
CAPSTONE PROJECT

AI AGENT FOR SMART FARMING ADVICE

Presented By:

Kapil Kumar - Graphic Era Hill University, Haldwani - B.Tech (CSE)

OUTLINE

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PROBLEM STATEMENT

- In rural and semi-urban farming communities, small-scale farmers often face significant challenges in accessing timely and accurate agricultural information. Despite being the backbone of food production, many lack access to real-time insights on crop suitability, soil health, pest outbreaks, weather patterns, and fluctuating market prices.
- Decisions about what to plant, when to irrigate, or where to sell are often based on traditional practices or word-of-mouth which can lead to suboptimal yields, crop losses, and reduced income. With climate variability and market volatility on the rise, the need for reliable, localized guidance has never been greater.
- Moreover, critical data from government departments, meteorological agencies, and agri-tech platforms remains underutilized due to poor dissemination and lack of accessible tools. This creates a growing knowledge gap between modern agricultural science and grassroots farming communities.
- As a result, there is a pressing need for an intelligent, easy-to-use advisory system that delivers personalized, real-time, and language-aware farming guidance helping farmers make informed decisions that reduce risk, improve yield, and increase profitability.

PROPOSED SOLUTION

To address the critical knowledge gap in rural agriculture, we propose SmartFarmingAI — an AI-powered advisory agent that delivers real-time, localized, and language-aware farming guidance to small-scale farmers.

Built using Retrieval-Augmented Generation (RAG) and powered by IBM Granite on IBM Cloud Lite, the agent acts as an intelligent assistant farmers can interact with using simple, natural language queries — just like asking a local agronomist.

Key Features of the Solution:

- Localized Crop Recommendations
 - Suggests best crops based on season, region, and soil type
 - Example: “What should I grow in Maharashtra this Kharif season?”
- Soil & Pest Management Guidance
 - Provides actionable advice on soil preparation and pest control
 - Example: “How do I control aphids on tomatoes?”
- Real-Time Market Price Insights
 - Retrieves current mandi rates for informed selling decisions
 - Example: “What is today’s tomato price in Nashik?”
- Weather-Aware Advisories
 - Integrates weather forecasts to guide irrigation and sowing

SYSTEM APPROACH

IBM Cloud Lite

- Free-tier platform for building and deploying AI agents

IBM Agent Lab

- Visual environment to design, test, and deploy the SmartFarmingAI agent

Watsonx.ai & IBM Granite

- Foundation models for retrieval and generation
- Models used: granite-3-3-8b-instruct

RAG (Retrieval-Augmented Generation)

- Knowledge sources: Crop guides, soil data, pest manuals, market rates

Integrated Tools

- Document Search – retrieves from local farming knowledge
- Weather Tool – provides real-time forecasts
- Google Search – fallback for external queries

Knowledge Base

- Uploaded as text and indexed using vector embedding

RAG ARCHITECTURE

The Smart Farming AI Agent is built on a Retrieval-Augmented Generation (RAG) architecture combining trusted knowledge retrieval with AI-powered response generation.

How RAG Works:

- **User Query**
 - Farmer asks: “What crop is best for Kharif in Maharashtra?”
- **Retrieval**
 - Agent searches a vector index of curated farming knowledge
 - Finds relevant context (e.g., cotton, soybean, sorghum recommended)
- **Generation**
 - Retrieved context + query is sent to IBM Granite (via watsonx.ai)
 - Model generates a natural, accurate response
- **Response**
 - Delivered instantly: “Best crops: Cotton, Soybean, Sorghum...”

RESULT

Demonstrating the Smart Farming AI Agent's Performance in IBM Agent Lab

Figure 1: Crop Recommendation for Kharif Season in Maharashtra

The screenshot displays the IBM watsonx Agent Lab interface. The top navigation bar includes the IBM watsonx logo, an upgrade button, a help icon, a notification bell, and user account information (Kapil Kumar's Account, Dallas, and a profile icon labeled KK). Below the navigation bar, the breadcrumb trail shows 'Projects / SmartFarmingAI / SmartFarmingAI'. The main interface is divided into two panels: 'Build' on the left and 'Agent preview' on the right.

Build Panel:

- Setup:**
 - Name:** SmartFarmingAI
 - Description:** An AI-powered agent designed to support small-scale farmers by providing advice on crop management (98/100 characters).
 - Icon:** A red circular icon with a white speech bubble and a smiley face.
 - Placeholder image:** A placeholder image showing a diagram of a farm with various crops and a person.
- Quick start questions:**
 - Add up to 4 quick start questions that your users can select.
 - What crops are best for this season?
 - What is today's mandi rate for tomatoes?
 - How can I prepare my soil for the upcoming Rabi season?
 - What are the best practices for controlling pests in my farm?
- Configuration:** A dropdown menu.
- Knowledge:** A section for adding knowledge.

Agent preview Panel:

The 'Agent preview' panel shows a conversation history:

- You:** 07:12 PM. Hi
- SmartFarmingAI:** 07:12 PM. Hi, I am SmartFarmingAI. How can I assist you with your farming queries?
► **How did I get this answer?**
- You:** 07:12 PM. What crop is best for Kharif season in Maharashtra?
- SmartFarmingAI:** 07:12 PM. For Maharashtra during the Kharif season, the best crops to consider are:
 - Cotton:** This is a major crop in Maharashtra during the Kharif season. It thrives in the semi-arid climate and black soil (Regur) of the region. Sowing should be done within 15 days of the first monsoon rains, and first irrigation is recommended after 30 days, avoiding waterlogging.
 - Soybean:** It is widely cultivated and export-oriented. It's long-duration and can be intercropped with pigeon pea (Tur/Arhar).
 - Sorghum (Jowar):** This is drought-tolerant and suitable for the region's climate.
 - Pigeon Pea (Tur/Arhar):** A long-duration pulse that can be intercropped with cotton, providing diversity and soil nutrition.

Tips for cultivation in Maharashtra during Kharif:

- Sow within 15 days of the first monsoon rains.
- First irrigation after 30 days, avoid waterlogging.
- Watch for red hairy caterpillar in cotton and manage pests accordingly.
- Use moisture conservation techniques like mulching to retain soil moisture.

Please consult local agricultural extension services for more precise, location-specific advice, as micro-variations in soil and climate can affect crop performance.

► **How did I get this answer?**

At the bottom, there is a text input field with the placeholder 'Type something...' and a send button.

RESULT

Demonstrating the Smart Farming AI Agent's Performance in IBM Agent Lab

Figure 2: Soil Preparation Advice for Wheat in Punjab

The screenshot displays the IBM watsonx Agent Lab interface. The top navigation bar includes the IBM watsonx logo, an 'Upgrade' button, a help icon, a notification bell, and user account information for 'Kapil Kumar's Account' in 'Dallas'. The main interface is divided into two panels: 'Build' on the left and 'Agent preview' on the right.

Build Panel:

- Setup:**
 - Name:** SmartFarmingAI
 - Description:** An AI-powered agent designed to support small-scale farmers by providing advice on crop management (98/100 characters).
 - Icon:** A red circular icon with a white speech bubble and a smiley face.
 - Placeholder image:** A diagram showing a central node connected to several peripheral nodes, representing a network or system architecture.
- Quick start questions:** A list of four questions that can be added to the agent's knowledge base:
 - What crops are best for this season?
 - What is today's mandi rate for tomatoes?
 - How can I prepare my soil for the upcoming Rabi season?
 - What are the best practices for controlling pests in my farm?
- Configuration:** A section for configuring the agent's settings.
- Knowledge:** A section for managing the agent's knowledge base.

Agent preview Panel:

- User Query:** "How should I prepare soil for wheat in Punjab?"
- Agent Response:** "Preparing soil for wheat in Punjab involves several steps:"
 - 1. Plowing:** Deep plowing is recommended to bury residues from the previous crop and to break up hardpan layers. This should be done before the onset of the winter rains.
 - 2. Harrowing:** After plowing, harrowing is done to create a fine seedbed. This can be done multiple times to ensure a smooth, level surface for seeding.
 - 3. Incorporation of Organic Manure:** Organic manure or compost can be incorporated into the soil to enhance its fertility. This should be done at least a week before sowing.
 - 4. Soil Testing:** Conduct a soil test to determine the pH and nutrient levels. Wheat prefers a slightly acidic to neutral pH (6.0-7.0). Based on the test results, apply necessary fertilizers. Commonly, nitrogen, phosphorus, and sulfur are applied.
 - 5. Weed Control:** Implement a weed control strategy. This could involve pre-sowing herbicide application or manual weeding.
 - 6. Seed Treatment:** Treat seeds with appropriate fungicides to prevent seed-borne diseases.
 - 7. Planting Depth and Timing:** Wheat is typically sown in Punjab between October and November, just as the winter rains begin. The seed should be sown at a depth of about 2.5 to 3 cm.
 - 8. Irrigation:** If rainfall is insufficient, ensure timely irrigation, especially during the critical growth stages.
- Additional Information:** "Remember, Punjab's alluvial soils are generally fertile, but they can become compacted over time. Regular crop rotation and maintaining soil cover can help maintain soil health." and "For the most accurate and localized advice, consider reaching out to local agricultural extension services or experts in Punjab. They can provide insights based on real-time conditions and recent research."
- Footer:** "How did I get this answer?"

RESULT

Demonstrating the Smart Farming AI Agent's Performance in IBM Agent Lab

Figure 3: Weather and Pest Control Advice

The screenshot displays the IBM watsonx Agent Lab interface. The top navigation bar includes the IBM watsonx logo, an 'Upgrade' button, a help icon, a notification bell, and user account information for 'Kapil Kumar's Account' in 'Dallas'. The main interface is divided into two panels: 'Build' on the left and 'Agent preview' on the right.

Build Panel:

- Setup:** Shows the 'Model' as 'granite-3-3-8b-instruct'.
- Configuration:** Includes 'Framework' (LangGraph) and 'Architecture' (ReAct).
- Instructions:** A text box containing the agent's role: 'You are a helpful agricultural assistant designed to support small-scale farmers. Use the available tools to provide detailed advice on crop management, weather forecasts, soil conditions, pest control, and market prices. When greeted, say "Hi, I am SmartFarmingAI. How can I assist you with your farming queries?"'
- Knowledge:** A section for adding knowledge sources.
- Tools:** A section for adding tools, with buttons for 'Add a tool' and 'Create custom tool'.
- Added tools (3):**
 - Google search:** Retrieve information from the internet with the Google search engine.
 - Document search - crop recommendation:** Search documents with vector indexes.
 - Weather:** Retrieve the weather of a city.

Agent preview Panel:

This panel shows a conversation log between the user and the SmartFarmingAI agent.

- User:** 'What is the weather in Pune Today?'
- SmartFarmingAI:** 'The current weather in Pune is with a temperature of 23.9°C, no rain reported, relative humidity at 88%, and wind speed of 4.7 km/h. ► How did I get this answer?'
- User:** 'How can I control aphids on tomatoes?'
- SmartFarmingAI:** 'Aphids can be controlled on tomato plants through several methods:
 - Natural Predators:** Encourage natural predators like ladybugs, lacewings, and parasitic wasps. These can be attracted by planting flowers like marigolds and dill near your tomato plants.
 - Insecticidal Soap:** Use insecticidal soaps or horticultural oils. These are less harmful to beneficial insects and can be sprayed directly onto aphids.
 - Neem Oil:** Spraying neem oil on the plants can disrupt the aphid's life cycle.
 - Diatomaceous Earth:** This natural powder can be sprinkled on the plants. It's effective but needs to be reapplied after rain.
 - Resistant Varieties:** Consider planting aphid-resistant varieties of tomatoes.
 - Water Spray:** A strong spray of water can knock aphids off your plants.Remember to always test any spray on a small portion of the plant first to ensure it doesn't damage the crop. ► How did I get this answer?'

The bottom of the interface features a text input field with the placeholder 'Type something...' and a send button.

RESULT

AI Agent has been successfully deployed in IBM Cloud

Figure 4: Deployment Details

IBM watsonx

Upgrade

?

🔔

Kapil Kumar's Account

Dallas

KK

⋮

Deployment spaces /

SmartFarmingAI_Space

Overview

Assets

Deployments

Jobs

Manage

🔍 Search

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Name	Type	Status	Asset	Asset type	Tags	Last modified	↓
🔗 SmartFarmingAI	Online	✅ Deployed	SmartFarmingAI	Ai service	wx-agent	52 seconds ago Kapil Kumar (You)	⋮

CONCLUSION

The Smart Farming AI Agent has been successfully developed using Retrieval-Augmented Generation (RAG) on the IBM Cloud Lite platform.

It provides localized, real-time agricultural guidance to small-scale farmers through natural language interaction.

The agent retrieves trusted information on:

- Crop recommendations
- Soil preparation
- Pest control measures

Powered by IBM Granite, it generates accurate and context-aware responses.

Successfully tested with real farming queries such as:

- *“What crop is best for Kharif in Maharashtra?”*
- *“How should I prepare soil for wheat in Punjab?”*
- *“How can I control aphids on tomatoes?”*

The agent was fully built and deployed within the IBM Cloud, using Agent Lab.

This project demonstrates how AI and RAG can bridge the knowledge gap in rural agriculture bringing smart farming to the grassroots.

FUTURE SCOPE

- Multilingual Support
 - Integrate IBM Watson Language Translator to allow farmers to interact in local languages (e.g., Hindi, Marathi, Tamil, Telugu).
 - Improve accessibility for non-English speakers.
- Voice-Based Interaction
 - Add voice input/output support for illiterate or low-digital-literacy users.
 - Enable farmers to speak their queries and receive spoken responses.
- Mobile App or WhatsApp Chatbot
 - Deploy the agent as a WhatsApp bot or Android app for wider rural reach.
 - Allow offline access to cached farming advice.
- Weather Forecast Automation
 - Integrate with OpenWeatherMap or IMD API for automated, hyper-local weather updates.
 - Send alerts for rainfall, drought, or extreme conditions.

REFERENCES

- IBM Cloud Documentation: <https://cloud.ibm.com/docs>
- IBM Agent Lab (Agent Builder): [LINK](#)
- watsonx.ai and IBM Granite Models: <https://www.ibm.com/watsonx>
- RAG Lab on IBM SkillBuild: [LINK](#)
- FAO Crop and Pest Management Guidelines: [LINK](#)

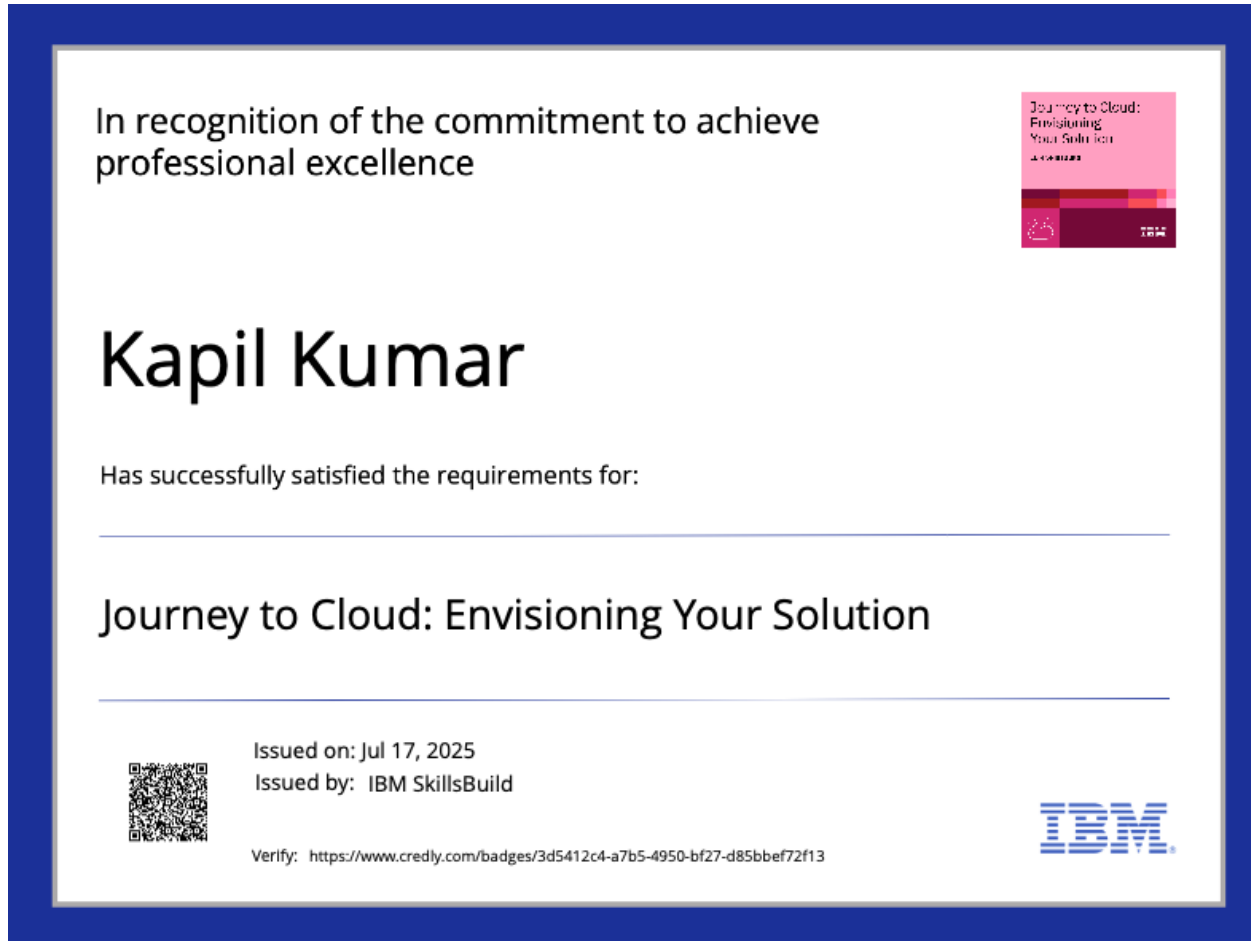
IBM CERTIFICATIONS

- Credly certificate (getting started with AI)



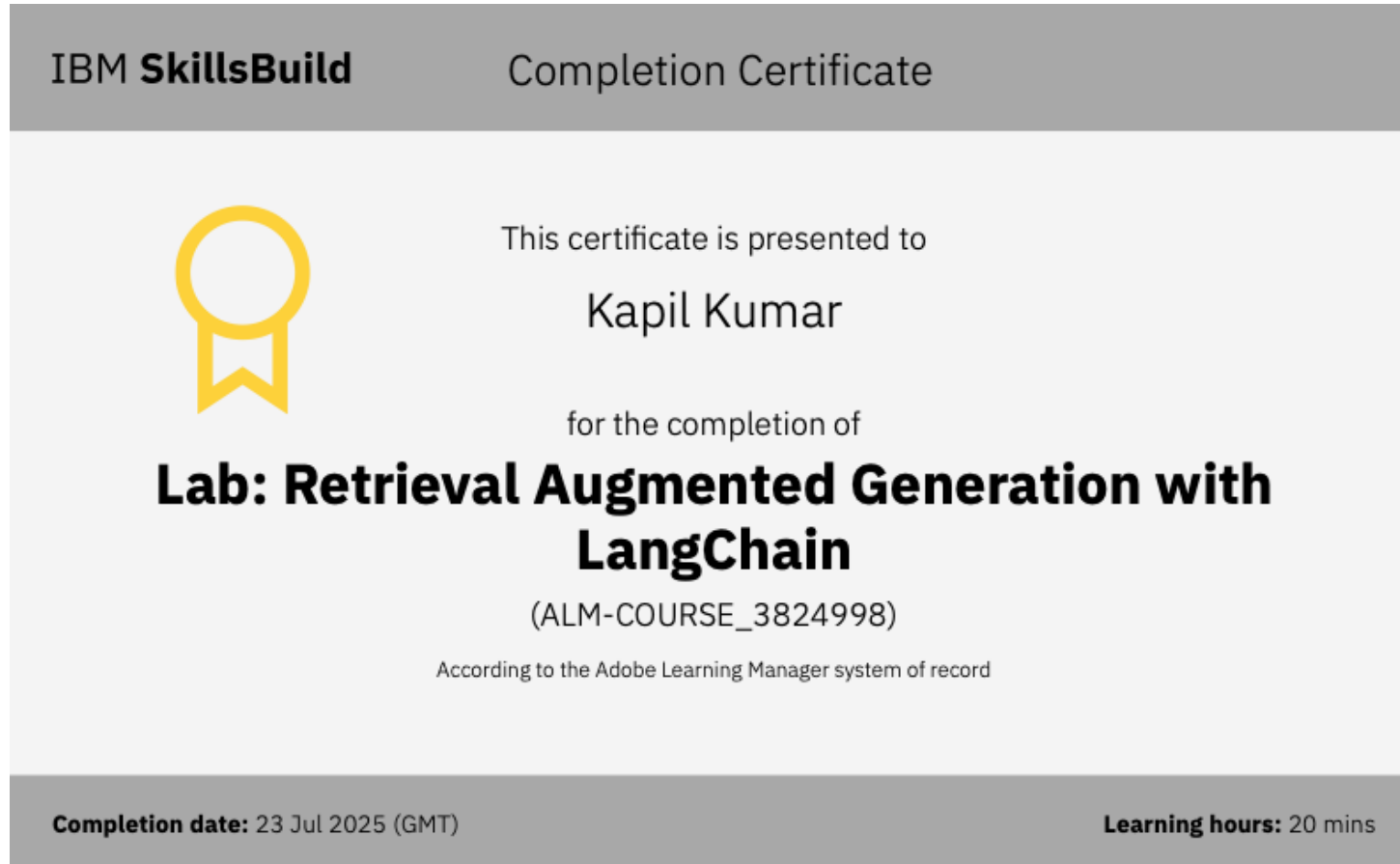
IBM CERTIFICATIONS

- Credly certificate (Journey to Cloud)



IBM CERTIFICATIONS

- Credly certificate (Journey to Cloud)





THANK YOU