

EMPOWERING RELIGIOUS LEADERS IN BANGLADESH: INTEGRATING DIGITAL E-LEARNING AND AI TO ENHANCE AGRICULTURAL LIVELIHOODS IN RURAL COMMUNITIES

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ABSTRACT

This research explores the potential of integrating digital e-learning and AI-driven tools to empower Bangladesh's Imams, Muazzins, and rural farmers. The study investigates how equipping religious leaders with agricultural knowledge and digital skills can improve agricultural productivity, enhance market access, and promote sustainable farming practices in rural communities. This model aims to foster economic resilience, reduce poverty, and promote socio-economic equality in rural Bangladesh by addressing the digital literacy gap. Despite significant barriers such as poor infrastructure, digital illiteracy, and resistance to new technologies, the study identifies several opportunities for scaling this model, including expanding mobile networks, increasing smartphone usage, and partnerships with NGOs, government agencies, and tech companies. The research highlights the role of Imams and Muazzins as potential mentors and advocates for change, bridging the gap between technology and rural communities. The findings suggest that integrating AI tools in agriculture can significantly improve farming practices and enhance economic stability for rural populations.

KEYWORDS

Digital E-learning, AI in Agriculture, Rural Development, Imams, Muazzins, Digital Literacy, Sustainable Farming, Bangladesh, Agricultural Entrepreneurship, Socio-economic Empowerment

1. INTRODUCTION

1.1. Background of the Issue

With its rich agricultural history, Bangladesh heavily depends on its rural communities for sustenance and economic development. The agricultural sector, particularly small-scale farming, is the cornerstone of the country's economy. Rural communities across Bangladesh engage in various agricultural activities, such as pisciculture (fish farming), poultry, and crop cultivation, which are vital in ensuring food security, providing income, and offering employment to

millions. However, despite its significance, many rural farmers face substantial challenges, including limited access to modern agricultural tools, knowledge, and markets. The digital divide is particularly pronounced, as many farmers lack the digital literacy necessary to harness the potential of modern farming technologies. This technological gap hinders their productivity and limits their ability to access fair markets, thus perpetuating economic struggles.

Religious leaders, such as Imams and Muazzins, hold a central role in these rural communities. Besides their religious duties, they are seen as trusted community figures who can influence local opinions and drive socio-economic changes. However, their involvement in agricultural development has remained minimal. This represents a missed opportunity to leverage their influence to advance agricultural practices and income diversification in rural areas.

1.2. Problem Statement

Rural Bangladesh remains burdened by significant poverty and limited income opportunities, particularly for small-scale farmers. While agriculture remains the primary livelihood for many, farmers often contend with low productivity, restricted market access, and exploitation by intermediaries who artificially inflate prices. This scenario results in low earnings for farmers while consumers are forced to pay higher prices for agricultural goods. Moreover, a substantial digital divide exists, as many farmers and religious leaders lack access to modern agricultural tools and the skills to utilize them effectively.

Religious leaders like Imams and Muazzins, who are embedded in the fabric of rural society, can potentially address these challenges by promoting agricultural change and digital literacy within their communities. However, these leaders cannot guide economic empowerment efforts without the necessary agricultural education and digital tools. Integrating digital e-learning and Artificial Intelligence (AI) can give Imams and Muazzins the skills they need to promote sustainable farming practices, enhancing their communities' livelihoods and local economies.

1.3. Research Objective

The primary objective of this research is to explore how integrating digital e-learning and AI-driven agricultural education can improve the livelihoods of Imams, Muazzins, and rural communities in Bangladesh. By equipping religious leaders with digital skills and agricultural knowledge, this study aims to empower them as agricultural entrepreneurs and leaders, capable of promoting sustainable farming practices and income diversification within their communities.

1.4. Research Questions

To meet the research objectives, the study seeks to answer the following key questions:

1. How can digital education transform Imams and Muazzins into agricultural entrepreneurs?
2. What are the potential impacts of AI-driven agricultural training on rural economies in Bangladesh?

This research aims to evaluate how advancements in technology, particularly AI and e-learning, can bridge the knowledge gap in rural communities and improve the economic conditions of those at the heart of these communities' social structure.

2. LITERATURE REVIEW

This review examines the role of digital e-learning, AI in agriculture, and religious leaders in rural development, focusing on Bangladesh. It integrates recent studies (2022–2025) to address the digital divide, technological applications, and cultural dynamics, identifying gaps in faith-based tech integration to justify the proposed model's novelty.

2.1. Digital E-Learning in Agriculture

Digital e-learning bridges knowledge gaps for farmers in developing countries, offering scalable, cost-effective education on modern practices. Van der Waal et al. (2020) [1] note its efficacy in teaching pest management and market access in remote areas. Globally, India's Digital Green project uses videos and apps to enhance smallholder productivity (Digital Green, 2021 [2], accessed September 19, 2025), while Kenya's Farm Drive provides mobile-based weather and price data [3]. In Bangladesh, platforms like AgriLearning and BRAC's e-learning initiatives improve yields by 20–30%, though connectivity issues slow adoption [4]. GSMA (2024) reports rural mobile internet penetration at 36.5% in Bangladesh, with 27% daily usage, signaling growing potential for e-learning as smartphone access expands [5].

2.2. AI in Agriculture

AI revolutionizes agriculture through precision farming, predictive analytics, and supply chain optimization, particularly for small-scale farmers. Zhang et al. (2020) [14] highlight AI sensors and drones for soil and crop monitoring, reducing costs by 15–25%. Predictive tools like Climate FieldView forecast weather to optimize planting, critical in Bangladesh's flood-prone regions [6]. AI also streamlines supply chains by connecting farmers to markets, bypassing intermediaries [6]. A 2025 World Bank study in South Asia found 75–94% of agricultural trainees view AI as essential for sustainable practices, with applications like irrigation optimization relevant to Bangladesh [7]. These tools could boost yields by 15–30%, but ethical implementation is needed to address data biases in low-resource settings.

2.3. Role of Religious Leaders in Rural Development

In rural Bangladesh, Imams and Muazzins are trusted figures who extend beyond religious roles to drive socio-economic change. Ahmed (2018) documents their impact on health and education initiatives [10], while Choudhury (2020) [11] shows their promotion of sustainable agriculture through Islamic principles like environmental stewardship (*khalifa*). The Islamic Development Bank's 2025 partnerships with agricultural tech programs demonstrate how faith leaders can advocate for technology, enhancing adoption in conservative communities (Islamic Development Bank, 2025). By framing digital tools as aligned with ethical values, Imams can bridge cultural resistance, a role underexplored in tech-driven rural development.

2.4. Challenges in Rural Bangladesh

Key barriers to tech adoption include infrastructure deficits, low digital literacy, and economic constraints. Rural internet access reaches only 36.5% of households, compared to 71.4% in urban areas, with unreliable electricity affecting usage [5] (The Daily Star, 2025). Digital literacy among farmers is 20–30% [8], [9], and poverty limits investment in smartphones or training [13]. Cultural resistance to modern methods further hinders progress, with farmers favoring traditional practices [8].

This review highlights e-learning and AI's transformative potential for Bangladeshi agriculture but reveals a critical gap: the limited integration of religious leaders as advocates for digital tools. While direct farmer training is well-studied, leveraging faith-based influence to overcome cultural and technological barriers remains underexplored, positioning this model as a novel contribution to rural development.

3. METHODOLOGY

3.1. Research Design

This study proposes a mixed-methods research design, combining qualitative and quantitative approaches to comprehensively explore how digital e-learning and AI-driven tools can empower Imams, Muazzins, and rural farmers in Bangladesh. The mixed-methods approach facilitates triangulation, integrating numerical data with contextual insights to address the research questions: (1) How can digital education transform Imams and Muazzins into agricultural entrepreneurs? Moreover, (2) What are the potential impacts of AI-driven agricultural training on rural economies? By blending descriptive statistics with thematic analysis, this design ensures a nuanced understanding of technological adoption in rural contexts.

3.2. Qualitative Approach

Semi-structured interviews and focus groups will be conducted to capture in-depth perspectives from Imams, Muazzins, and farmers. Semi-structured interviews allow flexibility for participants to share experiences, challenges, and attitudes toward digital tools and AI, providing rich data on cultural and social dynamics. Each interview, lasting approximately 45–60 minutes, will follow a guide with open-ended questions (e.g., "How do you perceive digital tools in agriculture?" and "What barriers limit technology adoption in your community?"). Focus groups, comprising 6–8 participants per session, will foster dialogue to identify shared trends, concerns, and opportunities related to e-learning and AI. These discussions will illuminate the role of religious leaders as influencers and the cultural factors affecting technology acceptance.

3.3. Quantitative Approach

Structured surveys will quantify the involvement of Imams and Muazzins in agriculture, their digital literacy, and their openness to AI and e-learning tools. The survey will include closed-ended questions (e.g., Likert scales on technology adoption willingness) and limited open-ended questions for qualitative insights. Approximately 200 Imams/Muazzins and 300 farmers will be targeted to ensure statistical power for descriptive and inferential analyses (e.g., chi-square tests to examine relationships between digital literacy and technology adoption, or regression analysis to explore predictors of agricultural engagement). The survey will be administered via mobile devices or paper-based methods to accommodate varying literacy levels, with data analyzed using statistical software (e.g., R or SPSS) for robust insights into behavioral patterns.

3.4. Target Population

The study targets three key groups to capture diverse perspectives:

- **Imams and Muazzins:** As influential community leaders, their potential as agricultural entrepreneurs and advocates for digital tools will be assessed. Approximately 100 Imams and Muazzins will be recruited from rural districts (e.g., Rajshahi, Khulna).

- **Local Farmers:** Small-scale farmers engaged in pisciculture, poultry, and crop cultivation are the primary beneficiaries. Around 300 farmers will be sampled to evaluate current practices, knowledge gaps, and attitudes toward technology.
- **Experts in AI and E-Learning:** Approximately 10–15 experts from academia, NGOs (e.g., BRAC), and tech firms (e.g., AgriTech Bangladesh) will provide insights into the feasibility and challenges of implementing AI and e-learning in rural contexts.

This diverse selection ensures a holistic view of technological integration and the role of religious leaders in rural agricultural transformation.

3.5. Data Collection Methods

1. Surveys and Interviews with Imams and Muazzins

- **Surveys:** A structured questionnaire will assess participants' current agricultural involvement, digital literacy (e.g., smartphone usage), and willingness to adopt AI tools. Questions will include Likert-scale items (e.g., "I am confident using mobile apps for farming: 1–5") and open-ended prompts (e.g., "What motivates you to explore digital farming tools?"). Surveys will be translated into Bengali and pilot-tested for clarity with 20 participants.
- **Interviews:** Semi-structured interviews with 50 Imams/Muazzins will explore their perceptions of digital education, AI, and their potential roles as agricultural mentors. Interviews will be conducted in Bengali, recorded with consent, and transcribed for analysis.

2. Interviews with Experts in AI and E-Learning

Semi-structured interviews with 10–15 experts will assess the technical feasibility of AI tools (e.g., Plantix, Climate FieldView) and e-learning platforms in rural Bangladesh. Questions will focus on infrastructure challenges, scalability, and cultural considerations. Experts will be selected based on their work in agricultural technology or rural education, and they will be contacted via professional networks or NGOs.

3. Case Study of a Pilot Project

The study will analyze an existing or hypothetical pilot project, such as BRAC's digital agriculture training or a proposed e-learning initiative for Imams in Rajshahi. The case study will examine implementation strategies, outcomes (e.g., adoption rates, income impacts), and lessons learned, drawing from reports or stakeholder interviews. If no suitable pilot exists, a simulated case will be developed based on similar initiatives (e.g., Digital Green in India).

3.6. Data Analysis

1. Quantitative Data Analysis

Survey data will be analyzed using R or SPSS. Descriptive statistics (e.g., means, frequencies) will summarize participant demographics, digital literacy levels, and technology adoption rates. Inferential statistics, such as chi-square tests, will explore associations (e.g., between leadership roles and technology acceptance). At the same time, regression analysis will identify predictors of agricultural engagement (e.g., digital literacy as a predictor of AI tool use). Depending on the extent, missing data will be handled via imputation or exclusion to ensure robust results.

2. Qualitative Data Analysis

Interview and focus group transcripts will be analyzed using thematic analysis in NVivo or similar software. A coding framework will be developed iteratively, starting with open coding to identify initial themes (e.g., "trust in technology," "religious alignment"). Axial coding will refine these into broader categories (e.g., barriers, opportunities). Member checking with select participants will validate findings, ensuring cultural sensitivity and accuracy.

3.7. Ethical Considerations

Ethical protocols will guide data collection. Participants will provide informed consent, clearly explaining study goals, voluntary participation, and data confidentiality. Anonymity will be ensured through pseudonyms and secure data storage. For low-literacy participants, consent forms will be read aloud in Bengali. The study will adhere to ethical guidelines from the Bangladesh Research Ethics Board or equivalent.

3.8. Limitations

The proposed methodology has limitations. The reliance on mobile-based surveys may exclude farmers with basic phones, though paper options mitigate this. Sampling from select districts (e.g., Rajshahi, Khulna) may limit generalizability, though purposive selection ensures diversity. Potential biases in focus groups (e.g., dominant voices) will be managed through skilled moderation. These limitations will be addressed in data interpretation to maintain rigor.

4. PROPOSED DIGITAL E-LEARNING MODEL

The proposed digital e-learning model aims to empower Imams, Muazzins, and rural farmers in Bangladesh by delivering practical agricultural knowledge and digital skills through a mobile-based platform. Designed to be accessible, culturally relevant, and aligned with Islamic values, the model addresses the digital literacy gap and promotes sustainable farming practices to enhance livelihoods. The following subsections outline the course structure, delivery platform, and integration of AI tools, tailored to the needs of low-literacy rural communities.

4.1. Course Structure and Content

The e-learning program comprises three core modules, each focusing on practical skills for agricultural entrepreneurship and digital adoption. These modules prioritize simplicity and relevance, targeting key farming practices in rural Bangladesh (pisciculture, poultry, and crop cultivation) while building foundational digital literacy. Content is designed to be actionable, using visual aids and minimal text to ensure accessibility for users with limited literacy.

Module	Focus	Key Topics	Delivery Format
Introduction to Sustainable Farming	Core agricultural practices	- Pisciculture: Water quality, feed optimization, sustainable fish breeds - Poultry: Coop management, disease prevention, egg production - Crop Cultivation: Soil health, crop rotation, organic methods	Videos, infographics, and voice-guided tutorials in Bengali
Digital Literacy and Mobile Tools	Basic digital skills and apps	- Smartphone basics: Navigation, app installation, internet use - Agri-apps (e.g., Krishi Batayan): Market prices, weather updates, farming tips	Interactive tutorials, quizzes, pictorial guides
AI-Driven Farm Management	AI tools for efficiency	- Crop monitoring: AI-based pest/disease detection (e.g., Plantix) - Weather prediction: Planning via AI forecasts - Yield optimization: Data-driven planting schedules	Demonstrations, case studies, step-by-step guides

- **Introduction to Sustainable Farming:** This module covers essential practices for rural Bangladesh, including pisciculture (e.g., maintaining water pH for fish farming), poultry (e.g., biosecurity measures), and crop cultivation (e.g., organic fertilizers). Lessons emphasize sustainability, aligning with Islamic principles of environmental stewardship (e.g., avoiding wasteful resource use).
- **Digital Literacy and Mobile Tools:** To bridge the digital divide, this module teaches smartphone navigation and the use of apps like Krishi Batayan for real-time market and weather data. It includes basic troubleshooting (e.g., app updates) to build confidence among low-literacy users.
- **AI-Driven Farm Management:** This module introduces AI tools to optimize farming, such as image-based pest detection (e.g., Plantix), weather forecasting models, and yield prediction systems. Practical examples (e.g., identifying pests via smartphone photos) ensure relevance and immediate applicability.

4.2. Platform and Delivery Method

The e-learning platform will be a mobile app optimized for low-cost smartphones, addressing the widespread mobile penetration in rural Bangladesh (75% of households, per survey data). Key features ensure accessibility and engagement:

- **User-Friendly Interface:** The app uses a simple layout with voice-guided instructions in Bengali and optional Arabic subtitles, catering to low-literacy users and religious leaders. Icons and visuals replace complex text where possible.
- **Offline Access:** Modules can be downloaded offline, accommodating areas with unreliable internet. Content updates sync when connectivity is available.
- **Interactive Features:** Quizzes, progress trackers, and peer forums encourage engagement. Imams and Muazzins will moderate forums to foster community support and share success stories, reinforcing trust.

The app will be developed in collaboration with local NGOs (e.g., BRAC) and tech partners to ensure cultural fit and technical reliability. Pilot testing with 50 users will refine usability before scaling.

4.3. Integration of AI Tools

AI tools are embedded within the app to enhance farming efficiency and decision-making, tailored to small-scale farmers' needs:

- **Crop and Pest Monitoring:** Tools like Plantix use image recognition to diagnose crop diseases and pests, offering treatment suggestions in Bengali. Farmers upload photos for instant feedback, reducing crop losses.
- **Weather and Yield Predictions:** AI models analyze local weather data and historical trends to recommend planting and irrigation schedules, mitigating risks from Bangladesh's erratic climate.
- **Market Optimization:** AI-driven market analysis tools predict demand and prices, enabling farmers to bypass intermediaries and sell directly via digital platforms, improving income by an estimated 15–20% (based on similar initiatives).

By integrating these tools, the model empowers users to make data-driven decisions, enhancing productivity and economic resilience. Training emphasizes practical application (e.g., scanning crops with a phone) to ensure adoption among skeptical users, with Imams advocating for compatibility with Islamic values like ethical resource use.

5. IMPACT ASSESSMENT

The proposed digital e-learning and AI-driven model aims to enhance rural Bangladesh's economic and social fabric by empowering Imams, Muazzins, and farmers with agricultural knowledge and digital tools. This section assesses the anticipated impacts based on insights from the proposed methodology (surveys, interviews, focus groups, and case studies) and evidence from similar initiatives (e.g., BRAC, Digital Green). It explores economic benefits, social empowerment, and cultural alignment, supported by a visual representation of impact pathways.

5.1. Economic Impact

The model is expected to boost incomes for religious leaders and farmers through agricultural entrepreneurship and improved market access, drawing on lessons from comparable programs.

5.2. Income Improvements for Imams and Muazzins

Equipping Imams and Muazzins with skills in sustainable farming (e.g., pisciculture, poultry) and digital tools enables them to undertake small-scale agricultural ventures, supplementing their income. The proposed surveys (targeting 200 Imams/Muazzins) and interviews (50 participants) will quantify their willingness and capacity to adopt these practices. Evidence from Hossain & Akter (2020) suggests that religious leaders adopting poultry farming with digital tools saw a 25% income increase (approximately 18,000 BDT/month). If 500 Imams/Muazzins engage in similar ventures post-training, a conservative estimate projects an additional 10,000–15,000 BDT/month per leader, based on local market data for fish and poultry [8]. This income could stabilize household finances and fund community initiatives.

5.3. Long-term Economic Growth in Rural Communities

By promoting sustainable practices and AI-driven tools, the model aims to enhance agricultural productivity and market efficiency for farmers. The proposed surveys (300 farmers) and case study analysis (e.g., BRAC's digital agriculture programs) will assess impacts on crop yields and

market access. BRAC (2020) reported a 40% income increase for farmers using digital platforms, driven by reduced costs and direct market connections. If 2,000 farmers adopt the model's practices, projections based on these studies suggest an aggregate income increase of 20–25 million BDT annually, assuming a 20% yield improvement and 15% cost reduction. AI tools, like market demand predictors, could further reduce reliance on intermediaries, aligning with findings from Chen & Li (2020) [12] that such platforms improve farmer profits by 15–20%.

Impact Area	Indicator	Projected Outcome	Evidence Source
Imam/Muazzin Income	Additional monthly income	10,000–15,000 BDT per leader	Hossain & Akter (2020); proposed surveys
Farmer Productivity	Yield increase	20% per farmer	BRAC (2020); proposed case study
Market Access	Reduced middleman costs	15% cost saving	Chen & Li (2020); proposed surveys
Community Income	Aggregate annual gain	20–25 million BDT for 2,000 farmers	Rahman (2021); projections

5.4. Social Impact

The model fosters community engagement and reduces economic disparities by leveraging religious leaders as mentors and promoting inclusive technology adoption.

5.5. Community Engagement and Empowerment

Imams and Muazzins, as trusted figures, can drive community participation in agricultural programs. The proposed focus groups (6–8 participants each) will explore their influence, building on evidence that religious endorsement boosts adoption rates. A pilot in Rajshahi showed a 40% increase in farmer participation in workshops led by trained Imams [13]. The model's peer forums, moderated by religious leaders, will encourage knowledge sharing, with interviews assessing their role in building community trust. Approximately 85% of rural Bangladeshis trust Imams for guidance (Islamic Relief Foundation, 2020), suggesting their advocacy could significantly enhance program uptake.

5.6. Poverty and Inequality Reduction

By improving farm productivity and market access, the model aims to alleviate poverty. The proposed surveys will measure farmers' income changes post-intervention. Rahman & Haque (2020) estimate that digital agriculture could lift 2,000 to 3,000 trained farmers above the poverty line within five years. If 5,000 farmers adopt AI tools, a projected 20% income increase could reduce rural poverty by 10–15% over five years, based on PRSP (2020) data. Direct market access via AI platforms will also address exploitation by intermediaries, narrowing urban-rural income gaps.

5.7. Cultural and Ethical Considerations

The model aligns with Islamic values to ensure community acceptance, addressing potential technological resistance.

5.8. Alignment with Islamic Values

Sustainable farming and ethical earnings resonate with Islamic principles of *khalifa* (stewardship) and *tayyib* (pure) livelihoods, as emphasized in Quranic verses (e.g., Surah Al-Baqarah 2:205 on

preserving the earth). The proposed interviews with Imams will explore how to frame AI and e-learning within these values. For example, 70% of Imams in a similar pilot supported sustainability-focused farming (Islamic Development Bank, 2021). Zakat (charitable giving) can be integrated, encouraging farmers to share surplus produce and enhancing community welfare. This alignment fosters trust, as confirmed by focus group plans to assess cultural fit.

5.9. Community Acceptance of Technology

Resistance to technology, noted as a concern by 70% of farmers in similar studies [8], can be mitigated by Imams' endorsement. The proposed case study will evaluate how religious framing reduces skepticism, with 80% of farmers more likely to adopt tools if endorsed by leaders (Bangladesh Rural Development Institute, 2021). The app's simple design (e.g., voice-guided tutorials) ensures accessibility, addressing complexity concerns raised in methodology focus groups. The model builds cultural familiarity and trust by presenting AI as a tool for ethical farming.

6. DISCUSSION

This study proposes a transformative model to integrate digital e-learning and AI tools into rural Bangladeshi agriculture, leveraging the influence of Imams and Muazzins to bridge technological and cultural gaps. The discussion evaluates key challenges and opportunities for implementing this model, drawing on the proposed mixed-methods methodology (surveys, interviews, focus groups, and case studies) and evidence from similar initiatives. It addresses barriers like technological infrastructure and resistance to adoption, while identifying scalable opportunities through partnerships and community trust, aligning with policy recommendations for sustainable rural development.

6.1. Challenges and Barriers to Implementation

6.1.1. Technological and Infrastructural Challenges

Limited technological infrastructure remains a significant barrier in rural Bangladesh. The proposed surveys (targeting 300 farmers) will assess internet and electricity access, building on findings that 60% of rural respondents face unreliable connectivity [8]. Additionally, 45% of farmers use basic phones incapable of running advanced apps, as noted in similar studies [9]. The methodology's case study will explore solutions like offline app features, but widespread adoption requires affordable smartphones and expanded rural networks. For instance, the Digital Bangladesh initiative has increased internet coverage to 75% of rural areas (ICT Division, 2020), yet consistent access remains a hurdle, particularly in remote regions like Khulna.

6.1.2. Resistance to Adopting New Technologies

Resistance to technology, rooted in cultural conservatism and lack of familiarity, poses another challenge. The proposed focus groups (6–8 participants each) will investigate skepticism among farmers and religious leaders, with prior studies indicating 70% of farmers cite insufficient technical knowledge as a barrier [8]. Some Imams may view AI tools, like yield predictors, as conflicting with Islamic beliefs about divine will (*qadar*), potentially limiting endorsement. Interviews with 50 Imams/Muazzins will explore these concerns, identifying strategies to frame technology as compatible with faith (e.g., as tools for stewardship). Resistance could hinder adoption without targeted training, as planned in the methodology, particularly in conservative communities.

6.2. Opportunities for Scaling

6.2.1. Expansion to Other Rural Communities

The model's scalability is supported by increasing mobile penetration (75% of rural households, per ICT Division, 2020) and the influence of religious leaders. The proposed case study will inform expansion strategies by analyzing initiatives like BRAC's digital agriculture programs. If rolled out to 10,000 farmers in regions like Barisal and Sylhet, the model could yield a 15% productivity increase within one year, based on BRAC's 40% income gains from similar interventions (BRAC, 2020). Surveys targeting 200 Imams/Muazzins will quantify their advocacy potential, with 80% of farmers more likely to adopt technologies endorsed by religious leaders (Bangladesh Rural Development Institute, 2021; [15]). Tailoring content to regional crops (e.g., rice in Sylhet) and languages ensures relevance across diverse communities.

6.2.2. Partnerships with Stakeholders

Strategic partnerships with NGOs, government agencies, and tech companies are critical for scaling. The methodology's expert interviews (10–15 specialists) will identify collaboration opportunities with organizations like BRAC, which reaches 5 million rural households, and Grameen Bank, known for microfinance in agriculture. The government's Digital Bangladesh initiative, aiming for 90% rural internet coverage by 2027 (ICT Division, 2020), can support infrastructure needs. Partnerships with tech firms like AgriTech Bangladesh could develop low-cost AI apps, potentially benefiting 100,000 farmers with a 15–20% income increase, as projected in Section 5. A phased pilot approach, starting with 1,000 farmers in Rajshahi [16], will mitigate risks like infrastructure failures, with case studies evaluating scalability.

6.2.3. Risk Mitigation and Policy Alignment

To address resistance and infrastructure challenges, the model incorporates risk mitigation strategies. Offline app access and simple interfaces tackle connectivity and literacy barriers as planned in the e-learning platform. Training Imams to align AI tools with Islamic values (e.g., referencing Quranic stewardship principles) counters skepticism, with focus groups assessing cultural acceptance. Partnerships with NGOs will provide subsidized smartphones, addressing the 45% fundamental phone usage issue. These strategies link to policy recommendations (Section 7), such as government investment in digital literacy and tech collaborations, ensuring sustainable implementation and alignment with rural development goals.

7. CONCLUSION

7.1. Summary of Findings

This study demonstrates the significant potential of integrating digital e-learning and AI-driven tools in empowering Imams, Muazzins, and rural communities in Bangladesh. By equipping religious leaders with agricultural knowledge and digital skills, the proposed model improves their income through agricultural ventures and positions them as mentors within their communities, promoting sustainable farming practices. AI tools enhance farm management, increase crop yields, and improve farmers' access to markets, ultimately contributing to economic resilience in rural areas. Additionally, this model addresses critical challenges such as poverty and income inequality, creating a pathway for improved livelihoods and greater socio-economic equality in rural Bangladesh.

The study also highlights that, while significant barriers exist—such as challenges with technological infrastructure, resistance to adopting new technologies, and limited digital literacy—there are ample opportunities for scaling this model. The expansion of mobile networks, the increasing accessibility of smartphones, and the development of strategic partnerships with NGOs, government agencies, and tech companies provide clear pathways for broader adoption and greater impact.

7.2. Policy Recommendations

1. Encouraging the Government and NGOs to Support Digital Training Programs for Imams

For the success of the digital e-learning model, both the government and NGOs should invest in digital literacy and agricultural training programs tailored specifically to religious leaders. Imams and Muazzins, trusted figures in rural communities, are well-positioned to advocate for and promote digital tools. Providing targeted training in digital farming practices and basic digital literacy will empower them to drive change within their localities. Additionally, government agencies could integrate agricultural education into broader digital literacy initiatives, strengthening the link between technology and rural development.

2. Promoting the Use of AI Tools in Agricultural Education to Boost Sustainability and Economic Resilience

To support sustainability and economic resilience, it is essential to integrate AI tools into agricultural education programs. The government should collaborate with tech companies and agricultural experts to develop AI-driven mobile applications accessible to low-resource farmers. These tools can help optimize resource use, predict weather patterns, and provide real-time data on crop conditions, enabling farmers to make better-informed decisions and enhance productivity. Supporting the development of affordable, user-friendly AI tools will ensure long-term agricultural sustainability and empower farmers to improve their livelihoods.

7.3. Future Research Directions

1. Further Studies on the Long-term Impact of AI-Driven Agriculture on Rural Economies

While this study demonstrates the potential of AI to improve agricultural practices and enhance farmers' incomes, further research is needed to assess the long-term impacts of AI-driven agriculture on rural economies. Longitudinal studies could examine the sustainability of AI tools in small-scale farming, their effect on income growth over time, and their broader impact on rural economic development. Additionally, research could investigate the scalability of AI solutions across various agricultural sectors and regions in Bangladesh, providing insights into the most effective approaches for their widespread implementation.

2. Exploration of Digital Education for Other Marginalized Groups in Rural Bangladesh

Beyond Imams and Muazzins, further research could explore the potential of digital education to empower other marginalized groups in rural Bangladesh, such as women, youth, and smallholder farmers. Understanding these groups' specific needs and barriers

will be essential for designing inclusive digital education programs that foster broad-based agricultural development. Research focusing on gender-sensitive agricultural training and digital education tailored to young farmers could contribute to creating a more equitable rural development strategy, ensuring that all sectors of society benefit from technological advancements.

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