal	₹ 1147 per quintal	-63(-4.62%)
Apple	Fruits	₹ 1607 per quintal	₹ 1628 per quintal	-21(-1.29%)

## F. FAQ Module

- Contained a curated list of frequently asked questions to help first-time users navigate the platform.
- Covered key topics: registration, scheme eligibility, weather/crop info usage, chatbot support.
- Helped reduce user confusion and increase self-service.

Krushak Setu					© FAQ	
equently Asked C	uestions					
answers to common questions ab	out Krushak Setu and its features					
General	Schemes	Weather	Crops	Technical		
General FAQs						
						_
vhat is krushak setu Navigatorr						^
What is Krushak Setu Navigatorr Inshak Setu Navigator is a comprehen armers with knowledge and tools to in	sive portal designed to connect farmers with prove their farming practices and livelihoods	government schemes, agricultural informatio 5.	n, weather updates, market insights, and ed	lucational resources. It	aims to empo	^
What is knushak setu Navigatorr Dushak Setu Navigatoris a comprehen armers with knowledge and tools to in s Knushak Setu available in multig	sive portal designed to connect farmers with prove their farming practices and livel/hoods ole languages?	government schemes, agricultural informatio 5.	n, weather updates, market insights, and ed	lucational resources. It	aims to empo	- 1988 
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vinit is knuishai setti havigatorr inshali Setti havigatorin a comprehen mmeni with knowledge and toolis to in s Knushak Setu availlable in multij fow do I create an account on Kr i my information secsee with Knu	sie portal designed fo connect fames with groue their familing practices and sixethrood ole fainguages? ushak Setu? shak Setu?	government schemes, agricultural informatio	rt weather updates, market insights, and ed	lucational resources. It	ains to empo	C 100 C 1

## G. Chatbot (Bhuvi) Integration

- Powered by Tawk.to, integrated seamlessly post-login.
- Handled basic query resolution, multilingual greetings, and navigation help.
- Persisted across modules without reloads due to optimized script placement in the app root.
- During testing:
  - Chatbot loaded in 100% of test sessions.
  - Provided instant, conversational support in both Marathi and English.

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H. Performance Metrics

- The Final build maintained a bundle size under 2MB, ensuring quick load and low data consumption.
- Page-level lazy loading and conditional rendering helped optimize resource usage.
- Dashboard performance benchmarks:
  - $\circ$  <2 seconds on 4G networks.
  - <5 seconds on 3G networks meeting rural user needs.
- Across all modules, the app delivered a smooth, consistent, and accessible experience under real-world test conditions.





## A. Key Research Findings

It can be concluded that there is a need to create awareness among farmers to get maximum benefits from the agricultural scheme of the government. Training and awareness through extension services helps in achieving the schemes for the farmers[6]. This research demonstrates the potential of a digital, bilingual, and AI-assisted chatbot platform to revolutionize the way farmers access welfare schemes. With improved awareness, reduced language barriers, and intelligent assistance, the gap between government intent and grassroots impact can be effectively bridged. The integration of analytics and conversational interfaces fosters better engagement and understanding, which are crucial for inclusive development in rural India.

## B. Future Enhancements

To further enhance the effectiveness and scalability of the platform, future development will focus on integrating a voice-enabled chatbot that can cater to farmers who are not literate or have limited experience with digital devices. This feature will allow users to speak in their native languages or dialects and receive spoken responses, significantly improving usability for a larger segment of the rural population.

Additionally, the platform will be extended to include Whats App chatbot integration, leveraging the widespread use of Whats App in rural India. This integration will provide farmers with an alternative and familiar mode of accessing scheme information, asking questions, and receiving notifications or updates about new schemes or deadlines.

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Another planned enhancement is the implementation of a GIS-based scheme mapping system. This system will allow farmers to view schemes relevant to their geographical location and visualize regional eligibility, making the process of identifying applicable programs more intuitive and data-driven.

The system will also be expanded to support additional regional languages such as Marathi, Tamil, Telugu, and Bengali to ensure broader inclusivity. Furthermore, direct API integration with government databases will enable real-time updates to the scheme repository, ensuring that users always have access to the latest information.

These enhancements aim to build a holistic and accessible ecosystem that empowers farmers across India to make informed decisions, improve productivity, and ensure sustained agricultural growth through effective utilization of government welfare schemes.

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