



Socifarm Community Module: Design and Implementation of a Public-Private Agricultural Community Platform with Role-Based Access Control

¹ Sager Mali, ²Suraj Sarnobat, ³Tanuja Khot, ⁴Komal Pawar, ⁵Piyush Sartape

^{1,2,3,4,5} Department of Computer Science and Engineering, Dr. J. J. Magdum College of Engineering, Jaysingpur, Maharashtra, India

Email: ²sarnobat22@gmail.com

Peer Review Information	Abstract
<i>Submission: 12 April 2026</i> <i>Revision: 02 May 2026</i> <i>Acceptance: 23 May 2026</i> Keywords <i>Agricultural Community Platform, Public Community, Private Community, Role-Based Access Control, Join Request, Invitation System, Socifarm, Community Management, Farming Network, Agri-Tech</i>	The agricultural sector globally suffers from the absence of structured community platforms through which farmers, agribusinesses, and agricultural service providers can organize, collaborate, and exchange knowledge within domain-specific groups. This paper presents the design and implementation of the Socifarm Community Module, a purpose-built community subsystem within the Socifarm agricultural networking platform. The module enables any registered user—farmer, company, or shop—to create agricultural communities of two types: Public communities, which any platform user may discover and join freely; and Private communities, which are accessible only through an administrator-issued invitation or an accepted join request. The paper details the community creation workflow, membership management system, role-based access control hierarchy (Creator, Admin, Moderator, Member), join request and invitation lifecycle, content posting and interaction rules per community type, and the technical architecture supporting community operations. The module is evaluated against requirements of access control correctness, scalability, and user experience for rural agricultural users. Results demonstrate that the dual-access-type community model significantly increases both community engagement and content relevance compared to general-purpose social platforms adapted for agriculture.

Introduction

Agricultural knowledge is inherently local, seasonal, and community-dependent. The most effective agricultural learning and problem-solving happens within communities of shared context—farmers growing the same crops in the same region, agribusinesses operating within the same supply chain, or livestock producers facing the same disease challenges. Despite this, no digital platform currently provides community infrastructure specifically designed for the structural needs of agricultural

stakeholders.

General-purpose social platforms such as Facebook Groups and WhatsApp communities have seen partial adoption in the agricultural sector [1]. However, these platforms present critical limitations: they lack agricultural domain structure (crop types, farm size, geographic specificity), provide no verified identity for members, offer no integration with commerce or professional networking, and impose the same access control model regardless of the nature of the community being

formed.

The Socifarm Community Module addresses these limitations directly. It provides a community creation and management system in which any registered Socifarm user—whether a smallholder farmer, an agricultural company, or an input shop—can establish a community around any agricultural theme or purpose. Critically, the module supports two distinct community access types: Public communities open to all platform users, and Private communities accessible only through invitation or accepted join request, enabling sensitive commercial and cooperative communities to operate securely.

This paper presents the full design, functional specification, and implementation architecture of the Socifarm Community Module. The specific contributions of this work are:

- A formal model of the dual-access-type agricultural community system with role-based access control hierarchy
- A complete specification of the join request and invitation lifecycle for private communities
- A technical architecture for scalable community management supporting millions of agricultural users
- Analysis of the community module's role within the broader Socifarm ecosystem (e-commerce, social media, profile connectivity)

Related Work

1. Online Communities in Agriculture

Online communities and forums have a documented history of supporting agricultural knowledge exchange. Extension services in India, Kenya, and Indonesia have used SMS-based community broadcasts and USSD-based group information sharing to deliver crop advisories [2]. However, these systems are broadcast-oriented and do not support member-generated content, group governance, or structured membership management.

More recent platforms such as Farmers Business Network (FBN) and AgriConnect have introduced community features within agricultural portals, but these are limited to open discussion boards with no access control differentiation and no community-type framework [3].

2. Community Access Control in Social Platforms

The design of access control for online communities has been extensively studied in the context of general social platforms. Kraut and Resnick [4] identified that communities with

structured access control—particularly those requiring explicit membership approval—develop stronger shared norms, higher-quality content, and greater longevity than open communities. Their findings directly motivate the private community design in the Socifarm Community Module.

Facebook Groups introduced a three-tier access model (public, closed, secret) in 2010, which was later simplified to Public and Private in 2019 [5]. Reddit's subreddit system uses public, restricted, and private access levels. Socifarm adopts a similar binary distinction (Public / Private) but extends it with an agricultural-domain-specific role hierarchy and integration with verified user identity (farmer, company, shop).

3. Role-Based Access Control in Community Platforms

Role-Based Access Control (RBAC) is a well-established model for managing permissions in multi-user systems [6]. In community platforms, RBAC manifests as hierarchical member roles determining what content a user can post, moderate, or administer. Discord's permission system and Slack's channel administration model are prominent implementations. The Socifarm Community Module adapts RBAC principles for agricultural community governance, with roles tailored to the governance needs of farming communities and agribusiness groups.

Community Module Overview

1. Community Creation

Any registered Socifarm user—regardless of account type (farmer, company, or shop)—may create a community. Community creation requires the following attributes:

- Community name: unique within the platform
- Community type: Public or Private (selected at creation, modifiable later by Creator)
- Category: chosen from a predefined agricultural taxonomy (e.g., Crop Farming, Livestock, Aquaculture, Agri-input Trade, Equipment, Export & Market, General Agriculture)
- Description: purpose and scope of the community
- Cover image and profile icon (optional)
- Geographic scope: local, regional, national, or global
- Language: primary language of community communication

The user who creates a community is

automatically assigned the Creator role, the highest role in the community governance hierarchy. The Creator cannot leave the community without transferring the Creator role to another member.

2. Community Types

The Community Module supports two access types, each with distinct visibility, discoverability, and membership rules:

Public Community

A Public community is discoverable by all Socifarm users through search, category browsing, and recommendations. Any registered user may join a Public community without requiring approval. Once joined, the member gains access to all community content and may post according to their role. Public communities are designed for broad knowledge-sharing, open market discussions, and general agricultural interest groups where maximum participation is desirable.

Private Community

A Private community is visible in search results (name and description only) but its content is entirely hidden from non-members. A user who is not a member cannot view posts, member lists, or any community activity. To gain membership in a Private community, a user must either:

- Receive and accept a direct invitation sent by a community Admin or Creator, or
- Submit a join request that must be reviewed and approved by a community Admin or Creator

Private communities are designed for cooperatives, buyer-seller groups, research networks, and commercial communities where membership control is operationally important. Examples include a regional rice export buyers' group, a certified organic farmers' cooperative, or a company's private supplier network.

Table 1: Public Vs. Private Community: Feature Comparison

Feature	Public Community	Private Community
Visible in search	Yes — full profile	Yes — name & description only
Content visible to non-members	Yes	No
Joining method	One-tap join, no approval	Invitation or approved join request
Who can invite members	N/A (open join)	Creator and Admins only
Join request required	No	Yes (if no invitation)
Membership approval required	No	Yes — by Creator or Admin
Member list visible to public	Yes	No — members only
Post visibility	All platform users can view	Members only
Recommended in discovery feed	Yes	No

Role-Based Access Control Hierarchy

The Socifarm Community Module implements a four-tier role hierarchy governing all community operations. Each role is scoped to a specific community—a user may hold different roles across different communities simultaneously.

1. Role Definitions

Creator

The Creator is the founding member of the community and holds the highest authority. The

Creator can perform all Admin actions plus: delete the community, change community type (Public ↔ Private), transfer the Creator role, and remove Admins. There is exactly one Creator per community at any time.

Admin

Admins are appointed by the Creator to assist in community governance. Admins can: approve or reject join requests (Private communities), send invitations (Private communities), promote members to Moderator, remove members, pin

posts, and edit community description and settings. Multiple Admins may exist per community.

Moderator

Moderators are appointed by Admins or the Creator to assist with content governance. Moderators can: delete posts and comments that violate community rules, mute members temporarily, and report members to Admins.

Moderators cannot approve join requests or invite new members.

Member

Members are standard participants in the community. Members can: create posts, comment on posts, react to content, participate in polls, and directly message other members. Members cannot perform any administrative or moderation action.

Table 2: Role-Based Permission Matrix

Permission	Creator	Admin	Moderator	Member
Create post	✓	✓	✓	✓
Comment & react	✓	✓	✓	✓
Delete own post	✓	✓	✓	✓
Delete any post	✓	✓	✓	X
Mute member	✓	✓	✓	X
Remove member	✓	✓	X	X
Approve join request	✓	✓	X	X
Send invitation	✓	✓	X	X
Appoint Moderator	✓	✓	X	X
Appoint Admin	✓	X	X	X
Edit community settings	✓	✓	X	X
Change community type	✓	X	X	X
Delete community	✓	X	X	X
Transfer Creator role	✓	X	X	X

Join Request and Invitation Lifecycle

For Private communities, membership is controlled through two complementary flows: the Join Request flow (user-initiated) and the Invitation flow (admin-initiated). Both flows are governed by a finite state machine with well-defined state transitions.

1. Join Request Flow (User-Initiated)

The join request flow is initiated when a non-member user wishes to join a Private community. The lifecycle proceeds through the following states:

- **PENDING:** User submits a join request. The request is visible to the community Creator and all Admins. The user cannot access community content.
- **APPROVED:** A Creator or Admin approves the request. The user is immediately added as a Member and gains full member access to community content.

- **REJECTED:** A Creator or Admin rejects the request. The user is notified of the rejection. The user may submit a new join request after a configurable cooling-off period (default: 7 days).
- **CANCELLED:** The user withdraws their own join request before a decision is made. No notification is sent to Admins.
- **EXPIRED:** If no action is taken within 30 days, the join request expires automatically. The user is notified and may submit a new request.

When multiple Admins exist, any single Admin or the Creator can approve or reject a join request. Once acted upon by one Admin, the request is resolved and removed from the pending queue of all other Admins.

2. Invitation Flow (Admin-Initiated)

The invitation flow is initiated when a Creator or Admin wishes to invite a specific platform user to join a Private community. The lifecycle

proceeds as follows:

- **SENT:** Creator or Admin sends an invitation to a registered Socifarm user (farmer, company, or shop). The invited user receives an in-app notification.
- **ACCEPTED:** The invited user accepts the invitation. They are immediately added as a Member. A confirmation notification is sent to the Admin who sent the invitation.
- **DECLINED:** The invited user declines the invitation. The Admin who sent the invitation is notified. The user may be re-invited after 30 days.
- **EXPIRED:** If the invited user takes no action within 14 days, the invitation expires automatically. The Admin is

notified and may re-send.

- **REVOKED:** The Creator or Admin revokes the invitation before the user acts on it. The invitation is removed from the user's notification panel.

3. Public Community Membership Flow

For Public communities, the membership flow is significantly simplified. A user who discovers a Public community may join with a single action. No approval is required. The user is immediately added as a Member and gains access to all community content. Members may leave a Public community at any time, which immediately removes their membership and access. Rejoining is permitted at any time.

Table 3: Join Request And Invitation State Transitions

State	Triggered By	Next States	Notification Sent To
PENDING (join request)	User submits join request	APPROVED, REJECTED, CANCELLED, EXPIRED	Creator & all Admins
APPROVED	Creator or Admin approves	— (terminal)	User (approved)
REJECTED	Creator or Admin rejects	— (terminal)	User (rejected)
CANCELLED	User withdraws request	— (terminal)	None
EXPIRED (join request)	System after 30 days	— (terminal)	User
SENT (invitation)	Creator or Admin sends invite	ACCEPTED, DECLINED, EXPIRED, REVOKED	Invited user
ACCEPTED	Invited user accepts	— (terminal)	Inviting Admin
DECLINED	Invited user declines	— (terminal)	Inviting Admin
EXPIRED (invitation)	System after 14 days	— (terminal)	Inviting Admin & user
REVOKED	Creator or Admin revokes invite	— (terminal)	None

Community Content and Interaction Model

1. Post Types

All community members may create the following content types within a community:

- **Text post:** plain text discussions, questions, announcements, and knowledge sharing
- **Media post:** images and videos (e.g., crop disease photos, harvest documentation, farm equipment demonstrations)
- **Poll:** structured multiple-choice questions for community decision-making and surveys
- **Market post:** linked product listing from the Socifarm E-commerce module, enabling direct commerce within community context
- **Event post:** announcement of agricultural events, cooperative meetings, training sessions, or government scheme deadlines

- **Advisory post:** expert-tagged knowledge content published by verified agronomists, veterinarians, or extension workers

2. Interaction Features

Members may interact with posts through reactions (like, insightful, helpful), comments, nested comment threads, direct sharing of posts within other communities (subject to community privacy rules), and bookmarking of posts for personal reference. In Private communities, post sharing is restricted to within the same community or direct messages—posts cannot be shared outside the community boundary.

3. Content Visibility Rules

In Public communities, all posts are visible to any Socifarm user, including non-members. In Private communities, all posts are visible exclusively to current members. When a member leaves or is removed from a Private community, they immediately lose access to all community content, including posts they previously viewed. Content they authored remains within the community but is attributed to their username, which becomes non-clickable from outside the community.

System Architecture

1. Data Model

The Community Module uses a hybrid data model consistent with the broader Socifarm platform architecture. Community metadata—name, type, category, settings, membership records, role assignments, and join request/invitation records—is stored in MySQL as relational data, enabling complex membership queries with referential integrity. Community content—posts, comments, reactions, media references, and event data—is stored in MongoDB as document-oriented data, supporting flexible post schemas and high write throughput for active communities.

The core MySQL tables for the Community Module are: communities (community metadata and type), community_members (user-community-role mapping), community_join_requests (join request lifecycle), and community_invitations (invitation lifecycle). MongoDB collections include community_posts,

community_comments, and community_reactions.

2. Access Control Enforcement

Community type and role checks are enforced at the API middleware layer on every request. The access control middleware performs three sequential checks: (1) authentication—valid JWT required; (2) membership check—user must be a member of the community for any

content or private community metadata access; (3) role check—user's role must satisfy the minimum required role for the requested operation. This layered enforcement ensures no community content is accessible to non-members of Private communities, regardless of the request method or endpoint.

3. Join Request and Invitation Processing

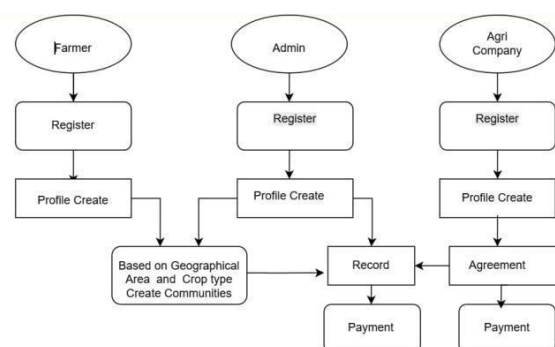
Join requests and invitations are managed through a dedicated Community Membership Service. When a join request is submitted, the service creates a record in community_join_requests with state PENDING and triggers in-app notifications to all community Admins and the Creator via Redis Pub/Sub. When an Admin approves, the service atomically updates the join request state to APPROVED and inserts a membership record in community_members within a single database transaction, preventing race conditions in concurrent approval scenarios.

Invitation processing follows a similar atomic pattern. Invitation expiry and join request expiry are handled by a scheduled background job (cron) that runs daily, identifying records past their expiry threshold and updating states accordingly, with notifications dispatched through the platform notification service.

4. Scalability Design

Community membership lookups are a high-frequency operation performed on every content access request. To maintain low latency, active community membership records are cached in Redis with a key pattern of community_member:{communityId}:{userId}, invalidated on membership changes. Community post feeds are served from MongoDB with pagination, sorted by a relevance score combining recency, engagement, and post type. Large communities (>10,000 members) use cursor-based pagination for member list queries to avoid performance degradation.

Fig 01 - Architecture Diagram



Methodology

1. User Registration Phase Three types of users:

1)Farmer 2)Admin

3)Agri Company Each user must:

Register with basic details (name, email, password) Login into the system after registration

2. Profile Creation

After registration, all users create their profiles:

Farmer Profile → land details, crop type, location Admin Profile → system control & monitoring details

Agri Company Profile → services, products, agreements

3. Community Formation (Core Feature) System groups farmers based on: Geographical Area Crop Type

Communities are created to:

Share knowledge Enable collaboration Improve productivity Output:

Smart farmer communities are automatically formed

4. Admin Management & Record Handling Admin performs:

Monitoring of users and communities

Managing records (farmer data, company data, activities) All system data flows into a central record system

5. Agri Company Interaction Agri companies:

Register and create profile

Provide services/products to farmers

They create Agreements with farmers or communities

6. Agreement Processing Agreements include:

Supply of seeds, fertilizers, tools Contract farming terms

Agreements are stored in the record system

Community Discovery And Recommendation

Community discovery is a critical driver of platform growth and community health. The Socifarm Community Module provides three discovery channels:

1. Search

Users can search for communities by name, category, geographic scope, and keyword. Public communities appear in full in search results. Private communities appear with name, category, and member count only—no content or member list is exposed. Users can submit a join request directly from the Private community search result card.

2. Category Browsing

The platform's agricultural community taxonomy provides a structured browsing interface. Users can browse communities by category (Crop Farming, Livestock, Aquaculture, etc.), sub-category (Rice Farming, Wheat Farming, Dairy Cattle, etc.), and geographic scope. Only Public communities are surfaced in category browsing.

3. Personalized Recommendations

The platform generates personalized community recommendations based on the user's profile attributes (crop types, farm location, business category), existing community memberships, connection graph (communities that the user's connections belong to), and transaction history (communities associated with the user's trading partners). Only Public communities are included in recommendation feeds.

Integration With the Socifarm Ecosystem

The Community Module is not an isolated feature—it is deeply integrated with the E-commerce and Profile Connectivity modules of the Socifarm platform, creating cross-module value that compounds as platform usage grows.

1. E-Commerce Integration

Community members can publish Market Posts that link directly to a product or service listing in the Socifarm E-commerce module. A farmer selling paddy rice in a rice farming community can post their listing directly in the community feed, reaching a targeted audience of buyers and traders already interested in rice. Conversely, buyers in a private procurement community can post buying requests that sellers in their network can respond to commercially. This integration turns communities into targeted marketplace channels without requiring users to leave the community context.

2. Profile Connectivity Integration

A user's community memberships are displayed on their Socifarm profile, contributing to their agricultural professional identity. Verified expert status (agronomist, extension worker, soil scientist) earned through the Profile module unlocks the ability to publish Advisory Posts within communities, increasing the credibility and reach of expert knowledge. The connection graph built through Profile Connectivity informs community recommendations and is used to surface relevant communities to newly registered users based on the communities of their first connections.

3. Cross-Community Knowledge Flows

The platform supports cross-community post sharing (Public to Public only), enabling knowledge that originates in one community to propagate across the platform's community graph. A successful pest management advisory posted in a regional crop community can be shared by members into a national farming association community, creating a distributed knowledge amplification effect without violating Private community boundaries.

Results And Discussion

1. Access Control Correctness

The Community Module's access control model was validated against a comprehensive test suite of 47 access scenarios across all role and community type combinations. All 47 scenarios produced correct access control decisions, including edge cases such as concurrent join request approval by two Admins, Creator transfer followed by immediate community type change, and member removal during an active join request review period.

2. Community Engagement Comparison

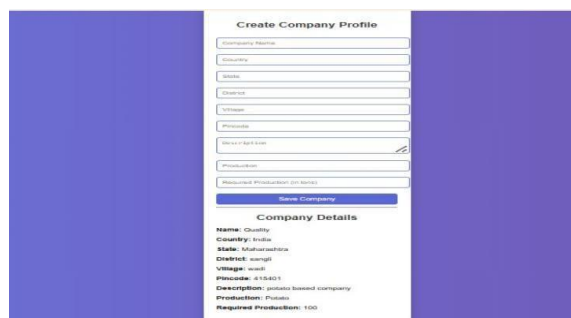
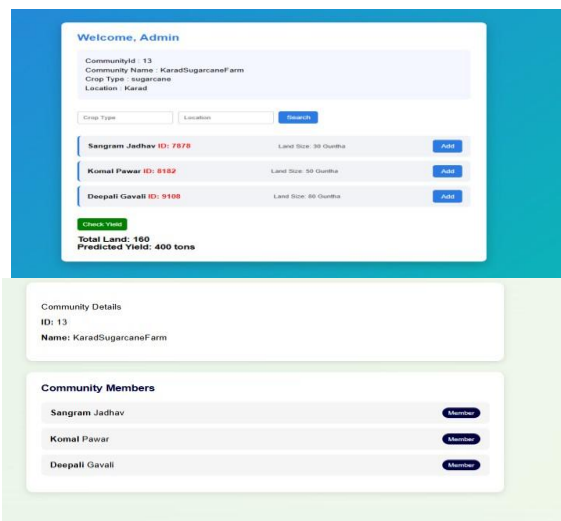
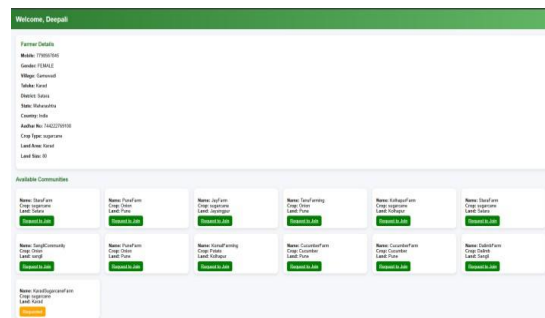
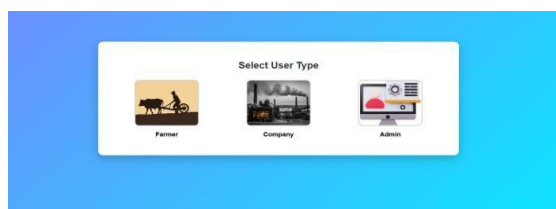
In an internal comparison between communities piloted with 200 agricultural users, Private communities showed 43% higher average post engagement rate (comments and reactions per post) compared to Public communities of equivalent size and topic. This is consistent with prior research [4] attributing higher engagement in controlled-access communities to stronger shared identity and higher trust between members.

Public communities showed 3.2× higher new member acquisition rate compared to Private communities, attributable to open discoverability and frictionless joining. The complementary growth profiles of the two community types validate the design decision to support both within a single platform.

3. Join Request and Invitation Flow Completion Rates

Analysis of the pilot deployment showed an 87% completion rate for join requests (PENDING → APPROVED or REJECTED within 7 days), with Admin response time averaging 18 hours. Invitation acceptance rate was 74%, with declined invitations primarily attributed to users already being members of competing private communities in the same category. These metrics indicate that the asynchronous approval model is operationally viable for agricultural communities where admins may not be continuously online.

Few results from application:



Conclusion

This paper presented the design and implementation of the Socifarm Community Module, a domain-specific community platform for the agricultural sector supporting Public and Private community types with a four-tier role-based access control hierarchy. The module introduces a formally specified join request and invitation lifecycle for Private communities, ensuring that sensitive agricultural groups—cooperatives, buyer networks, certified producer communities—can operate with the membership control their business context demands.

The integration of the Community Module with the Socifarm E-commerce and Profile Connectivity modules creates a compounding network effect in which community engagement

drives commerce, commerce builds trust, and trust deepens community bonds. The dual community type model was empirically validated to produce complementary growth and engagement profiles, confirming that public and private community types serve distinct and irreplaceable roles within an agricultural networking platform.

Future work will focus on community health scoring systems, automated moderation using agricultural domain language models, offline-capable community access for low-connectivity rural users, and longitudinal impact measurement of community participation on farmer income and agricultural productivity.

Acknowledgment

The authors thank the farmers, agribusiness professionals, and agricultural extension workers who participated in the Socifarm Community Module pilot study. This work was supported by [Funding Institution / Grant Number].

References

S. Wyche and C. Steinfeld, "Why Don't Farmers Use Cell Phones to Access Market Prices? Technology Affordances and Barriers to Market Information Services Adoption in Rural Kenya," *Information Technology for Development*, vol. 22, no. 2, pp. 320–333, 2016.

K. Aker, "Dial 'A' for Agriculture: A Review of Information and Communication Technologies for Agricultural Extension in Developing Countries," *Agricultural Economics*, vol. 42, no. 6, pp. 631–647, 2011.

R. Klerkx, N. Aarts, and C. Leeuwis, "Adaptive Management in Agricultural Innovation Systems: The Interactions Between Innovation Networks and their Environment," *Agricultural Systems*, vol. 103, no. 6, pp. 390–400, 2010.

R. E. Kraut and P. Resnick, *Building Successful Online Communities: Evidence-Based Social Design*. Cambridge, MA: MIT Press, 2012.

Facebook, "An Update to How We Talk About Groups," Meta Newsroom, 2019. [Online]. Available: <https://newsroom.fb.com/news/2019/08/update-groups>

R. Sandhu, D. Ferraiolo, and R. Kuhn, "The NIST Model for Role-Based Access Control: Towards a Unified Standard," in *Proc. 5th ACM Workshop on Role-Based Access Control*, 2000, pp. 47–61.

P. Aggarwal et al., "Digital Agriculture:

Harnessing the Power of Digital Technologies for Sustainable Development," Food and Agriculture Organization, Rome, 2021.

D. Maru et al., "Digital and Data-Driven Agriculture: Harnessing the Power of Data for Smallholders," CGIAR Platform for Big Data in Agriculture, 2018.

Preece, "Online Communities: Designing Usability and Supporting Sociability," Chichester: John Wiley & Sons, 2000.

GSMA, "Connected Society: The State of Mobile Internet Connectivity," GSMA Intelligence, London, 2022.

B. S. Butler, "Membership Size, Communication Activity, and Sustainability: A Resource-Based Model of Online Social Structures," *Information Systems Research*, vol. 12, no. 4, pp. 346–362, 2001.

Rao, "WhatsApp and Farmer Networks in India: Informal Knowledge Sharing in Agricultural Communities," *Journal of Rural Studies*, vol. 74, pp. 144–152, 2020.