Pertanika Proceedings 2 (2): 71 - 78 (2026)

PERTANIKA JOURNALS

PERTANIKA PROCEEDINGS

Journal homepage: http://www.pertanika.upm.edu.my/

AI Communicators and Literacy to Unlocking Agriculture 5.0: Climate-Resilient Communication Strategies for Sustainable Development

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ABSTRACT

The transformation toward Agriculture 5.0 marks a new era in agricultural innovation, where Artificial Intelligence (AI) and digital technologies play a crucial role in balancing productivity, sustainability, and climate resilience. AI-driven approaches offer new opportunities for adaptation and communication across agricultural systems. The Agriculture 5.0 transformation requires technological advancement and AI literacy among all agricultural actors. The aims are to conceptualise AI as a synthetic communicator and to enhance AI literacy that supports climate mitigation and adaptation efforts in strengthening stakeholders' capacity with AI-generated climate information. This study employs the SALSA (Search, Appraisal, Synthesis, and Analysis) method to conduct a systematic literature review of studies. AI as a synthetic communicator emphasises the ways AI is an agentic presence, symbolic interlocution, affective simulation, and algorithmic mediation. The findings indicate that AI literacy functions as both an enabler and outcome of Agriculture 5.0. Strengthening AI literacy across technological, pedagogical, and content domains becomes essential for enabling farmers, educators, and rural communities to critically interpret, engage with, and benefit from AI-generated climate information. These findings contribute to achieving Sustainable Development Goals (SDGs) 2 (Zero Hunger), 8 (Decent Work and Economic Growth), and 13 (Climate Action).

Keywords: Climate-resilient, communication strategy, synthetic communicator, TPACK AI literacy framework

ARTICLE INFO

Article history:
Received: 09 July 2026
Published: 21 September 2026

DOI: https://doi.org/10.47836/pp.2.2.012

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e-ISSN: 3083-9475

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INTRODUCTION

A primary concern of sustainable climate change mitigation is using cutting-edge technology as a tool and systems thinking. Global climate change mitigation strategies are alternatively coped with by the integration of blockchain, Internet of Things (IoT), and Artificial Intelligence (AI), especially AI to mitigate atmospheric carbon dioxide concentrations (Pourrahmani et al., 2025) and for sustainable climate resilience in policymaking and corporate decision-making (Khan et al., 2025). Recently, there has been national and global recognition of the problems associated with the emerging development of Artificial Intelligence (AI) in Agriculture 5.0. The fifth agricultural evolution, known as "Agriculture 5.0," aims to strike a balance between sustainability and cutting-edge technologies in agriculture. The concept of Agriculture 5.0 represents the challenges and opportunities facing the agricultural sector today. The concept includes agriculture's focus on emerging technologies, such as the Internet of Things (IoT), AI, machine learning, and the use of agricultural data (Parte et al., 2024).

A search of the literature revealed few studies in which the nexus of climate change, human health, and food systems in the Global South is related to food production as an important factor of climate change (Gomes et al., 2024). In addition, non-linear problems such as the impact of climate change on public health are addressed by Machine Learning (ML) tools. Human decision makers are used in making machine learning, such as for data collection, data preprocessing and feature selection, model design and selection, training and validation, interpretability and explainability, usability, and monitoring or human-in-the-loop (HITL) ML (Mosqueira-Rey et al., 2023; Pizzulli et al., 2021).

Despite growing advancements in digital agriculture and the increasing use of AI-driven tools for climate adaptation, an urgent gap remains in understanding how AI can function not only as a technological instrument but as a synthetic communicator which are shaping meaning, influences perceptions, and facilitates climate change communication among agricultural stakeholders. There is a growing body of literature that recognises the importance of how AI's agentic presence and symbolic interlocution can enhance farmers' climate awareness, decision-making, and resilience building. However, there has been no detailed investigation of AI as agentic communicators and enhance AI literacy. This study proposes a novel contribution to how AI literacy for climate change communication mediates the interaction between human users and AI systems.

RESEARCH QUESTIONS

This paper has two key aims. Firstly, conceptualise and analyse AI as a synthetic communicator. Secondly, enhance AI literacy that supports climate mitigation and adaptation efforts, while strengthening stakeholders' capacity to interpret, trust, and meaningfully engage with AI-generated climate information.

METHODS

Qualitative methods can be more useful for identifying and characterising the potential of AI as a Synthetic Communicator and AI literacy in the TPACK framework; these are explored for a fundamental Climate Change Communication Strategy using narrative review. To structure this analysis, we adopted AI as a Synthetic Communicator (Setianingrum et al., 2025) and AI literacy in the TPACK framework (Ng et al., 2021). A narrative review was employed by searching related articles using the Search, Appraisal, Synthesis, and Analysis (SALSA) methodology (Grant & Booth, 2009). Table 1 delineated a set of standardised procedures for critical assessment (Goldstein et al., 2017; Tod, 2019; Tod et al., 2022) to ensure methodological rigour through transparent and consistent evaluation.

Table 1
Summarise the critical appraisal theories or models of AI communicators and AI literacy

Theories or Models	Description	Perceived Strengths	Perceived Weaknesses
AI as Synthetic Communicator (Setianingrum et al., 2025)	an operational paradigm that views AI as a synthetic communicator with aspects of algorithmic mediation, affective simulation, symbolic interlocution, and agentic presence.	Reveal an integrated framework that captures the multidimensional ways of AI in participates, influences, and restructures communication ecosystems.	The risk of over-attributing agency and communicative intention to AI systems, potentially obscuring human authorship, accountability, and embedded algorithmic biases.
Technological, Pedagogical and Content Knowledge (TPACK) (Ng et al., 2021)	Determine how educators can integrate technology into the pedagogical approaches and subject matter expertise. It conceptualise their ability and knowledge in AI literation	Structured model that helps educators align technological tools with appropriate teaching methods and subject content	The TPACK framework provides limited direction for addressing the rapid evolution of technologies such as AI, which frequently progress at a pace that exceeds the ability of curricula and teacher training systems to adapt.

Source: Secondary data analysis, 2026

RESULTS AND DISCUSSION

The development of Agriculture 5.0 must be harnessed by AI literacy to all agricultural actors. AI literacy is not a luxury but a development necessity to ensure Agri 5.0 benefits are inclusive and economically sustainable. AI, cloud computing, quantum computing, blockchain technologies, digital twin, edge computing, and big data analytics are just a few of the additional technologies that academics have proposed for Agriculture 5.0 (Bissadu et al., 2025).

In this context, AI is no longer limited to data processing or automation. It increasingly functions as a synthetic communicator that interprets climate data, generates tailored messages, and mediates meaning-making processes within agricultural decision-making. However, understanding and leveraging this communicative role requires strengthening AI literacy, particularly within the TPACK framework where technological, pedagogical, and content knowledge intersect to support effective climate change communication. The following sections are elaborated, first, by conceptualising AI as a synthetic communicator for climate communication, and second, by detailing the role of AI literacy within the TPACK framework.

AI as Synthetic Communicator for Climate Change Communication

In previous studies by Setianingrum et al. (2025), the AI conceptualisation as communicators emerged; there are four main roles which mapped align with Robert T. Craig's framework of seven communication traditions. Several studies have identified agentic presence; symbolic interlocution; affective simulation; and algorithmic mediation. Concerns were expressed about climate change AI communicator is summarised in Table 2.

Table 2
Climate change AI communicator

Synthetic Communicator	Core Function	Key Characteristics	Climate Change Mitigation	Communication Implications	References
Agentic Presence	Initiates, maintains, and adapts climate-related interactions autonomously	• Interactive, adaptive dialogue • Transparency cues enhance trust • Context-aware responses	Chatbots (e.g., UNDP Mission 1.5 Bot) guide users to tackle the climate crisis; AI-generated social media influencers advocate climate action	Enhances engagement and trust; reframes AI from tool to communicative partner in sustainability dialogue	Haastrup & Marshall, 2024; Hartmann et al., 2025; United Nations Development Programme, 2020
Symbolic Interlocution	Co-constructs meanings and generates symbolic codes shaping environmental narratives	• Produces symbolic and semiotic representations • Blurs human/non-human authorship • Influences credibility perception	Generative AI visualises future environmental scenarios to raise awareness	Expands meaning-making beyond human communication; raises ethical questions about authenticity and authority	Muncie, 2026

Table 2 (*continued*)

Synthetic Communicator	Core Function	Key Characteristics	Climate Change Mitigation	Communication Implications	References
Affective Simulation	Simulates empathy and emotional presence to evoke pro-environmental attitudes	• Emotion recognition and expression • Personalisation of emotional cues • Relational depth through simulated affect	AI-driven storytelling platforms personalise climate impact stories (e.g., rising sea levels in user's region) to evoke empathy and motivation	Strengthens emotional connection to climate issues; supports behavioral change through affective engagement	Moezzi et al., 2017; Shahbazi et al., 2025; Stockholm Resilience Centre, 2025; United Nations Development Programme, 2020
Algorithmic Mediation	Filters, ranks, and structures climate discourse in digital spaces	• Curates and amplifies content • Reflects algorithmic bias or transparency • Shapes agenda-setting and visibility	AI algorithms prioritise credible climate news and down-rank misinformation; recommender systems highlight sustainable living content	Reconfigures public discourse; necessitates algorithmic literacy and transparency in climate communication strategies	Adamopoulos et al., 2025; Adapa, 2024

Source: Primary Data Analysis (2026)

AI Literacy in TPACK Framework for Climate Change Communication

AI literacy contributes to innovation multiplier effects that stimulate broader rural economic development. By positioning AI literacy as both a driver and a product of digital transformation, the agricultural sector can ensure that the benefits of Agri 5.0 are widely shared, economically sustainable, and inclusive across rural communities. In terms of AI, this literacy becomes relevant to several economic theories, such as how AI can be used to increase profits, reduce production costs, and minimise risk. Two of these theories are Pareto & Neoclassical about Production Efficiency (Lopez-Velasco, 2024; Pareto, 1897) and Ronald Coase's about Transaction Cost Economics (Aivazian & Callen, 2023; Araral, 2013; Coase, 1960; Libecap, 2025). Where AI helps achieve technical efficiency and allocative efficiency, such as precision agriculture or predictive maintenance.

Technological Knowledge: Tools and Artefacts for AI Literacy

AI Literacy integration begins with identifying and utilising technologies that support understanding of AI systems and their relevance to environmental sustainability.

AI-driven learning artefacts such as teachable machines and AI-powered chatbots can be used to demonstrate how AI models detect environmental patterns (e.g. predicting droughts, floods, or pollution trends).

Pedagogical Knowledge

The teaching strategies and learning design must align with effective AI literacy that promotes inquiry, reflection, and ethical reasoning. Inquiry and project-based learning can engage users in solving local environmental issues using AI, for instance, developing chatbot prototypes that educate communities about waste reduction or sustainable farming.

Content Knowledge

Curricular integration and learning objectives were designed to merge technical AI competencies with an understanding of climate systems and sustainability communication. Based on Touretzky et al (2019), there are five main core concepts: perception, representation and reasoning, learning, natural interaction, and societal impact.

CONCLUSION

This study demonstrates advancing climate change communication within Agriculture 5.0. The climate-resilient communication strategies require moving beyond treating AI solely as a technological tool and instead recognising its emerging role as a synthetic communicator that shapes meaning, influences perceptions, and facilitates interactive climate dialogue among agricultural stakeholders. By integrating insights from the AI as Synthetic Communicator and the TPACK AI literacy framework, this narrative review highlights how agentic presence, symbolic interlocution, affective simulation, and algorithmic mediation collectively reconfigure communicative processes in climate adaptation and mitigation. Strengthening AI literacy across technological, pedagogical, and content domains becomes essential for enabling farmers, educators, and rural communities to critically interpret, engage with, and benefit from AI-generated climate information.

ACKNOWLEDGEMENT

The authors gratefully acknowledge Universitas Negeri Surabaya (UNESA) for its institutional support in conducting this research on climate change communication and Agriculture 5.0. The support provided by UNESA has been invaluable in advancing research on AI literacy, climate resilience, and sustainable agricultural communication.

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