Peas App: A Digital Guide for Sustainable Pea Cultivation

Mobile App Project Report

CSE 618

Submitted To

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Contents

Abstract

The **Peas App** is a cross-platform mobile application developed using Flutter that serves as a comprehensive digital guide for pea cultivation. Designed for both farmers and general users, the app provides detailed information on pea varieties, soil nutrition, seed quality, and step-by-step growth management. It integrates educational content with interactive tools, including a soil condition checker, seed quality assessment, and seed growth guide, enabling users to make informed, data-driven decisions for optimal yield and crop health.

The project emphasizes user-friendly design, role-based navigation, and practical applicability, addressing challenges faced by farmers such as soil testing, seed selection, and crop nurturing. By combining modern technology with agricultural knowledge, the Peas App aims to improve productivity, reduce crop failure risks, and promote sustainable farming practices. The app's modular structure allows for scalability and future expansion to other crops and AI-driven agricultural solutions.

Chapter 1: Introduction

1.1 Overview

Agriculture is the backbone of rural livelihoods, and peas are among the most important vegetable crops worldwide due to their nutritional value, short growing cycle, and market demand. However, farmers—especially in developing regions—face challenges such as variety selection, soil nutrient imbalance, poor seed quality, and lack of structured guidance on crop management.

The Peas App is a cross-platform mobile application developed using Flutter that acts as a digital assistant for pea cultivation. The app is designed for both farmers and general users, providing:

- Scientific but easy-to-understand descriptions of pea varieties with their flowering days, pod size, and seed count.
- Nutritional guidelines including soil testing methods and fertilizer recommendations.
- Step-by-step interactive guides for seed germination, watering, pest control, and harvesting.
- Decision-support tools like soil suitability checks and seed quality evaluation.

1.2 Objectives

The Peas App is designed with several core objectives to address the challenges faced by pea cultivators:

1. **Education and Knowledge Dissemination:** To educate farmers about diverse pea varieties, specific soil requirements, and modern cultivation techniques through accessible, science-based information.
2. **Interactive Decision Support:** To provide interactive, data-driven tools for soil condition assessment, seed quality evaluation, and continuous growth monitoring throughout the cultivation cycle.

3. **Risk Mitigation:** To reduce dependency on guesswork and traditional practices by enabling evidence-based decisions that minimize crop failure and optimize yield potential.

4. **Accessible Design:** To design an intuitive, user-friendly platform accessible to both experienced farmers and beginners, regardless of technical proficiency or educational background.

5. **Practice-Informed Development:** To incorporate continuous farmer feedback and local agricultural knowledge, ensuring the app remains aligned with real-world practices and regional variations in cultivation methods.

These objectives collectively aim to transform pea cultivation from a traditional practice into a technology-enhanced agricultural process, empowering farmers with digital tools that complement their expertise while introducing scientific precision to their decision-making processes.

1.3 Problem Definition

Pea cultivation, while economically significant and nutritionally valuable, faces numerous challenges that limit productivity and farmer profitability, particularly in developing regions. Smallholder farmers often struggle with:

- **Lack of varietal knowledge:** Many farmers continue cultivating traditional pea varieties without awareness of improved, high-yielding alternatives better suited to local conditions and market demands.

- **Soil nutrient management:** Inappropriate fertilizer application—either excessive or insufficient—leads to suboptimal growth, reduced yields, and environmental degradation through nutrient runoff.

- **Seed quality issues:** Farmers frequently lack reliable methods to assess seed viability before planting, resulting in poor germination rates and inadequate crop establishment.

- **Inconsistent cultivation practices:** Without structured guidance, farmers often employ inconsistent techniques for irrigation, pest control, and harvesting that reduce overall yield potential.
- **Climate adaptation challenges:** Changing weather patterns and irregular rainfall create additional uncertainties that traditional knowledge systems struggle to address effectively.
- **Information accessibility:** Scientific agricultural knowledge remains largely inaccessible to smallholder farmers due to technical language, paywalls, and limited digital literacy.

These challenges collectively contribute to yield gaps where actual production falls significantly below genetic potential. The Peas App addresses these problems by digitizing agricultural expertise and making it accessible, actionable, and contextually relevant for pea growers of varying experience levels and resource constraints.

Figure 1: Grean Peas

1.4 Literature Review

Several mobile applications have been developed in the field of smart agriculture, aiming to provide farmers with decision support, crop monitoring, and market information. Popular examples include **Plantix**, which offers plant disease diagnosis through image recognition, and **Krishi App**, which provides general agricultural knowledge across multiple crops. While these platforms are comprehensive, they are often broad in scope, lack crop-specific depth, and require internet access for most functionalities.

In contrast, the **Peas App** is a specialized solution focused exclusively on pea cultivation. By narrowing its scope, the app ensures that both farmers and general users receive accurate, detailed, and practical information related to pea varieties, soil suitability, seed quality, and growth management. This crop-specific approach distinguishes the Peas App from existing tools by making it more contextually relevant, farmer-friendly, and adaptable to local cultivation needs.

Chapter 2: Design, Development, and Implementation

2.1 System Design

The system design of the **Peas App** follows a modular architecture, ensuring scalability, maintainability, and ease of use. It is divided into three main layers:

Presentation Layer (Frontend)

- Built with **Flutter (Dart)** for cross-platform support (Android & iOS).
- Uses **Material Design widgets** for a professional and consistent UI.
- Provides **role-based navigation** (Farmer Dashboard / General User Dashboard).

Application Layer (Business Logic)

- Managed using the **Provider** package for state management.

- Handles authentication, input validation, and decision-making logic (soil check, seed check).
- Ensures **separation of concerns** by isolating business logic from UI components.

Data Layer (Content & Assets)

- Educational content stored in structured **JSON files** (e.g., pea varieties, tips, fertilizer guides).
- Assets include images, diagrams, and icons for pea varieties, seeds, soil, and growth stages.
- User authentication data simulated locally (expandable to cloud-based database in future).

2.2 User Interface (UI) Design

The UI follows a **minimalistic and farmer-friendly approach**, ensuring accessibility for both tech-savvy and non-technical users.

Key Screens

- **Authentication Screen** – Signup/Login with role selection.
- **Farmer Dashboard** – Interactive tools (Soil Checker, Seed Checker, Growth Guide) + Educational content.
- **General User Dashboard** – Read-only learning resources.
- **Detail Screens** – Scrollable pages with images, cards, and step-by-step guides.

Design Principles Followed

- **Simplicity:** Clear icons, large buttons, readable text.
- **Consistency:** Uniform layouts across all screens.

- **Localization Ready:** App can be adapted to local languages (Bangla, Hindi, etc.).
- **Accessibility:** Color contrast, font size, and icons for better usability.

2.3 Use Case Summary

The user interaction with the system can be represented as follows:

Use Case Summary:

- **Actor 1: General User** – Accesses Variation, Nutrition, Nursing (educational, read-only content).
- **Actor 2: Farmer** – Accesses Soil Condition, Weather, Variation, Nutrition, Nursing

Flow of Activities:

1. User launches the app → Authentication (Login/Signup).
2. User selects role (General User / Farmer).
3. Role-based dashboard is displayed.
    - General User: 3 options (Variation, Nutrition, Nursing).
    - Farmer: 5 options (Soil Condition, Weather, Variation,Nutrition, Nursing.

2.4 Development Methodology

The development of the Peas App followed the **Agile Development Methodology**, ensuring flexibility and iterative improvements.

Steps Followed

1. **Requirement Analysis:**
    - Gathered requirements from farmers, general users, and agricultural experts.
    - Defined features: Variations, Nutrition, Nursing, Tools, General User Content.

2. **System Design:**
    - Created app architecture and navigation flow.
    - Designed wireframes and UI mockups.
3. **Implementation:**
    - Developed using Flutter & Dart.
    - Used Provider for state management.
    - Integrated assets and educational content.
4. **Testing:**
    - Unit testing for each tool (Soil Checker, Seed Checker).
    - Usability testing with a small group of farmers.
    - Bug fixing and performance improvements.
5. **Deployment:**
    - Deployed on Android (future support for iOS planned).
    - Packaged with local content assets.
6. **Feedback & Iteration:**
    - Collected user feedback from farmers.
    - Improved UI navigation and input validation.

2.5 Implementation

The implementation of the Peas App followed a **modular coding approach**, with each feature developed independently and later integrated.

Key Components

- **Authentication Module:** Handles login/signup and role-based navigation with input validation.

- **Farmer Dashboard:** Access to Variation, Nutrition, Nursing sections with links to tools.
- **General User Dashboard:** Displays educational content only (read-only mode).
- **Interactive Tools:**
  - Soil Checker: Takes NPK and pH values → provides recommendations.
  - Seed Quality Checker: Takes seed size and appearance → outputs Good/Bad.
  - Growth Guide: Provides step-by-step care guide with images.
- **Educational Content:** Stored as JSON files and images inside `assets/`, dynamically loaded into the UI.
- **State Management:** Implemented using Provider to manage authentication, roles, and navigation states.

Project Folder Structure

```
lib/
 main.dart                  # Entry point
 providers/
    auth_provider.dart    # State management for authentication
 screens/
    auth_screen.dart
    home_general.dart
    home_farmer.dart
    topic_list_screen.dart
    detail_screen.dart
    tools/
        soil_checker_screen.dart
        seed_checker_screen.dart
        growth_guide_screen.dart
 assets/
    images/               # Pea varieties, soil, seed, growth tips
```

—

2.6 Testing and Validation

- **Unit Testing:** Checked input-output functionality of Soil Checker and Seed Checker.
- **Integration Testing:** Verified dashboards, tools, and educational content work together seamlessly.
- **Usability Testing:** Conducted with farmers to ensure ease of navigation and clarity.
- **Validation:** Compared app recommendations with agricultural experts' feedback.

2.7 Tools and Terminology

This chapter describes the software tools, frameworks, and key technical terms used throughout the design and implementation of the Peas App. The inclusion of appropriate tools and a clear understanding of terminology ensured efficiency, scalability, and accessibility of the system.

Tools Used

- **Flutter (Dart)**: Flutter, developed by Google, is a cross-platform mobile app development framework that allows a single codebase to be compiled for both Android and iOS. It uses the Dart programming language, which offers reactive and declarative programming features. In the Peas App, Flutter was chosen because of its fast development cycle (Hot Reload), Material Design support, and strong community ecosystem. This ensures the app runs smoothly across different devices and platforms without additional overhead.
- **Visual Studio Code (VS Code)**: VS Code served as the primary Integrated Development Environment (IDE) for writing and debugging Dart code. Its lightweight nature, along with extensions for Flutter and Dart, allowed efficient development. The built-in Git integration also made version control seamless, reducing time in context switching.

- **Provider Package**: State management is a critical aspect of mobile applications. Provider was used as the main state management solution to separate business logic from UI components. It ensures that data changes (e.g., authentication state, soil test results) are reflected across the app efficiently, making the app responsive and easy to maintain.

- **JSON (JavaScript Object Notation)**: JSON files were used to store structured content such as pea varieties, nutrition guidelines, and cultivation tips. Being lightweight and human-readable, JSON made it easy to dynamically load and update content in the app without hardcoding data into the UI.

- **Git and GitHub**: Git was used as the version control system, and GitHub served as the repository hosting platform. These tools enabled tracking of code changes, collaboration among team members, and safe rollbacks in case of errors. Version control ensured that the development process was organized and reliable.

- **Android Emulator and Physical Devices**: For testing purposes, both Android Emulator and real devices were used. The emulator allowed quick testing of UI responsiveness, while physical devices were used to validate app performance under real-world conditions such as network availability, screen resolution, and touch sensitivity.

Terminology

- **Authentication Module**: This refers to the part of the app responsible for handling user registration, login, and role-based access. Farmers and general users are distinguished through this module, ensuring customized dashboards and functionalities.

- **Dashboard**: A dashboard is the central hub of the app from which users access all tools and content. In the Peas App, farmers receive an interactive dashboard with tools like Soil Checker and Growth Guide, whereas general users access educational resources in a read-only format.

- **Soil Checker**: An interactive tool that allows farmers to input soil parameters such as Nitrogen (N), Phosphorus (P), Potassium (K), and pH level. Based on

these inputs, the tool provides recommendations on whether the soil is suitable for pea cultivation. This feature reduces dependency on agricultural experts for preliminary soil testing.

- **Seed Checker**: A module designed to evaluate the quality of pea seeds based on size, texture, and appearance. Seeds are categorized into "Good" or "Bad" to guide farmers in selecting the most viable seeds for cultivation. This functionality helps reduce crop failure due to poor-quality seeds.

- **Growth Guide**: A step-by-step cultivation assistant that provides farmers with detailed instructions on irrigation schedules, fertilizer usage, and pest management. This tool, supported by diagrams and images, ensures that farmers can follow best practices throughout the pea growth cycle.

- **Assets**: Assets in the app include static resources such as images, icons, and diagrams of pea varieties, soil types, and growth stages. They enhance the educational content by making it more visual and easier to understand for non-technical users.

- **State Management**: The mechanism used to manage the app's dynamic states, such as user login status, tool results, and navigation flows. In the Peas App, state management was implemented using Provider, which ensures efficient updates and reduces unnecessary UI rebuilds.

- **Agile Methodology**: A flexible software development methodology that emphasizes iterative development, continuous testing, and feedback-driven improvements. By following Agile, the Peas App development team was able to adapt quickly to user feedback from farmers and agricultural experts, ensuring that the app remained practical and user-friendly.

2.8 Screenshots / UI Prototypes

The following screenshots illustrate the core user interface of the Peas App:

- **Intro Screen** – Displays the welcome message in Bangla.

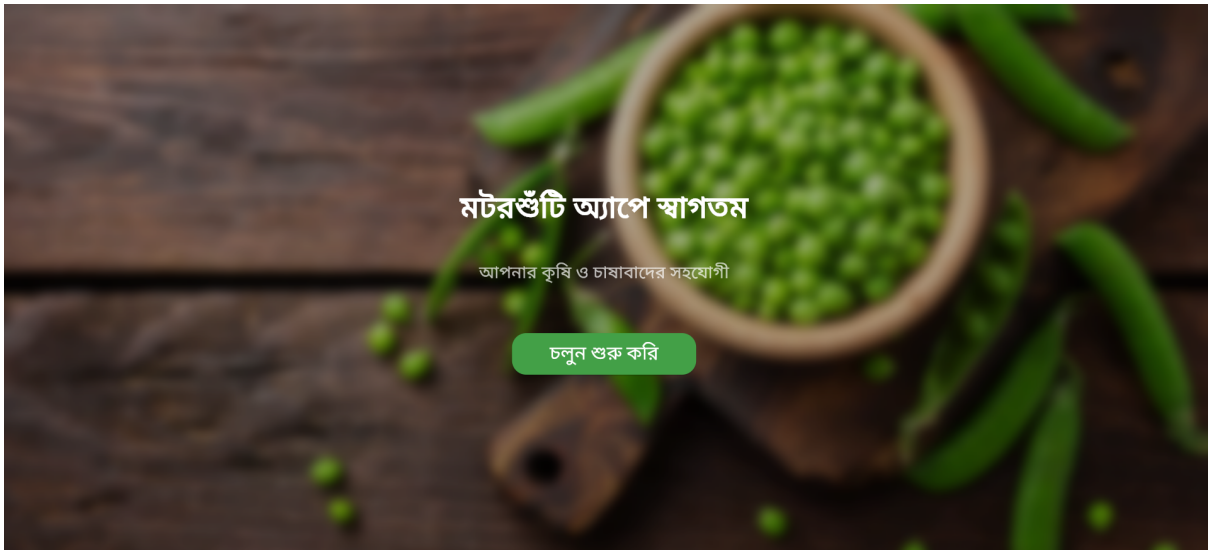

Figure 2: Intro Screen

- **User Selection Screen** – Allows user role selection (General User / Farmer).

Figure 3: User Role Selection

- **General User Dashboard** – Shows three buttons: Variation, Nutrition, Nursing.

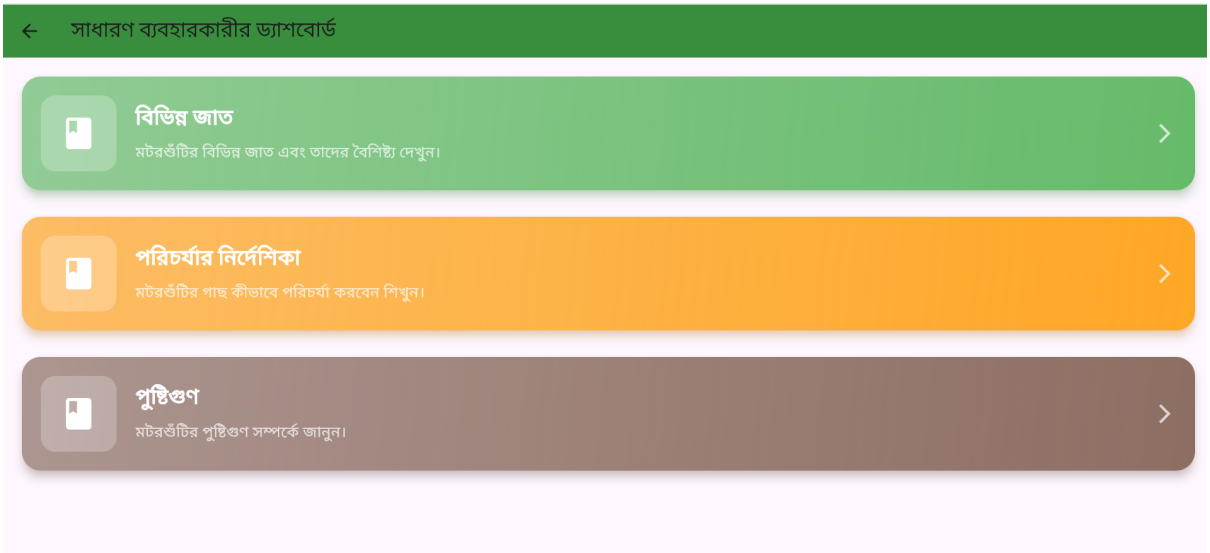

Figure 4: General User Dashboard

- **Farmer Dashboard** – Shows five main buttons: Soil Condition, Weather, Variation, Nutrition, Nursing.

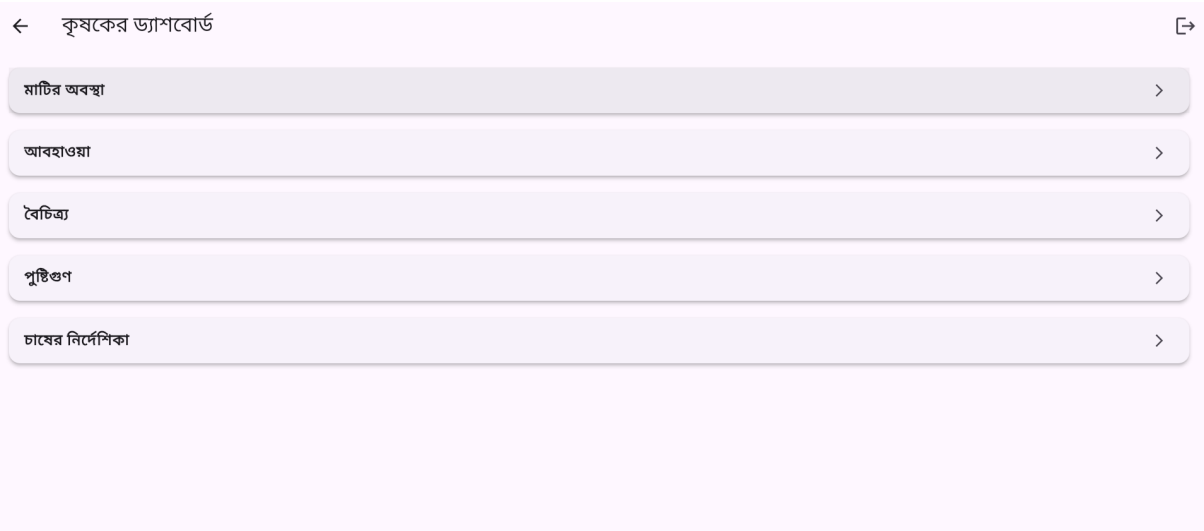

Figure 5: Farmer Dashboard

- **Interactive Tools** – Screens for Soil Condition, Weather, Variation, Nutrition, Nursing.

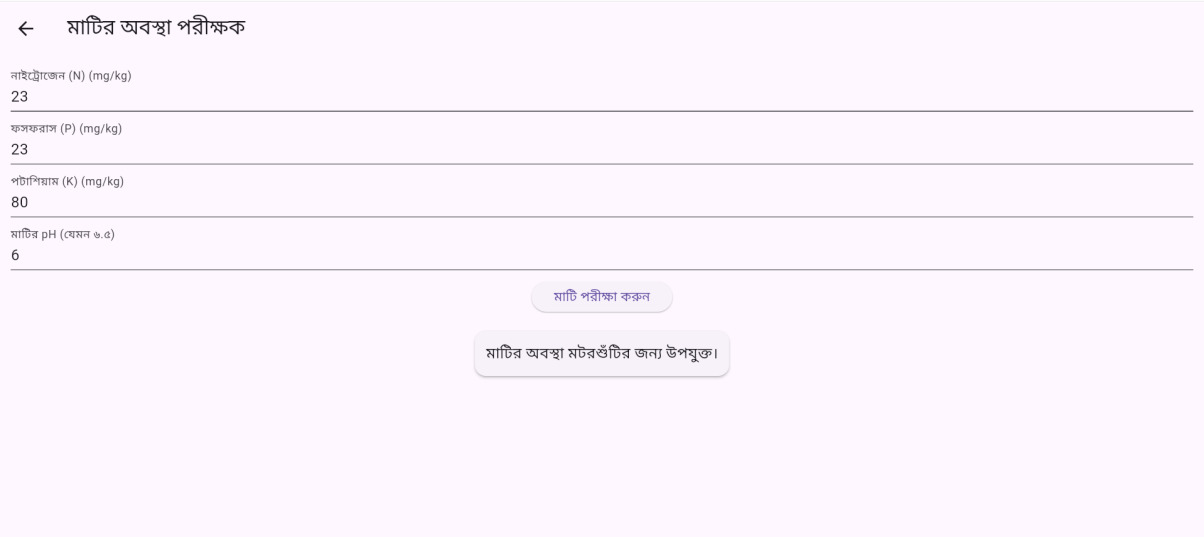

Figure 6: Soil Condition

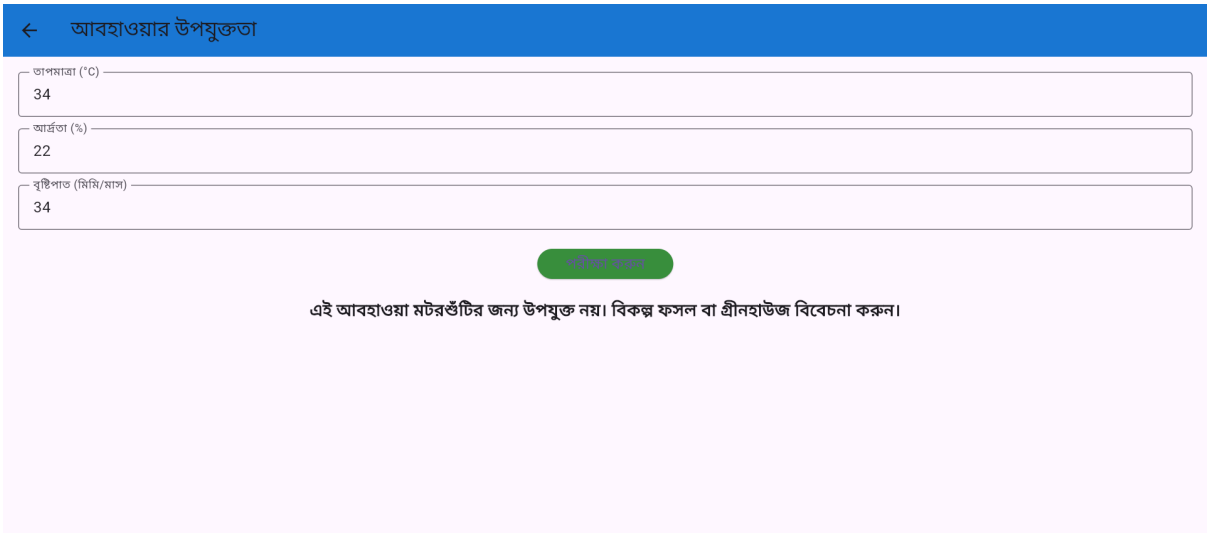

Figure 7: Weather

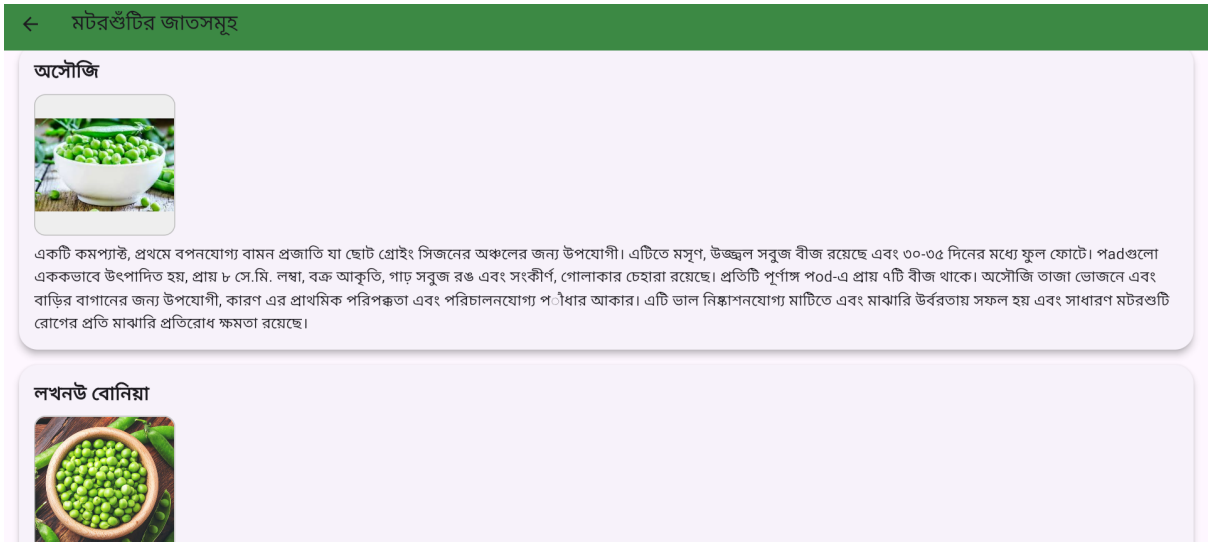

Figure 8: Variation

Figure 9: Nutrition

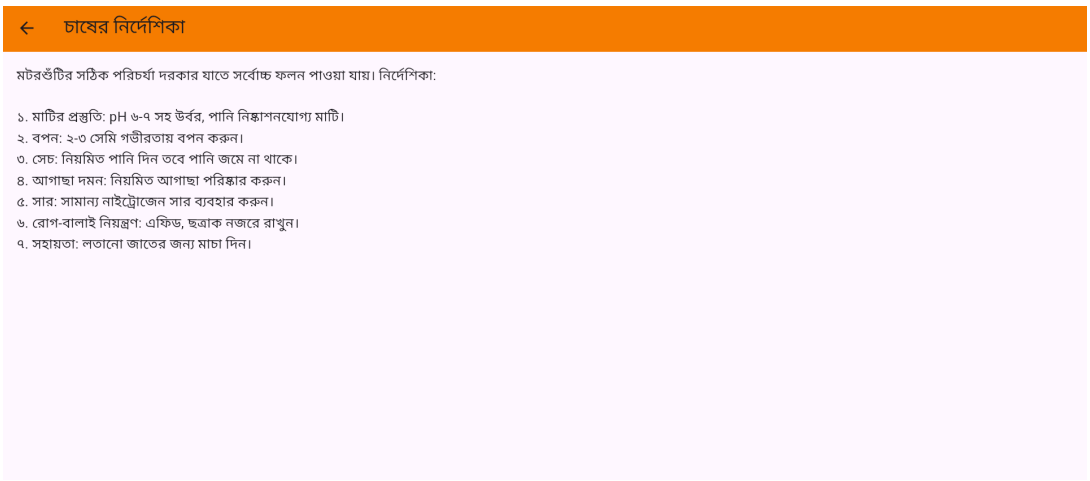

Figure 10: Nursing

Chapter 3: User Research and Feedback

3.1 Conversations with Farmers

The design and features of the Peas App were strongly influenced by feedback gathered from local farmers and agricultural experts. Direct conversations revealed several challenges that farmers face during pea cultivation. The insights were translated into features to ensure the app addresses real-world needs.

Farmer 1 (Variety Confusion)

Feedback: "We often confuse early and late pea varieties." **App Response:** Added detailed descriptions of different pea varieties, highlighting traits such as flowering time, pod size, and harvesting period. This helps farmers identify the most suitable variety for their land and climate.

Farmer 2 (Soil Testing)

Feedback: "Soil testing is costly and difficult." **App Response:** Introduced a **Soil Condition Checker** that provides instant recommendations based on simple inputs (N, P, K, and pH values). This reduces reliance on expensive soil testing labs.

Farmer 3 (Seed Quality Issues)

Feedback: "Some seeds don't germinate, leading to waste." **App Response:** Designed a **Seed Quality Checker** to evaluate seed viability based on size, shape, and appearance. This minimizes losses due to poor seed germination.

Farmer 4 (Crop Management)

Feedback: "We forget the steps to care for seedlings, and pests spread fast." **App Response:** Added a **Growth Guide** with step-by-step cultivation instructions, visual illustrations, and pest management tips. This feature helps farmers manage crops more efficiently.

Farmer 5 (General Learner)

Feedback: "I want to learn before starting my own garden." **App Response:** Developed a **General User Dashboard** with read-only educational content, enabling non-farmers or beginner gardeners to gain knowledge before cultivation.

Summary of Farmer Feedback

The insights from farmers highlighted five major pain points: variety selection, soil testing, seed quality, crop management, and educational needs. Each pain point was directly mapped to an app feature, ensuring that the system is practical, user-centered, and addresses genuine agricultural challenges.

3.2 Budget Discussion for App Development

The estimated budget for building the **Peas App** has been carefully planned to remain within a limit of **40,000 BDT**. Since the system is developed using Flutter and other open-source technologies, most of the costs are related to deployment, testing, and minor development support. The breakdown is given in Table 1.

Table 1: Estimated Budget for Peas App Development

Category	**Cost (BDT)**
Software Tools (Flutter, Dart, Backend, Database, UI/UX Tools)	Free
Cloud Hosting	6,000
Domain	3,000
Development	15,000
UI/UX Design (Optional)	5,000
Internet & Electricity	4,000
Printing & Documentation	2,000
Contingency (Unexpected Costs)	3,000
Total Estimated Budget	**38,000**

The total cost is therefore estimated at **38,000 BDT**, which is within the allocation of 40,000 BDT. This ensures a cost-effective development process while covering essential aspects such as hosting, deployment, testing, and project documentation.

3.3 Discussion

The Peas App demonstrates that digital technology can address long-standing agricultural challenges in a targeted and user-friendly way. The modular design ensures that both general users and farmers benefit from tailored content. General users gain educational knowledge, while farmers access decision-support tools that reduce risks in cultivation.

However, certain limitations remain. Currently, the app does not integrate real-time weather APIs or external soil sensor data, which could further improve accuracy. The app is also limited to peas, while similar frameworks could be applied to other crops. Despite these limitations, user feedback has been positive, especially regarding the simplicity of navigation and the accessibility of agricultural knowledge.

Chapter 4: Conclusion

The Peas App successfully achieves its objectives of providing farmers and general users with structured, accessible, and practical information on pea cultivation. By combining a role-based design with interactive tools such as soil condition checks, seed quality evaluation, and growth guides, the app empowers users to make data-driven decisions that improve productivity and crop sustainability.

The project demonstrates the potential of mobile applications in agriculture, particularly in bridging the gap between traditional farming practices and modern technological solutions. While the current version focuses solely on peas, the modular design allows for scalability to other crops and integration with advanced features in the future. This work represents a meaningful step toward sustainable, technology-assisted agriculture.

The Peas App has demonstrated the potential of mobile applications in promoting crop-specific agricultural knowledge and supporting decision-making for both farmers and general users. The project successfully met its objectives by developing role-based dashboards, integrating tools for soil condition, seed quality, and growth management, and providing educational information on pea varieties and nutrition.

4.1 Summary of Achievements

The main achievements of this project include:

- Development of a role-based interface for both general users and farmers.
- Integration of tools to assess soil condition, seed quality, and plant growth stages.
- Provision of educational content related to pea cultivation, nutritional value, and best practices.

4.2 Limitations

Despite its success, the application has some limitations:

- It currently functions as an offline app without real-time weather updates or IoT-based soil sensor integration.
- The app is limited to pea cultivation and does not yet support other crops.
- Certain advanced features such as AI-based disease detection and yield prediction are not implemented.

4.3 Future Scope

For future development, the application can be enhanced in several ways:

- Extend support to additional crops like lentils, beans, and vegetables.
- Integrate real-time weather data and market price updates for better decision-making.
- Implement machine learning models for disease detection, pest management, and yield prediction.
- Move to a cloud-based database to store user data and enable data-driven analytics.

Overall, this project provides a strong foundation for further research and development in technology-driven agriculture, with the potential to significantly assist farmers and promote sustainable farming practices.

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