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Integrated Waqf Environment Model (IWEM): Proposal for funding sustainable agriculture through waqf to embrace the Era of Smart Agriculture 5.0

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ABSTRAK

Introduction

Although global food production has tripled, sustainable agriculture remains threatened by climate change, land degradation, and financial gaps, especially in smallholder communities. This study introduces the Integrated Waqf Environment Model (IWEM) as a waqf-based funding mechanism to support sustainable agriculture. Additionally, sentiment analysis using VADER Python is employed to assess public perceptions of sustainable agriculture.

Objectives

This research aims to measure public sentiment regarding sustainable agriculture on the Twitter social media platform. Additionally, the study proposes the Integrated Waqf Environment Model (IWEM) for sustainable agriculture funding as a response to the challenges faced in the agricultural sector.

Method

The research methodology involves the extraction and classification of tweet data using the Python library called VADER (Valence Aware Dictionary and Sentiment Reasoner). The study utilizes tweet data posted within the last year. The research findings indicate fluctuations and a decrease in the number of tweets discussing sustainable agriculture. The location with the highest tweet activity related to sustainable agriculture is Brussels, Belgium, with 642 tweets during the observation period.

Results

Word cloud analysis on keywords reveals that, in positive sentiment, terms like "food security" and "climate change" dominate the visualization. On the other hand, in negative sentiment, words like

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"farmer" and "private farmland" appear more frequently. Overall, the majority of tweets express a positive attitude toward sustainable agriculture, with 68.5% positive sentiment. Approximately 22.3% of tweets indicate neutral sentiment, without a strong positive or negative tendency. Only 9.1% of tweets contain negative sentiment, suggesting that a small portion expresses less supportive views of sustainable agriculture.

Implications

The research provides insights into public sentiment on sustainable agriculture and proposes IWEM as a sustainable financing solution. IWEM can bridge financial gaps, enhance technological adoption, and support policy development for sustainable agriculture. This model aligns with the SDGs, ensuring long-term agricultural resilience and environmental conservation.

Originality/Novelty

This study uniquely integrates Islamic social finance with Smart Agriculture 5.0 through IWEM. It also employs sentiment analysis to understand public perceptions, offering data-driven insights for policymakers. The research contributes a novel waqf-based framework that can be scaled for sustainable agricultural development.

INTRODUCTION

The escalating global challenges in financing sustainable agriculture have increasingly drawn attention from scholars, policymakers, and development institutions. Smallholder farmers, who produce over 70% of the world's food, face persistent obstacles such as limited access to finance, climate vulnerability, and inequitable market structures. These constraints directly hinder their capacity to adopt technological innovations and contribute to the achievement of the United Nations Sustainable Development Goals (SDGs), particularly SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 13 (Climate Action) (Huang & Huang, 2023; Ristić et al., 2020). Moreover, the lag in adopting sustainable practices among smallholders, exacerbated by inadequate infrastructure and limited knowledge transfer, underscores the urgent need for financing frameworks that are inclusive, equitable, and adaptive (Cao & Solangi, 2023; Du & Fan, 2023).

Existing financial systems, largely profit-oriented, often fail to accommodate the socio-economic realities of rural communities. Interest-bearing loans pose systemic risks for smallholders already burdened by climate-induced uncertainty and structural poverty. In response, researchers have called for ethical financing solutions that

promote resilience, equity, and sustainability. Islamic social finance—particularly waqf—has emerged as a promising alternative. Waqf, rooted in Islamic jurisprudence, is a philanthropic instrument that offers perpetual, interest-free capital dedicated to societal welfare. Literature has demonstrated its potential for funding public goods such as education, healthcare, and increasingly, agriculture (Mohamed & Shafiai, 2021; Rusydiana et al., 2023b).

Despite this promise, conventional financing models continue to dominate agricultural policy. Existing solutions such as government subsidies, donor-led grants, and microcredit have shown limited scalability and sustainability. Many such interventions lack embedded ethical considerations, fail to leverage community participation, and do not adequately address the structural financial exclusion of smallholders. Furthermore, while digital finance tools and fintech platforms are increasingly applied to rural development, they are rarely integrated with Islamic finance principles (Ningrat & Nurzaman, 2019; Thaker et al., 2020). This disjunction between Islamic ethical values, technological innovation, and sustainable development goals represents a significant theoretical and practical gap.

The literature increasingly acknowledges waqf's capacity to support socio-economic development beyond its traditional charitable applications. Studies have shown that waqf can effectively fund infrastructure, education, and sustainable agriculture when integrated with proper governance and contemporary instruments like cash waqf linked sukuk (C-WLS) (Aini & Kamilah, 2025; Hasibuan & Achiria, 2024; Pinasti & Achiria, 2024; Riani & Fatoni, 2022). Compared to conventional finance, waqf offers several advantages: it operates on a non-debt basis, emphasizes ethical investment, promotes financial inclusion, and encourages community-based governance (Aliyu, 2022; Zauro et al., 2020). Its ability to mobilize community assets and institutionalize redistribution makes it particularly suited to address the funding challenges of smallholder farmers.

Empirical studies have begun to demonstrate the viability of waqf in agriculture. In Malaysia and Indonesia, integrated models involving waqf and Islamic microfinance have been deployed to fund rice farming and livestock projects with positive outcomes (Azganin et al., 2021; Sukmana et al., 2024). These models leverage waqf to provide startup capital, reduce dependency on credit, and create revolving funds for sustainable investment. Additionally, studies by Ascarya et al. (Ascarya et al., 2022) and Dewanto & Hilyatin (2021) emphasize that productive waqf can support land protection and agricultural innovation, especially when aligned with the Maqasid al-Shariah (objectives of Islamic law) and SDGs.

The current discourse also stresses the importance of public perception and community engagement in shaping successful sustainable agriculture models. Social media platforms like Twitter and Facebook have emerged as tools for gauging public opinion, mobilizing stakeholders, and disseminating knowledge. Studies by Jabeen & Gul (2023) and Sabillón et al. (2022) illustrate that positive public sentiment enhances adoption rates of sustainability initiatives and increases trust in financing mechanisms. The integration of sentiment analysis and digital discourse into model design is

therefore essential to ensure responsiveness and legitimacy in public-facing agricultural strategies.

However, a comprehensive framework that unites waqf-based financing, sustainable agriculture, digital integration, and public sentiment remains underdeveloped. While individual elements of Islamic social finance, smart agriculture, and sentiment analysis have been explored in isolation, few studies have synthesized these into a coherent, scalable model. This fragmentation limits the practical application of Islamic financing tools in contemporary agricultural systems and hinders their potential to contribute meaningfully to SDG implementation.

This study proposes the Integrated Waqf Environment Model (IWEM), a novel framework that fuses Islamic social finance, sustainable agricultural practices, and public sentiment into a unified model for inclusive agricultural development. The model employs Twitter-based sentiment analysis using the VADER algorithm to capture public perception of sustainable agriculture, informing the design of an adaptive, community-responsive waqf-based financing scheme. IWEM is structured across five stages—preparation, launching, development, confirmation, and expansion—incorporating Islamic contracts such as mudarabah, musyarakah, and qard hassan, while leveraging digital tools for governance and transparency.

The study's novelty lies in its interdisciplinary approach, bridging Islamic finance theory, computational linguistics, and agricultural development. It contributes to the growing discourse on ethical, inclusive financing by demonstrating how waqf can be strategically deployed for agricultural innovation in the digital age. The scope encompasses conceptual modeling, sentiment analysis, and policy implications, offering a replicable template for waqf institutions, governments, and researchers. Ultimately, IWEM advances a paradigm shift from reactive, donor-dependent models to a proactive, values-driven system grounded in community ownership and ethical sustainability.

LITERATURE REVIEW

Theoretical Foundations and Historical Context of Waqf in Agriculture

The application of waqf in agriculture is grounded in Islamic jurisprudence (fiqh) and the moral imperative of sustaining communal welfare. Rooted in Maqasid al-Shariah, waqf functions as a perpetual endowment that contributes to societal equity and the preservation of essential values such as property, intellect, and livelihood. This theoretical framing positions waqf within the broader Islamic social finance ecosystem, alongside zakat and infaq, emphasizing redistribution and long-term societal benefit (Rusydiana et al., 2023a; Winarsih et al., 2019).

Historically, waqf has served as a pillar of socio-economic infrastructure in Islamic civilizations. From the Prophet Muhammad's era through the Ottoman Empire, waqf financed public services, including schools and agricultural irrigation. In recent decades, the revitalization of waqf has included models such as Cash Waqf Linked

Sukuk (CWLS), which reflect waqf's evolution into a dynamic financial instrument aligned with contemporary development goals (Abas & Raji, 2018; Riani & Fatoni, 2022).

Integration with sustainable agriculture has become increasingly viable, particularly through participatory governance and digitized waqf models. These initiatives foster local ownership, transparency, and long-term productivity (Fauziah & Kassim, 2022; Ismal, 2022). Scholars also advocate for professionalized nazhir management and technology integration to overcome inefficiencies and promote scalable, accountable, and SDG-aligned applications of waqf (Almomani et al., 2024).

Empirical Insights on Islamic Social Finance and Agricultural Innovation

Empirical studies highlight the significant role of Islamic social finance instruments—notably waqf, zakat, and Islamic microfinance—in advancing rural development and agricultural innovation. Waqf has proven effective in funding long-term agricultural infrastructure, enhancing food security, and reducing poverty through community-based models like musaqah (Mohamed & Shafiai, 2021; Rosman et al., 2022).

Zakat, as a redistributive mechanism, complements waqf by providing immediate financial support for smallholder farmers. Integrated approaches that combine zakat and waqf have demonstrated increased efficiency and sustainability in funding agricultural development, especially in impoverished regions (Adinugraha et al., 2023; Sari et al., 2024). Such synergy enables both short-term relief and long-term empowerment.

Islamic microfinance further addresses the financing gaps faced by rural farmers. Products like murabaha and musharakah offer Shariah-compliant alternatives to conventional credit, facilitating investment in tools, seeds, and infrastructure (Hasan et al., 2022; Thaker et al., 2020). Empirical models such as Integrated Agricultural Land Crowdfunding (IALCM) confirm that combining crowdfunding and Islamic finance can democratize access and stimulate community-led agricultural growth.

Digital Integration of Religious Philanthropy to Support the SDGs

Recent literature emphasizes the growing synergy between Islamic philanthropy and digital technology in support of the Sustainable Development Goals (SDGs). Digital waqf platforms enhance transparency, real-time tracking, and fund distribution efficiency, encouraging broader donor engagement (Almomani et al., 2024; Saputri, 2024). These innovations also foster youth participation and global connectivity in charitable giving.

Mobile-based zakat and sadaqah platforms offer scalable solutions for inclusive philanthropy. Tools such as user-friendly apps and blockchain-integrated systems increase trust and accountability among donors and recipients (Abubaker et al., 2025; Purnawan & Irfaniah, 2025). Strategic partnerships between Islamic institutions and fintech companies have further improved efficiency in delivering community benefits and aligning financing with SDGs.

E-philanthropy models combining Islamic principles, financial innovation, and digital tools have expanded access to education, healthcare, and food security.

Platforms that integrate crowdfunding, AI, and community engagement contribute to a more participatory and resilient philanthropic ecosystem (Al Kahfi & Nurfajriani, 2025; Ibrahim & Kollin, 2024). These frameworks affirm the feasibility of digitalizing Islamic finance to support holistic and sustainable development.

Research Gap and Significance of the Study

Despite the robust literature on Islamic social finance, there remains a lack of integrative models that holistically connect waqf, sentiment analysis, and smart agriculture. Most prior studies focus on sector-specific instruments or limited geographic case studies. The absence of a unified conceptual framework limits the scalability and replicability of Islamic social finance in supporting agriculture within the Smart Agriculture 5.0 context.

This study addresses the gap by proposing the Integrated Waqf Environment Model (IWEM), which fuses sentiment-driven public responsiveness, Islamic ethical finance, and sustainable agricultural goals. IWEM offers a novel blueprint for bridging funding gaps in agricultural innovation while preserving the socio-religious foundations of waqf. The model's originality lies in its interdisciplinary approach, its alignment with both SDGs and Maqasid al-Shariah, and its potential to inform policy design and impact assessment in Islamic social finance ecosystems.

METHOD

Research Design and Objectives

This study adopts a qualitative-quantitative mixed method approach aimed at developing the Integrated Waqf Environment Model (IWEM) for financing sustainable agriculture in the context of Smart Agriculture 5.0. The study is exploratory and conceptual in nature but incorporates data-driven elements through social media sentiment analysis. The objectives are threefold: (1) to assess public perception regarding sustainable agriculture using Twitter data, (2) to derive thematic clusters that inform the model design, and (3) to construct a theoretically grounded framework that aligns Islamic social finance with agricultural innovation.

Data Collection Procedure

Data was collected from Twitter using the Twitter API via Python programming. The sampling technique used was purposive and quota-based, focusing on keywords such as "sustainable agriculture," "smart farming," and "climate-resilient agriculture." The initial dataset consisted of over 100,000 tweets gathered between January 1 and December 31, 2024. To ensure thematic and geographic relevance, tweets were filtered using additional criteria such as language (English and Indonesian), geolocation (where available), and recency.

Given the open-access nature of Twitter, ethical clearance was not required; however, the data was anonymized and analyzed only in aggregate form. All user identifiers were removed to maintain privacy. The tweets collected represent real-time
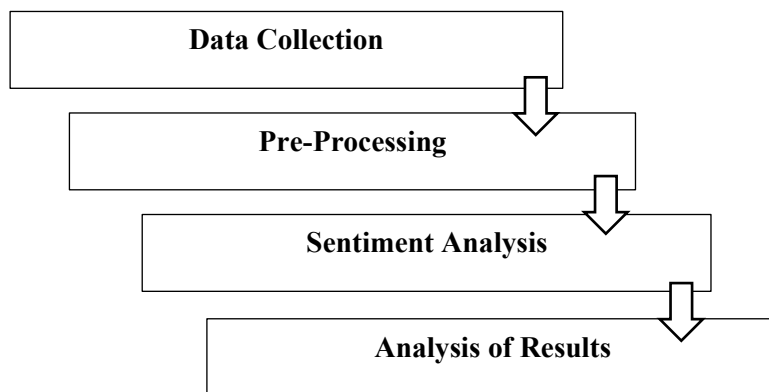
public sentiment and discourse and serve as a proxy for community engagement and awareness regarding sustainable agriculture topics.

Sentiment Analysis and Data Processing

The sentiment analysis was conducted using the VADER (Valence Aware Dictionary for sEntiment Reasoning) library in Python, which is suitable for social media texts due to its sensitivity to slang, emojis, and informal language. The polarity scores produced by VADER classify each tweet as positive, neutral, or negative. The scoring thresholds were as follows: compound score > 0.05 (positive), between -0.05 and 0.05 (neutral), and < -0.05 (negative).

Figure 1

Steps in Sentiment Analysis

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        ┌──────────────────────────────────┐
        │       Data Collection            │
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        │        Pre-Processing            │
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        ┌──────────────────────────────────┐
        │       Sentiment Analysis         │
        └──────────────────────────────────┘
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        ┌──────────────────────────────────┐
        │       Analysis of Results        │
        └──────────────────────────────────┘
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Source: Secondary data. Authors' analysis.

Text pre-processing included the removal of stop words, punctuation, and hyperlinks, as well as stemming and lemmatization to standardize textual data. Duplicates, advertisements, and bot-generated tweets were filtered out. The cleaned dataset was then subjected to frequency and cluster analysis using natural language processing (NLP) techniques to extract key themes.

The final dataset included 68.5% positive tweets, 22.3% neutral, and 9.1% negative. Positive tweets most frequently included terms such as "climate change," "food security," and "agritech," suggesting public optimism towards sustainable agriculture's potential. Conversely, negative tweets referenced "lack of support," "private land grabbing," and "policy failure," indicating structural barriers and community concerns.

Theoretical Modeling and Framework Development

The development of IWEM integrates insights from sentiment analysis with foundational principles of Islamic social finance and sustainable development theory. The process employed a deductive-inductive approach. The inductive stage drew on the empirical data to identify public expectations, concerns, and aspirations regarding sustainable agriculture. The deductive phase was informed by concepts from Maqasid al-Shariah, SDGs, and Islamic financing contracts such as mudarabah, musyarakah, and qard hassan.

The framework is structured into five stages:

1. Preparation: Institutional setup, waqf asset mobilization, and stakeholder mapping.
2. Launching: Fundraising campaigns, community outreach, and project identification.
3. Development: Disbursement of funds, implementation of agricultural technologies, and farmer training.
4. Confirmation: Monitoring, auditing, and evaluation.
5. Expansion: Scaling successful models, reinvestment, and diversification.

Each stage integrates both waqf management best practices and agricultural innovation cycles. Governance protocols, transparency mechanisms, and digital tools (e.g., blockchain for fund tracking) are embedded into the model to ensure accountability and long-term sustainability.

Validity and Reliability Measures

Although the research is conceptual, the use of computational tools for sentiment analysis adds an empirical layer that enhances its validity. VADER's lexicon is validated in prior research for high accuracy in classifying social media sentiment. To ensure reliability, the data extraction and analysis process was repeated on a 10% sample for cross-validation, yielding over 95% consistency in sentiment classification.

The theoretical model underwent peer debriefing and was evaluated against existing waqf models such as IWEP and WMSCM to test its conceptual coherence and feasibility. Expert consultation was conducted with practitioners in Islamic finance and sustainable agriculture to assess the operational relevance and institutional compatibility of the model.

Limitations of the Method

The study acknowledges several methodological limitations. The Twitter-based sentiment analysis may not fully represent the views of offline stakeholders such as rural farmers who lack digital access. Furthermore, the sentiment classifier may occasionally misinterpret sarcasm, idioms, or non-English tweets. While sentiment analysis provides valuable signals, it does not replace deep ethnographic understanding or field-based validation.

Additionally, the IWEM model remains conceptual and has not yet undergone pilot testing in real-world agricultural contexts. Future research should therefore empirically implement and refine the model through experimental or participatory action research designs.

Ethical Considerations

Although the research used publicly available data, ethical protocols were followed to protect digital privacy and data integrity. No individual users were identified or profiled. The study did not involve any human or animal subjects directly and thus did not require institutional ethics review. The waqf-based model proposed also incorporates

ethical finance principles to ensure that funding mechanisms serve inclusive and non-exploitative purposes.

RESULTS

Temporal Distribution of Tweet Activity

The analysis of tweet frequency over time, as illustrated in Figure 2, reveals notable fluctuations in public discourse on sustainable agriculture between July and December 2024. The month of February saw the highest engagement, peaking at 3,524 tweets. This spike could be associated with environmental events, agricultural campaigns, or policy dialogues that may have prompted increased public interest. Following this peak, a steady decline in tweet activity was observed, suggesting a potential drop in momentum or shifting public priorities.

Figure 2

Count of Text Clean by Month
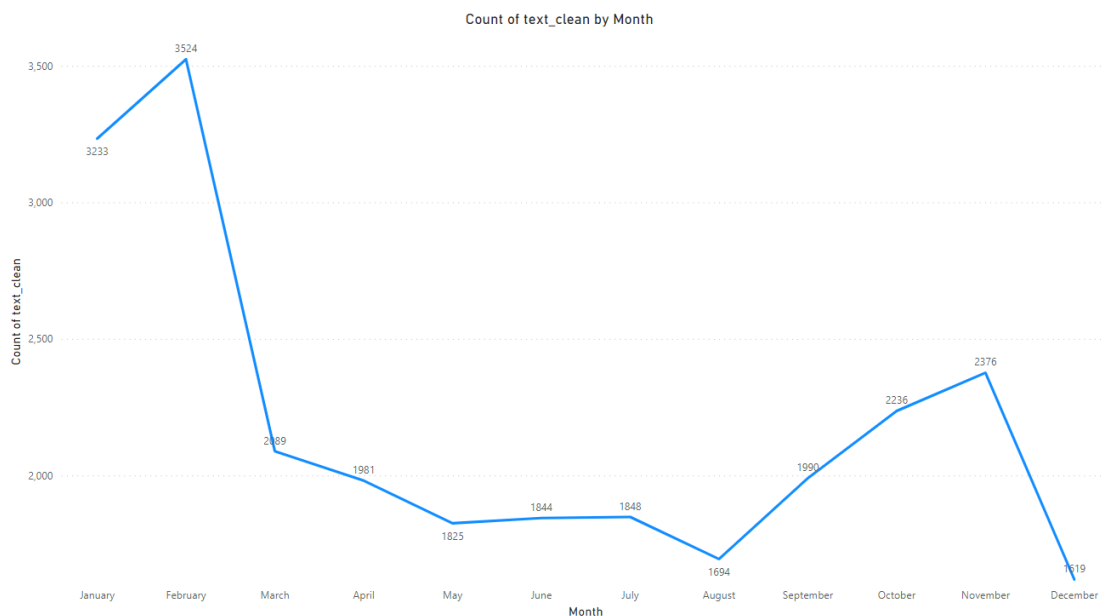
Source: Secondary data. Authors' analysis.

This temporal pattern underscores the need for consistent engagement strategies. Sustaining interest in sustainable agriculture requires continuous advocacy, dynamic content dissemination, and the strategic timing of waqf-related awareness efforts. Periodic engagement boosts—possibly aligned with planting seasons or international sustainability days—may help maintain public interest.

Geographic Spread of Public Discourse

Table 1 presents a detailed breakdown of tweet distribution by location. Brussels, Belgium leads with 642 tweets, followed by the United States (352), Washington, DC (331), India (306), and New Delhi (252). This concentration of tweet activity in both Western and South Asian urban centers highlights the global reach of discourse on sustainable agriculture.

Tabel 1

Distribution of Data Tweets by Location

No	Location	Total
1	Brussels, Belgium	642
2	United States	352
3	Washington, DC	331
4	India	306
5	New Delhi, India	252

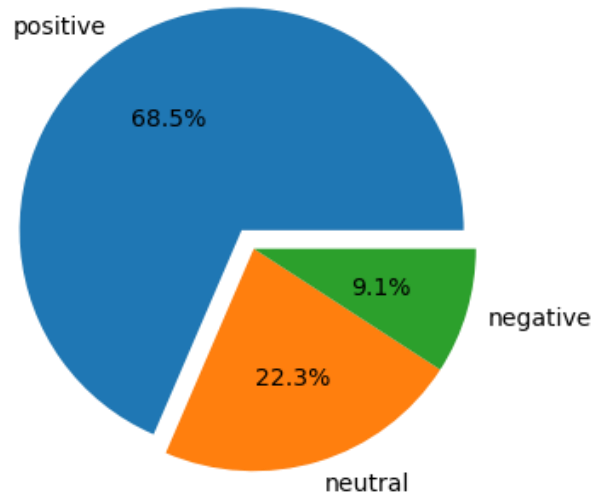Source: Secondary data. Authors' analysis.

The high participation from Brussels may reflect EU-level environmental policymaking, while interest from the U.S. and India indicates concern among countries with substantial agricultural sectors. The geographical data supports the adaptability of the IWEM framework across diverse regulatory and cultural contexts, reinforcing its global applicability. It also signals potential hotspots for pilot implementation and stakeholder collaboration.

Sentiment Polarity and Public Perception

As shown in Figure 3, sentiment analysis using the VADER algorithm classified the dataset into three sentiment categories: positive (68.5%), neutral (22.3%), and negative (9.1%). The predominance of positive sentiment affirms a supportive online environment for sustainable agriculture initiatives.

Positive tweets often expressed optimism, shared success stories, or endorsed sustainable farming practices. Neutral tweets typically conveyed factual information, event notices, or shared research links without explicit approval or disapproval. In contrast, negative sentiment tweets often expressed skepticism about implementation, concern over land ownership, or criticism of agricultural policy gaps.

The strong leaning toward positive sentiment is a promising indicator for the implementation of IWEM. It implies a readiness among the online public to accept ethical, non-debt financing models that support agriculture and environmental sustainability.

Figure 3

Sentiment Polarity on Tweets Data

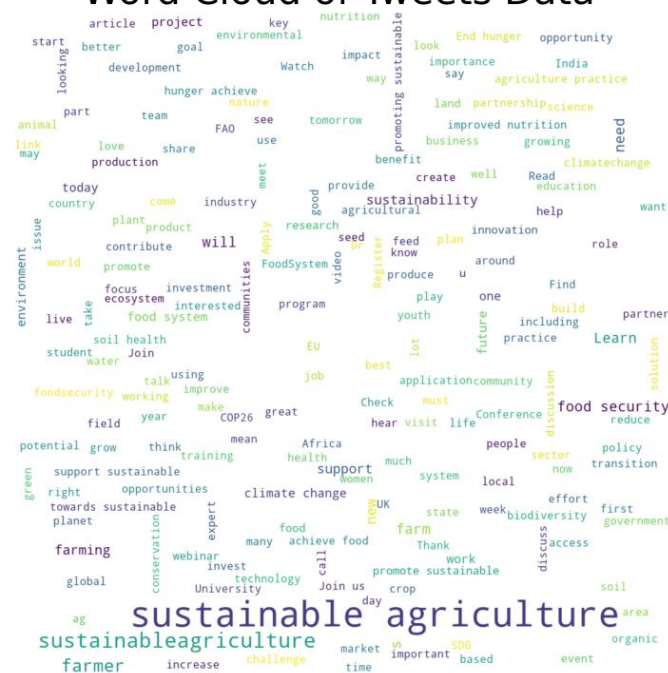Source: Secondary data. Authors' analysis.

Semantic Themes from Word Cloud Analysis

Figure 4 provides a visual representation of keyword frequency segmented by sentiment polarity. The overall word cloud highlights "sustainable agriculture" as the most frequently occurring term, validating the relevance of the dataset.

Figure 4

Word Cloud of Tweets Data
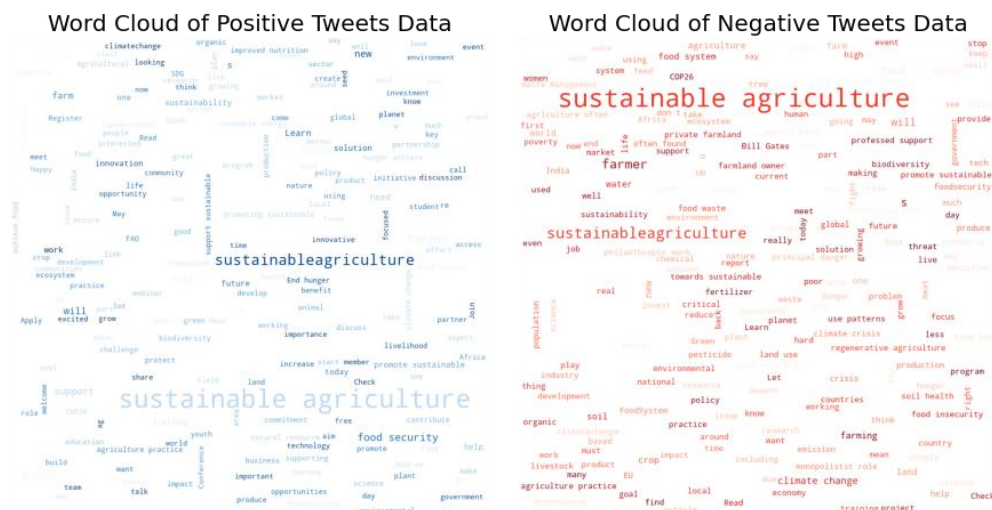
Word Cloud of Tweets Data

Source: Secondary data. Authors' analysis.

In the positive sentiment category, dominant keywords include "food security" and "climate change." These associations suggest that public support for sustainable agriculture is often tied to broader global challenges. The frequent pairing of sustainable agriculture with food security reflects a recognition of its role in mitigating hunger and ensuring long-term resource availability. Meanwhile, the emphasis on climate change indicates its perceived utility in addressing environmental degradation.

Negative sentiment tweets revealed recurring keywords such as "farmer" and "private farmland." These terms point to structural concerns regarding land ownership, access to resources, and the burdens placed on farmers. Such concerns indicate potential resistance if sustainable agriculture models are perceived to favor institutional or technological elites over grassroots farmers.

Understanding these semantic nuances allows IWEM to fine-tune its communication and implementation strategy. Positive associations can be reinforced through targeted messaging, while negative concerns must be proactively addressed through transparent, inclusive design.

Integration of Findings into IWEM Design

The empirical findings from sentiment and keyword analysis directly inform the operational structure of IWEM. Positive sentiment surrounding climate and food security provides a mandate for aligning IWEM's funding priorities with these domains. This justifies allocating greater resources toward technologies and practices that support climate resilience and nutrition security.

Concerns reflected in the negative sentiment cluster have also been incorporated into the IWEM framework. For instance, equity-related issues inform the use of qard

hassan as a non-repayable, interest-free loan mechanism for vulnerable farming communities. Similarly, musyarakah and mudarabah structures are employed to promote participatory investment and profit-sharing models.

The IWEM model's design stages—outlined conceptually and operationalized through the phases of preparation, launching, development, confirmation, and expansion—have been shaped to address both the opportunities and risks highlighted by the sentiment data. For example, the confirmation stage includes public campaigns that leverage high sentiment periods to reinforce engagement, while the expansion phase is guided by regional sentiment metrics to identify readiness and scalability.

Proposal for an Integrated Waqf Environment Model (IWEM)

Figure 5

Integrated Waqf Environment Model (IWEM)
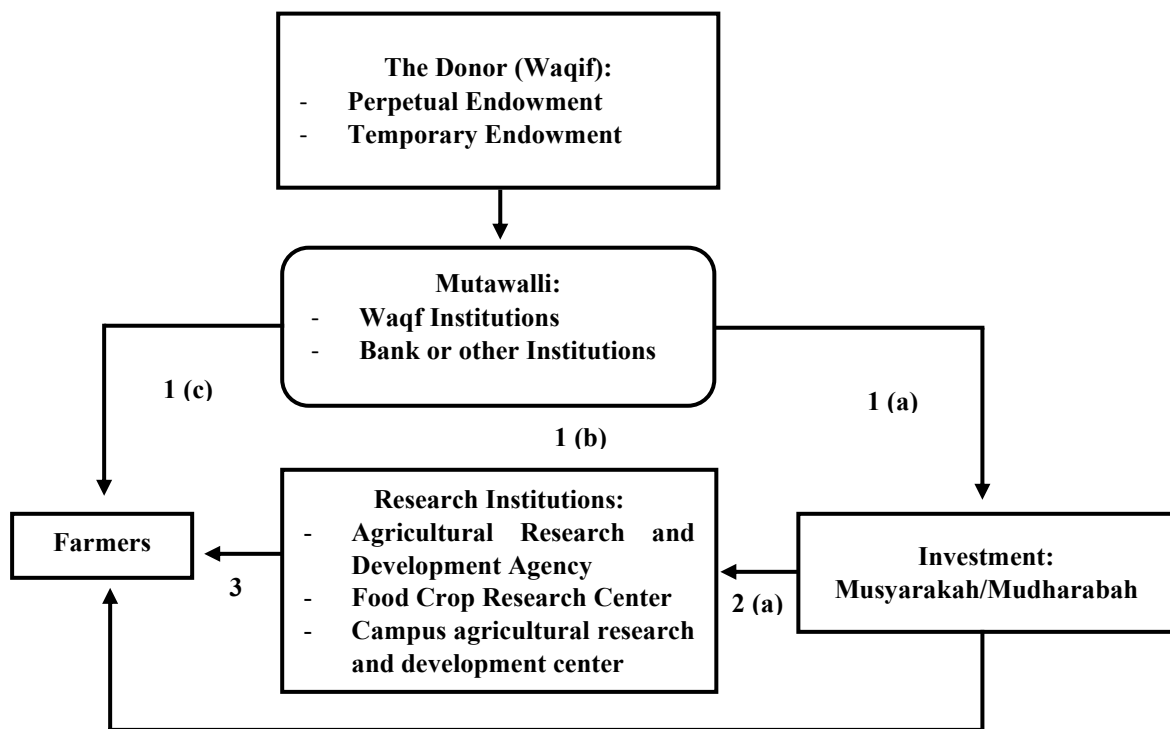
Source: Secondary data. Authors' analysis.

In several countries, waqf has become a tax incentive, which can encourage the community to dedicate their properties for charitable purposes (Afroz et al., 2019). The donors then become waqif, and waqf institutions, banks, or other entities act as mutawalli responsible for managing the funds. They are also accountable for making necessary investment decisions from the waqf funds to generate income. Farmers and agricultural research and development institutions become the beneficiaries (mawquf 'alayh) in this waqf model. The mutawalli can invest the funds in any Sharia-compliant company using mudarabah and musyarakah contracts, as illustrated in 1 (a) in Figure 5. The generated income is then distributed to farmers and research and development

institutions, as shown in 2 (a) and 2 (b) in Figure 5. In arrow 2 (a), financial assistance is directed to support agricultural research and development institutions to expedite the dissemination and development of technology to enhance food productivity. Subsequently, the research outcomes will be directly implemented for farmers, as indicated in 3 in Figure 5, under the guidance and supervision of the mutawalli. In arrow 2 (b), financial aid is aimed at assisting farmers to continue cultivating their land in the event of natural disasters. This assistance may include the purchase of new seed varieties and other equipment requiring financing.

Similarly, the mutawalli can directly allocate a portion of the waqf principal to research institutions to purchase durable goods such as conservation land, advanced technology, and other necessary equipment for research, as depicted in 1 (b). Furthermore, for farmers, waqf assets are provided as a loan based on qard hassan, as indicated by 1 (c) in Figure 5. After each farmer generates profit, the waqf principal is to be returned to the mutawalli indefinitely and without interest.

This is how the concept of sustainability is applied to waqf assets for the environment. The disbursed funds can then be utilized directly by farmers and research institutions or by the waqf institution as the mutawalli to provide necessary facilities for farmers to address the issues and challenges they face. In addition to addressing financial problems and access to capital, it can also tackle problems from the perspective of implementing agricultural technology towards smart farming 5.0 through research and development institutions for food crops.

Development Scenario for the Integrated Waqf Environment Model (IWEM)

Preparation Stage: 1–2 years

Launching the model in accordance with the established design and elements. In the initial steps, the identification of farming locations in several potential agricultural areas in Indonesia will be carried out. BWI as the mutawalli will also identify investment instruments and involve relevant government entities to formulate the legal structure for waqf, ensuring compliance with Sharia principles. Additionally, in this phase, research institutions in agriculture, such as Regional Research and Development Agencies and Agricultural Research Centers on campuses, will be identified as mauquf alayh, requiring financial assistance to develop agricultural technology.

Launching Stage

In this phase, the model will be tested as one of the waqf innovations launched by the Indonesian Waqf Board (BWI). A management and supervisory board will be formed, consisting of environmental experts, financial experts, and representatives from BWI. During this stage, investment policies in line with Sharia principles and with a focus on sustainability will also be established.

Development Stage

During the development stage, there will be a diversification of the investment portfolio to achieve long-term growth and sustainability. Regular evaluations of investment performance will be conducted, and strategies will be adjusted as necessary. An

effective monitoring system will be implemented to ensure that the funds are used in line with the waqf's objectives. Additionally, periodic reports on the project's impact and fund management will be provided to donors and the community.

Confirmation Stage

During the confirmation stage, a massive campaign will be conducted to raise public awareness about the environment and the importance of waqf. All stakeholders are expected to collaborate in encouraging the community to participate in financial support and engage in environmental projects, such as agriculture.

Expansion of Collaboration

During this stage, partnerships will be established with environmental organizations and Islamic financial institutions to enhance impact and support. Additionally, at this stage, the model can be implemented across all regions of Indonesia and other countries, becoming an environmental waqf model that can bring positive impacts to the progress of agriculture and the environment.

In its development, the Integrated Waqf Environment Model (IWEM) will have a broad impact if all parties can synergize. The ultimate goal is for this model not only to be implemented in the field of agriculture; IWEM is also expected to be adopted in various sectors of sustainable environments. Below is a table with information that the author has considered.

Tabel 2

Impacts and Challenges of the Waqf Model for the Environment

Impacts	Challenges
Waqf funds can be utilized to support research and the implementation of environmentally friendly agricultural technologies.	The challenges in waqf management and the need to maintain transparency can be significant issues, especially in the absence of robust governance.
Waqf can provide sustainable financial resources for environmental projects, such as agriculture.	Investing waqf in environmental projects like agriculture may entail financial risks, and the uncertainty of investment returns could pose challenges.
Waqf can be used to support environmental literacy and awareness programs, helping communities understand the importance of nature conservation.	If waqf relies entirely on donations, there may be uncertainty in funding sources and project sustainability.
Through waqf, communities can develop sustainable economic projects that support the environment and empower local communities.	The lack of specific regulations governing waqf for the environment may pose challenges related to diverse regulations and legal frameworks in different regions, requiring careful understanding and adaptation.
The innovation of an environmentally-based waqf model serves as a platform for enhancing literacy and inclusion in Islamic philanthropy, particularly in the context of waqf. Furthermore, the environmental waqf model can stimulate	

active community participation in sustainable agriculture and environmental initiatives, fostering awareness and shared responsibility.

Source: Authors' analysis.

DISCUSSION

Integration of Waqf into Agricultural Development Strategies in the Era of Smart Agriculture 5.0

The findings of this study underscore the relevance of waqf as a funding mechanism that complements sustainable agriculture objectives. The proposed Integrated Waqf Environment Model (IWEM) highlights how waqf can be operationalized to address funding gaps for smallholder farmers and agricultural research institutions. This model aims to connect Islamic philanthropic instruments with digital and ecological innovations aligned with Smart Agriculture 5.0.

This proposition is supported by previous studies emphasizing waqf's role in socio-economic development. Aini & Kamilah (2025) and Dev et al. (2023) demonstrated that waqf financing can empower marginalized communities by funding agricultural infrastructure and supporting land preservation. Dewanto & Hilyatin (2021) similarly highlighted the potential of waqf-based land use optimization strategies in mitigating land degradation. In the Malaysian context, Salam-based agricultural contracts have proven useful in improving farmers' cash flow and reducing market volatility risks (Ahmed & Fida, 2020; Bello et al., 2018). Moreover, mudarabah and musyarakah financing mechanisms ensure equitable risk-sharing and reduce dependency on interest-based credit, which has historically marginalized smallholder farmers (Anwar et al., 2021; Syarifuddin, 2025).

Conversely, some studies caution against the overly optimistic assumption of waqf scalability, especially in regions lacking regulatory clarity or institutional capacity (Niswatin & Santoso, 2025; Setiawan, 2019). Such limitations highlight the need for robust legal frameworks and trained mutawalli to safeguard and optimize waqf assets. Theoretically, the integration of waqf in agricultural policy advances Islamic finance discourse by expanding its application beyond conventional sectors. Practically, IWEM offers a participatory financing pathway that aligns Islamic ethics with digital agriculture, emphasizing resilience, productivity, and community welfare. This indicates that when supported by legal reform, waqf could play a strategic role in agricultural transformation policies.

Public Sentiment and Community Engagement via Social Media Analysis

This study found that 68.5% of Twitter users expressed positive sentiment regarding sustainable agriculture, with "food security" and "climate change" being the most associated terms. This suggests a strong alignment between public perception and sustainable agriculture initiatives, providing a favorable environment for the acceptance of innovative models like IWEM.

These findings are consistent with prior research demonstrating the utility of social media sentiment analysis in capturing public discourse. Maulida & Devi (2023) employed similar methods and found strong public engagement in conversations related to agricultural sustainability. Rizki (2023) argued that real-time data from platforms like Twitter can inform policymakers about community values and guide targeted outreach. Additionally, aspect-based sentiment analysis has proven effective in isolating public attitudes toward specific agricultural components (Ganganwar & Rajalakshmi, 2019; Mohd Sofi & Selamat, 2022; Tubishat et al., 2018).

However, the effectiveness of sentiment analysis is not without limitations. Some studies (Kumaresan & Thangaraju, 2023; Smetanin, 2020; Wankhade et al., 2022; Yue et al., 2019) pointed out issues related to language ambiguity, data noise, and demographic representation. These concerns suggest the need for triangulation with qualitative methods to validate findings. From a theoretical standpoint, this study expands the methodological toolkit in Islamic economics by integrating sentiment mining with model design. Practically, the positive sentiment detected offers a strategic entry point for waqf institutions to promote IWEM and similar innovations. It also highlights the potential for policymakers to use social media analytics as an informal yet dynamic public consultation tool.

Ensuring Financial Sustainability and Risk Mitigation in Waqf-Based Investments

The IWEM framework is designed to deliver long-term sustainability by leveraging perpetual waqf capital. Nevertheless, the volatile nature of agriculture demands well-established governance and risk mitigation mechanisms. This study outlines several instruments within IWEM to achieve that, including diversification of investment portfolios, qard hassan-based financing, and staged development with performance monitoring.

Similar frameworks have been proposed in prior studies. Sukmana et al. (2024) emphasized the importance of diversifying waqf investments to protect against sector-specific risks. Huda & Santoso (2022) advocated for alignment with SDGs to ensure environmental and financial sustainability. Moreover, Owais & Manaf (2023) highlighted that governance clarity and professionalization of mutawalli significantly improve asset management outcomes.

Nonetheless, waqf-based models continue to face systemic barriers, such as fragmented regulations, limited donor incentives, and lack of public transparency (Abas & Raji, 2018; Mohd Roslan & Nor Muhamad, 2024). To overcome these barriers, studies recommend digitizing waqf management and enhancing partnerships with local institutions (Almomani et al., 2024; Pratama et al., 2023). Theoretically, the risk mitigation components embedded in IWEM contribute to the evolving discourse on sustainable Islamic social finance. Practically, IWEM's multi-actor, multi-phase structure offers a scalable governance framework that can be adapted to different jurisdictions. The emphasis on transparency, legal alignment, and environmental co-benefits further strengthens its relevance in global discussions on ethical investment and climate-resilient agriculture.

The findings of this study support the feasibility and relevance of IWEM as a hybrid model uniting Islamic finance and sustainable agriculture. By aligning community sentiment, ethical funding, and technological integration, IWEM offers a novel response to contemporary agricultural challenges. Future research should focus on pilot implementation, regulatory harmonization, and long-term impact assessment to validate and refine this conceptual contribution.

CONCLUSION

This study proposes the Integrated Waqf Environment Model (IWEM) as a sustainable, Shariah-compliant financing mechanism for supporting agricultural innovation in the era of Smart Agriculture 5.0. Drawing on sentiment analysis of over 100,000 tweets, the research reveals a predominantly positive public perception (68.5%) toward sustainable agriculture, reinforcing the model's relevance and social receptiveness. IWEM bridges Islamic social finance and environmental objectives, providing a structured approach to fund both farmers and research institutions through a waqf-based system.

The integration of waqf with smart agriculture addresses several pressing challenges: limited access to capital, low technological adoption among smallholder farmers, and inadequate policy support. The study shows that when properly governed and supported by enabling regulations, waqf instruments—especially when combined with risk-sharing contracts and digital tools—can offer resilient, non-debt financing for sustainable agricultural systems.

This research contributes to the growing body of literature on Islamic social finance by offering a comprehensive framework that integrates empirical sentiment data, conceptual waqf mechanisms, and strategic development stages. The model serves not only as a theoretical construct but also as a blueprint for policy and institutional innovation. Ultimately, IWEM advances the discourse on ethical and inclusive financing in agriculture and lays a foundation for further exploration and implementation of Shariah-based sustainability models across various sectors.

Limitation of the Study

Despite its contributions, this study has several limitations that must be acknowledged. First, the sentiment analysis was based solely on Twitter data, which, while valuable for real-time insights, may not be fully representative of the broader public, especially populations without internet access or those less active on social media platforms. This introduces a potential demographic and regional bias that may influence the generalizability of the sentiment findings. Second, the conceptual model of IWEM has not been empirically tested in real-world agricultural settings. While the proposed mechanisms are grounded in theory and supported by previous literature, practical implementation could present unforeseen challenges, including regulatory inconsistencies, institutional inefficiencies, and cultural resistance among stakeholders.

Additionally, the study's reliance on secondary data and automated text analysis techniques like VADER—though methodologically sound—limits the depth of qualitative

interpretation regarding the motivations and contextual nuances behind public sentiment. Finally, the financial projections, risk factors, and governance structures within IWEM are discussed at a conceptual level without quantitative validation. The absence of simulations, pilot studies, or stakeholder consultations reduces the ability to assess the model's operational feasibility or long-term impact. These constraints highlight the need for a cautious interpretation of findings and underscore the importance of future empirical work.

Recommendations for Future Research

Future research should move beyond conceptual modeling and focus on empirical validation of IWEM in diverse agricultural contexts. Pilot programs in selected rural areas—possibly under the supervision of national waqf boards or agricultural ministries—could provide valuable data on the model's financial viability, institutional compatibility, and socio-economic impact. Such studies would help refine the IWEM framework and offer context-specific adaptations. Moreover, future research should broaden the scope of sentiment analysis by incorporating additional social media platforms such as Facebook, Instagram, and region-specific forums to capture a more diverse and representative sample. Combining sentiment data with qualitative methods like interviews or focus groups would enrich the interpretation of public attitudes and enhance model responsiveness.

There is also a need for interdisciplinary collaboration, involving agricultural economists, Islamic finance experts, policymakers, and technology developers, to co-design and test waqf-based financial tools suited for smart agriculture. Exploring partnerships with fintech firms could also lead to the development of digital waqf platforms that ensure transparency, traceability, and efficiency. Finally, future research should consider applying IWEM principles to other sustainability-focused sectors, such as renewable energy, water conservation, or climate adaptation, expanding the model's relevance and demonstrating the broader potential of Islamic social finance for inclusive and sustainable development.

Author Contributions

Conceptualization	S.M. & A.S.R.	Resources	S.M. & A.S.R.
Data curation	S.M. & A.S.R.	Software	S.M. & A.S.R.
Formal analysis	S.M. & A.S.R.	Supervision	S.M. & A.S.R.
Funding acquisition	S.M. & A.S.R.	Validation	S.M. & A.S.R.
Investigation	S.M. & A.S.R.	Visualization	S.M. & A.S.R.
Methodology	S.M. & A.S.R.	Writing – original draft	S.M. & A.S.R.
Project administration	S.M. & A.S.R.	Writing – review & editing	S.M. & A.S.R.

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Informed Consent Statement

Informed consent was obtained before respondents filled out the questionnaire.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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Conflicts of Interest

The authors declare no conflicts of interest.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used ChatGPT, DeepL, Grammarly, and PaperPal to translate from Bahasa Indonesia into American English and improve the clarity of the language and readability of the article. After using these tools, the authors reviewed and edited the content as needed and took full responsibility for the content of the published article.

REFERENCES

Abas, F. N., & Raji, F. (2018). Factors contributing to inefficient management and maintenance of waqf properties: A literature review. *UMRAN - International Journal of Islamic and Civilizational Studies*, *5*(3), 53–67. https://doi.org/10.11113/umran2018.5n3.233

Abubaker, J. Y., Alkhawaldeh, A., Alnimer, E. M., Al-Adwan, A., Al-Shaer, B., & Alwreikat, E. I. (2025). The impact of artificial intelligence in enhancing the performance of blockchain technology for the services sector listed on the Amman Stock Exchange and its role in achieving sustainable development goals. *Journal of Lifestyle and SDGs Review*, *5*(3), e04642. https://doi.org/10.47172/2965-730x.sdgsreview.v5.n03.pe04642

Adinugraha, H. H., Shulhoni, M., & Achmad, D. (2023). Islamic social finance in Indonesia: Opportunities, challenges, and its role in empowering society. *Review of Islamic Social Finance and Entrepreneurship*, *2*(1), 45–62. https://doi.org/10.20885/risfe.vol2.iss1.art4

Afroz, R., Muhibbullah, Md., & Morshed, M. N. (2019). Factors Affecting the Intention of the Rice Farmers to Adopt the Integrated Cash Waqf Environmental Protection Model: An Empirical Study in Kedah Malaysia. *The Journal of Asian Finance, Economics and Business*, *6*(4), 189–199. https://doi.org/10.13106/JAFEB.2019.VOL6.NO4.189

Ahmed, U., & Fida, B. A. (2020). Investigating determinants of bay' salam financing product for agricultural sector in the sultanate of oman. *International Journal of Islamic Thought*, *12*(1), 121–130. https://doi.org/10.24035/ijit.18.2020.187

Aini, R. & Kamilah. (2025). Solusi keuangan syariah terhadap pembiayaan sektor pertanian untuk mencapai sustainable development goals [Islamic finance solutions for financing the agricultural sector to achieve sustainable development goals]. *Ecoplan*, *8*(1), 51–60. https://doi.org/10.20527/ecoplan.v8i1.1117

Al Kahfi, & Nurfajriani, W. V. (2025). Innovative collaboration fintech and Islamic financial institutions in optimizing Islamic philanthropy for economic empowerment of the ummah. *ITQAN: Journal of*

Islamic Economics, Management, and Finance, *4*(2), 123–142. https://doi.org/10.57053/itqan.v4i2.107

Aliyu, S. U. R. (2022). Reflections on the socioecomic role of waqf in an Islamic economic system. *IJUS | International Journal of Umranic Studies*, *2*(1), 31–43. https://doi.org/10.59202/ijus.v2i1.560

Almomani, M. A.-A., AbuAlhoul, M. A., Alqudah, M. T. S., & Al-Khalidi, I. K. S. (2024). Exploring digital waqf management: Opportunities and challenges. *International Journal of Religion*, *5*(12), 20–30. https://doi.org/10.61707/ax7vd794

Anwar, A. Z., Susilo, E., Rohman, F., Santoso, P. B., Gunanto, E. Y. A., & Darwanto, D. (2021). Performance analysis of Islamic micro finance institutions on sustainable rural development in Indonesia. *Journal of Finance and Islamic Banking*, *3*(2), 44–57. https://doi.org/10.22515/jfib.v3i2.2965

Ascarya, A., Hosen, M. N., & Rahmawati, S. (2022). Designing simple productive waqf models for Indonesia. *International Journal of Ethics and Systems*, *38*(3), 380–401. https://doi.org/10.1108/ijoes-07-2020-0101

Azganin, H., Kassim, S., & Saad, A. A. (2021). Islamic P2P Crowdfunding (IP2PC) platform for the development of paddy industry in Malaysia: An operational perspective. *Journal of Islamic Finance*, *10*(1), 65–75. https://doi.org/10.31436/jif.v10i1.563

Bello, H. S., Galadima, I. S., & Jibrin, A.-M. A. (2018). Appraisal of the salam Islamic mode of financing agribusiness and agriculture among rural farmers in Bauchi State of Nigeria. *SocioEconomic Challenges*, *2*(1), 56–62. https://doi.org/10.21272/sec.2(1).56-62.2018

Cao, J., & Solangi, Y. A. (2023). Analyzing and prioritizing the barriers and solutions of sustainable agriculture for promoting sustainable development goals in China. *Sustainability*, *15*(10), 8317. https://doi.org/10.3390/su15108317

Dev, P., Khandelwal, S., Yadav, S. C., Arya, V., Mali, H. R., & Poonam. (2023). Climate based smart agriculture: Need for food security and sustainability. *International Journal of Environment and Climate Change*, *13*(3), 224–231. https://doi.org/10.9734/ijecc/2023/v13i31702

Dewanto, R. W., & Hilyatin, D. L. (2021). Desain perlindungan lahan pertanian melalui strategi wakaf istibdal [Agricultural land protection design through istibdal waqf strategy]. *Indonesian Journal of Cultural and Community Development*, *10*, Article 2. https://doi.org/10.21070/ijccd2021757

Du, Y.-W., & Fan, Y.-P. (2023). Spatiotemporal dynamics of agricultural sustainability assessment: A study across 30 Chinese provinces. *Sustainability*, *15*(11), 9066. https://doi.org/10.3390/su15119066

Fauziah, N. N., & Kassim, S. (2022). Cash Waqf Model for Social Enterprise to Achieve Sustainable Development Goals in Indonesia. *Al-Muzara'ah*, *Special Issue 2022*, 95–105. https://doi.org/10.29244/jam.specialissue2022.95-105

Ganganwar, V., & Rajalakshmi, R. (2019). Implicit aspect extraction for sentiment analysis: A survey of recent approaches. *Procedia Computer Science*, *165*, 485–491. https://doi.org/10.1016/j.procs.2020.01.010

Hasan, R., Velayutham, S., & Khan, A. F. (2022). Socially responsible investment (SRI) Sukuk as a financing alternative for post COVID-19 development project. *International Journal of Islamic and Middle Eastern Finance and Management*, *15*(2), 425–440. https://doi.org/10.1108/imefm-07-2020-0379

Hasibuan, A. R., & Achiria, S. (2024). Implementation of CWLS SW001 as a productive waqf from the perspective of Maqashid Shariah. *Unisia*, *42*(2), Article 22. https://doi.org/10.20885/unisia.vol42.iss2.art22

Huang, T., & Huang, Q. (2023). Research on agricultural and rural public governance and sustainable development: Evidence from 2350 data. *Sustainability, 15*(10), 7876. https://doi.org/10.3390/su15107876

Huda, M., & Santoso, L. (2022). Implementation of corporate waqf core principles in the development of waqf in Indonesia. *Academic Journal of Interdisciplinary Studies*, *11*(5), 114–124. https://doi.org/10.36941/ajis-2022-0129

Ibrahim, B., & Kollin, M. (2024). Analysis of the role of Islamic philanthropy in urban poverty alleviation. *Seriat Ekonomisi*, *1*(3), 71–79. https://doi.org/10.35335/sd0ef186

Ismal, R. (2022). Identifying the optimal cash waqf linked Sukuk: Indonesian experience. *Hamdard Islamicus*, *45*(3), 9–27. https://doi.org/10.57144/hi.v45i3.500

Jabeen, N., & Gul, J. (2023). Role of social media in promoting sustainable agriculture practices. *Indus Journal of Agriculture and Biology*, *2*(1), 17–32. https://doi.org/10.59075/ijab.v2i1.212

Kumaresan, C., & Thangaraju, P. (2023). Sentiment analysis in multiple languages: A review of current approaches and challenges. *REST Journal on Data Analytics and Artificial Intelligence*, *2*(1), 8–15. https://doi.org/10.46632/jdaai/2/1/2

Maulida, S., & Devi, A. (2023). Mining netizen's opinion on sustainable agriculture: Sentiment analysis of Twitter data. *Business and Sustainability*, *2*(1), Article 2. https://doi.org/10.58968/bs.v2i1.323

Mohamed, M. I., & Shafiai, M. H. Mohd. (2021). Islamic agricultural economic financing based on zakat, infaq, alms and waqf in empowering the farming community. *IQTISHADUNA: Jurnal Ilmiah Ekonomi Kita*, *10*(1), 144–161. https://doi.org/10.46367/iqtishaduna.v10i1.334

Mohd Roslan, N. R. I., & Nor Muhamad, N. H. (2024). Waqf reporting standardization: Towards a comprehensive governance framework. *International Journal of Academic Research in Business and Social Sciences*, *14*(1), 3072–3080. https://doi.org/10.6007/ijarbss/v14-i1/20610

Mohd Sofi, S., & Selamat, A. (2022). Implicit aspect extraction techniques in sentiment analysis: A survey. *Malaysian Journal of Information and Communication Technology (MyJICT)*, 18–27. https://doi.org/10.53840/myjict7-1-6

Ningrat, R. G., & Nurzaman, M. S. (2019). Developing fintech and Islamic finance products in agricultural value chain. *Journal of Islamic Monetary Economics and Finance*, *5*(3), 491–516. https://doi.org/10.21098/jimf.v5i3.1077

Niswatin, & Santoso, I. R. (2025). Factors affecting non-performing finance in Islamic banking in Indonesia's agricultural sector. *Banks and Bank Systems*, *20*(1), 323–333. https://doi.org/10.21511/bbs.20(1).2025.26

Owais, M., & Abdul Manaf, Z. I. (2023). Comparative analysis of waqf institutions governance in India and Singapore. *El Barka: Journal of Islamic Economics and Business*, *6*(2), 257–282. https://doi.org/10.21154/elbarka.v6i2.5321

Pinasti, U. S., & Achiria, S. (2024). The effect of financial literacy and financial capability on the interest in social investment-based cash waqf linked Sukuk investment. *Journal of Islamic Economics Lariba*, *10*(2), 999–1020. https://doi.org/10.20885/jielariba.vol10.iss2.art20

Pratama, T., Sembada, Y. S., & Syahmirwan. (2023). Productive waqf and poverty alleviation: Government contribution in realizing sustainable development goals. *Moneta: Journal of Economics and Finance, 1*(1), 1–14. https://doi.org/10.61978/moneta.v1i1.15

Purnawan, P., & Irfaniah, N. R. (2025). Optimalisasi pengelolaan Ziswaf untuk mendukung pencapaian SDGs di Indonesia [Optimizing the management of zakat, infaq, sadaqah, and waqf to support

the achievement of SDGs in Indonesia]. *Jurnal Ilmu Manajemen, Ekonomi Dan Kewirausahaan*, *5*(1), 1–10. https://doi.org/10.55606/jimek.v5i1.5743

Riani, R., & Fatoni, A. (2022). Waqf on infrastructure: How far has been researched? *International Journal of Waqf*, *2*(2), Article 2. https://doi.org/10.58968/ijf.v2i2.167

Ristić, L., Despotović, D., & Dimitrijević, M. (2020). Multifunctionality of agriculture as a significant factor for sustainable rural development of the Republic of Serbia. *Economic Themes, 58*(1), 17–32. https://doi.org/10.2478/ethemes-2020-0002

Rizki, J. (2023). Social media sentiment analysis to understand agricultural market trends and consumer preferences. *Jurnal Minfo Polgan*, *12*(2), 1734–1743. https://doi.org/10.33395/jmp.v12i2.12970

Rosman, R., Redzuan, N. H., Mokhtar, N. Z. N., Engku Ali, E. R. A., & Mohammed, M. O. (2022). Islamic social finance and sustainable development goals: Issues and challenges. *Journal of Islamic Finance*, *11*(2), 56–67. https://doi.org/10.31436/jif.v11i2.690

Rusydiana, A. S., Sukmana, R., & Laila, N. (2023a). Developing green waqf model for environmental issues. *Islamic Economics Methodology*, *2*(2), Article 5. https://doi.org/10.58968/iem.v2i2.319

Rusydiana, A. S., Sukmana, R., & Laila, N. (2023b). Waqf and partnerships for the goals (SDG-17): A Maqasid framework. *Maqasid Al-Shariah Review*, *2*(1), Article 3. https://doi.org/10.58968/msr.v2i1.305

Sabillón, B. H., Gerster-Bentaya, M., & Knierim, A. (2022). Measuring farmers' well-being: Influence of farm-level factors on satisfaction with work and quality of life. *Journal of Agricultural Economics*, *73*(2), 452–471. https://doi.org/10.1111/1477-9552.12457

Saputri, M. (2024). Transformasi digital dalam filantropi Islam: Optimalisasi pengelolaan zakat dan wakaf melalui fintech syariah [Digital transformation in Islamic philanthropy: Optimizing zakat and waqf management through Islamic fintech]. *SANTRI : Jurnal Ekonomi Dan Keuangan Islam*, *2*(6), 305–314. https://doi.org/10.61132/santri.v2i6.1143

Sari, D. P., Pratami, E., & Harpepen, A. (2024). Inovasi pembiayaan sosial syariah untuk meningkatkan ketahanan sosial ekonomi Kota Bengkulu [Sharia social financing innovation to improve the socio-economic resilience of Bengkulu City]. *MESTAKA: Jurnal Pengabdian Kepada Masyarakat*, *3*(6), 639–644. https://doi.org/10.58184/mestaka.v3i6.512

Setiawan, I. (2019). The role of Islamic banking in the development of economic sectors in Indonesia. *International Journal of Applied Business Research*, *1*(2), 88–99. https://doi.org/10.35313/ijabr.v1i02.70

Smetanin, S. (2020). The applications of sentiment analysis for Russian language texts: Current challenges and future perspectives. *IEEE Access*, *8*, 110693–110719. https://doi.org/10.1109/ACCESS.2020.3002215

Sukmana, R., Ratnasari, R. T., Majid, R., & Mohd Shafiai, M. H. (2024). Designing waqf-based financing model for livestock project: Empirical evidence from Indonesia. *International Journal of Islamic and Middle Eastern Finance and Management*, *17*(3), 599–617. https://doi.org/10.1108/imefm-06-2023-0211

Syarifuddin, F. (2025). Islamic macroprudential policy to support staple agricultural sector financing. *Economia Agro-Alimentare Food Economy - Open Access*, *26*(3), 15–45. https://doi.org/10.3280/ecag2024oa16369

Thaker, H. M. T., Khaliq, A., Sakaran, K. C., & Thaker, M. A. M. T. (2020). A discourse on the potential of crowdfunding and Islamic finance in the agricultural sector of East Java, Indonesia. *Jurnal Ekonomi & Keuangan Islam*, *6*(1), 10–23. https://doi.org/10.20885/jeki.vol6.iss1.art2

Tubishat, M., Idris, N., & Abushariah, M. A. M. (2018). Implicit aspect extraction in sentiment analysis. *Inf. Process. Manage.*, *54*(4), 545–563. https://doi.org/10.1016/j.ipm.2018.03.008

Wankhade, M., Rao, A. C. S., & Kulkarni, C. (2022). A survey on sentiment analysis methods, applications, and challenges. *Artificial Intelligence Review*, *55*(7), 5731–5780. https://doi.org/10.1007/s10462-022-10144-1

Winarsih, R., Masrifah, A. R., & Umam, K. (2019). The integration of Islamic commercial and social economy through productive waqf to promote pesantren welfare. *Journal of Islamic Monetary Economics and Finance*, *5*(2), 321–340. https://doi.org/10.21098/jimf.v5i2.1065

Yue, L., Chen, W., Li, X., Zuo, W., & Yin, M. (2019). A survey of sentiment analysis in social media. *Knowledge and Information Systems*, *60*(2), 617–663. https://doi.org/10.1007/s10115-018-1236-4

Zauro, N. A., Saad, R. A. J., Ahmi, A., & Mohd Hussin, M. Y. (2020). Integration of Waqf towards enhancing financial inclusion and socio-economic justice in Nigeria. *International Journal of Ethics and Systems*, *36*(4), 491–505. https://doi.org/10.1108/ijoes-04-2020-0054