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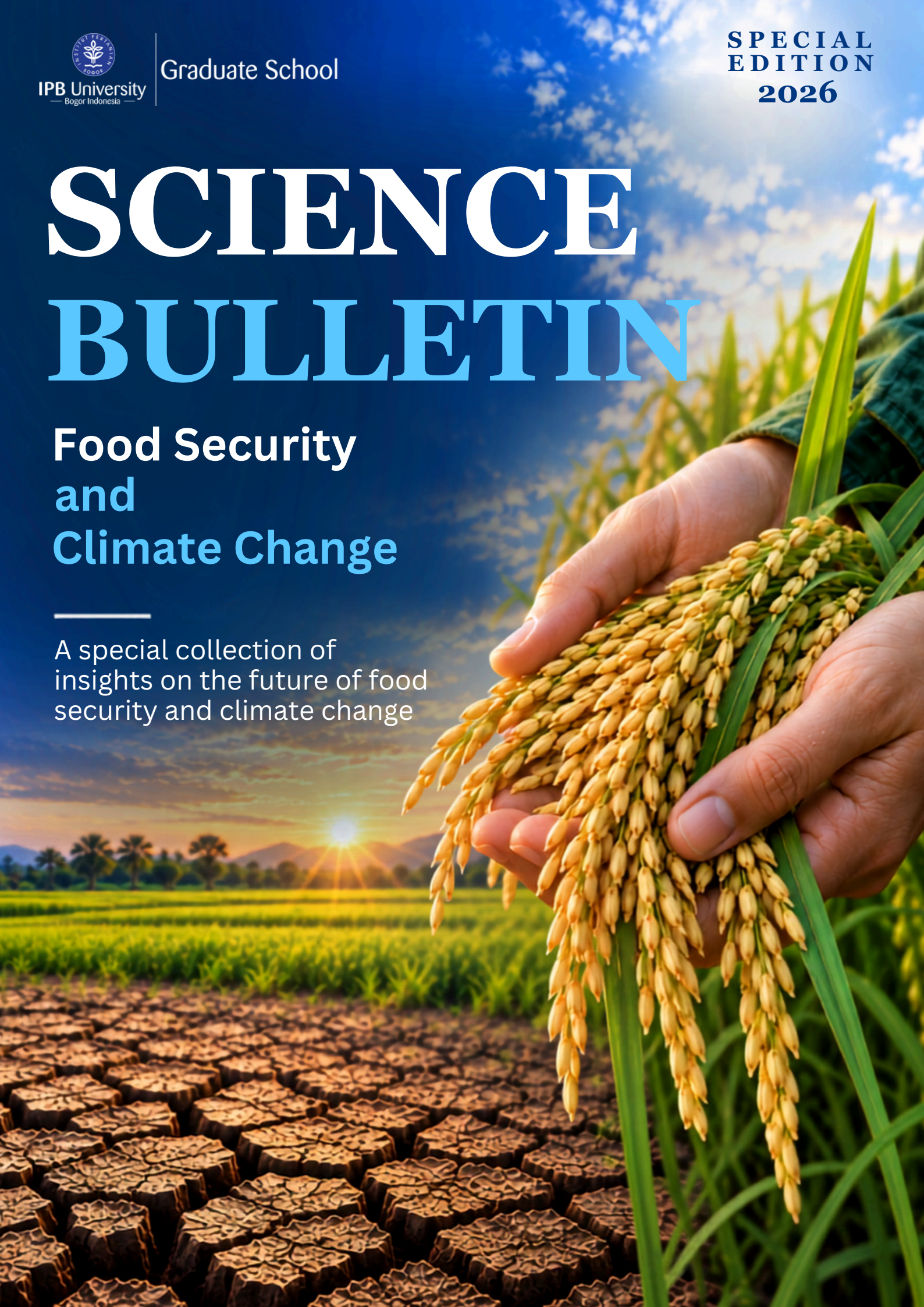

OPINION

Can Agricultural Extension Enhance the Climate Resilience of Smallholder Farmers?

Evidence from West Java, Indonesia

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Climate change is no longer a distant threat for agriculture, it is a present reality, particularly for smallholder farmers who depend heavily on natural conditions. In West Java, regions such as Karawang and Subang, which are key rice-producing areas, have increasingly faced climate-related risks like flooding and drought. These challenges threaten not only food production but also the livelihoods and well-being of rural communities.

Our recent study explores how agricultural extension and different forms of livelihood capital contribute to the climate resilience of smallholder rice farmers in West Java. We found that resilience is shaped by multiple factors, including government policy, human capital, physical capital, social capital, and pluralistic extension services.

> *Strengthening rice farmers' resilience is not only about providing information, but also about connecting people, resources, and policies in a holistic way.*

The results show that human capital ($p < 0.001$) and social capital ($p = 0.007$) significantly contribute to farmers' resilience. Physical capital does not directly affect resilience capacity ($p = 0.352$), but it plays an important role in supporting the sustainability of farming businesses ($p = 0.06$). Interestingly, government agricultural extension services alone did not have a significant influence ($p = 0.700$), suggesting that a more inclusive and pluralistic approach is needed.

"Sustainable agri-food systems for a more resilient future."

Key Lessons

These findings highlight an important lesson: farmers need more than technical information. They need access to education, strong social networks, adequate infrastructure, and supportive government policies. Agricultural extension should therefore be delivered through a combination of public, private, and community-based services that work together to strengthen farmers' adaptive capacity and long-term transformation.

Looking Ahead

Building climate resilience among smallholder farmers requires collective action. Government institutions, researchers, extension providers, and local communities must collaborate to create a supportive environment where farmers can adapt to changing conditions and thrive sustainably.

Strengthening rice farmers' resilience is essential not only for securing food production in West Java, but also for ensuring the sustainability of our agri-food systems in the face of climate change.

Reference

Azhari, R., Amanah, S., Fatchiya, A., & Kinseng, R. (2025). Can Agricultural Extension Enhance the Climate Resilience of Smallholder Farmers? Evidence from West Java, Indonesia. B10 Web of Conferences, 171, 04001.

OPINION

A Review of Climate-Smart Agriculture Research using a Systematic Literature Review and Text Mining Approach

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"Data, knowledge, and collaboration for climate-resilient agriculture."

Climate change has become one of the most pressing global challenges, and agriculture is both highly vulnerable to its impacts and a significant contributor to greenhouse gas emissions. In response, Climate-Smart Agriculture (CSA) has emerged as a strategic approach to increase productivity, strengthen food security, enhance climate resilience, and mitigate emissions.

My research reviews the global development of CSA research by combining a systematic literature review, bibliometric analysis, and topic modeling using Latent Dirichlet Allocation (LDA). By analyzing 3,179 scientific articles from 2013-2024, the study maps research trends, influential authors and countries, collaboration networks, and key themes, while also identifying emerging opportunities and knowledge gaps.

> *Climate-smart agriculture is not only about technology, but also about people, sustainable resources, and supportive policies working together for a more resilient and food-secure future.*

The findings show that research on CSA is multidimensional, shaped by technological, environmental, socio-economic, and policy factors. Human and social capital play important roles, while physical capital such as infrastructure supports the sustainability of farming businesses. Interestingly, the integration of digital technologies such as Artificial Intelligence (AI) and the Internet of Things (IoT) remains limited, suggesting a need for more inclusive and interdisciplinary research in the future.

Key Lessons

CSA research is growing rapidly and covers multiple disciplines, from technology and environment to socio-economic and policy.

Strengthening smallholder farmers' resilience requires more than technical information, but also education, access to resources, and supportive policies.

Digital technologies such as AI and IoT offer great potential, but remain underexplored and present important opportunities for future research.

Looking Ahead

Building climate-resilient and sustainable agri-food systems requires collaborative efforts among researchers, practitioners, government institutions, and local communities. By closing research gaps and integrating digital innovation, CSA can better support smallholder farmers in facing future climate challenges.

Reference

Fadilah, H., Sitanggang, I. S., & Wijaya, S. H. (2025). A Review of Climate-Smart Agriculture Research using a Systematic Literature Review and Text Mining Approach. Bulletin of Electrical Engineering and Informatics.

OPINION

Assessing Household Climate Resilience in DKI Jakarta

A Local Perspective for a More Adaptive and Equitable City

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"Data-driven insights for a more resilient and inclusive urban future."

Climate change is no longer a distant threat for urban areas. In DKI Jakarta, households increasingly face the risks of flooding, tidal inundation, drought, and extreme heat. These challenges not only affect physical infrastructure but also the well-being and livelihoods of urban communities.

Our recent study develops a Household Climate Resilience Index (HCRI) using a robust geographically weighted principal component analysis (Robust GWPCA-MCD). Based on a 2022 survey of 211 households across 17 urban villages in five municipalities of DKI Jakarta, we found that household resilience varies significantly across locations and is shaped by multiple factors, including exposure to climate hazards, sensitivity conditions, and adaptive capacity.

> *Building a climate-resilient city starts from resilient households, because stronger communities create a stronger and more sustainable future.*

The results show that more than half of the households fall into the high and very high resilience categories, yet nearly one-fifth remain in the extremely low category. Key factors such as proximity to flood sources, housing conditions, land size, medication expenditure, and post-drought health impacts emerge as important local drivers of resilience.

Key Lessons

Our findings highlight that household climate resilience is spatially homogeneous. Households need more than technical information; they require access to education, adequate infrastructure, health services, and supportive policies. Urban climate adaptation should be designed through a combination of public, private, and community-based efforts to strengthen local resilience.

Looking Ahead

Enhancing household resilience requires collective action. Government institutions, researchers, and local communities must work together to create an enabling environment where households can better prepare for and recover from climate-related risks.

Investing in household climate resilience today will contribute to a safer, healthier, and more equitable Jakarta tomorrow.

Reference

Sundari, M., Sadik, K., Wigena, A. H., Fitrianto, A., Boer, R., & Zulkarnain. (2026). Assessing Household Climate Resilience Index to Climate Change Impacts in DKI Jakarta: Robust Geographically Weighted PCA Approach. Forum Geografi.

OPINION

Spatiotemporal Patterns of Meteorological Drought in the National Food Barn Region

A Case Study of South Sulawesi Province

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Drought has become one of the most significant challenges to agricultural productivity and food security, particularly in regions that serve as Indonesia's food barns. South Sulawesi, a major producer of rice, maize, and other food crops, is highly vulnerable to drought due to its climatic variability and dependence on rain-fed agriculture. Understanding how drought occurs, varies across space, and evolves over time is essential for strengthening climate resilience in this strategic region.

Our recent study analyzed the spatiotemporal patterns of meteorological drought in South Sulawesi (1981–2020) based on the Standardized Precipitation Index (SPI), applying a combination of rotated Principal Component Analysis (PCA), run theory, and trend analysis to uncover spatial patterns, event characteristics, and long-term trends. The result reveal three distinct drought regions with different characteristics, providing important insights for region-spesific drought risk management and food security strategies.

> *Understanding drought is not only about analyzing climate data, but also about supporting resilient food systems and sustainable livelihoods for future generations.*

> *"Climate knowledge for a more resilient and food-secure Indonesia."*

These findings emphasize that drought management should consider regional differences and be integrated with adaptive agricultural planning, early warning systems, and supportive policies to ensure food security in the face of a changing climate.

Key Lessons

Our study highlights several important lessons. First, drought characteristics vary significantly across regions—northern South Sulawesi experiences more frequent and intense droughts, while the western region faces longer durations and larger magnitudes. Second, a significant drying trend was detected in the southern part of the central-eastern region, indicating increasing vulnerability. These findings suggest that drought risk management must be tailored to regional conditions and should involve integrated efforts across government, research institutions, and local communities.

Looking Ahead

Strengthening drought resilience requires collective action. Future research should integrate meteorological drought with agricultural and hydrological drought assessments, and explore the direct impacts on crop productivity and farmers' livelihoods. By combining science, policy, and community engagement, we can build a more resilient agricultural sector and ensure sustainable food security for Indonesia.

Reference

Andini, N., Santikayasa, I. P., & Setiawan, A. M. (2025). Spatiotemporal Patterns of Meteorological Drought in the National Food Barn Region: A Case Study of South Sulawesi Province. Agromet, 39(2), 120–130.

OPINION

Factors Determining the Performance of the Indonesian Agricultural Sector in the Era of Climate Change

Insights for a More Resilient and Sustainable Agriculture

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"Evidence-based policy for a resilient and productive agricultural future."

The agricultural sector plays a crucial role in Indonesia as a provider of food, a source of employment, and a key driver of economic growth. However, in recent decades, the sector has faced increasing challenges due to climate change, land conversion, and evolving economic dynamics. Understanding the factors that influence agricultural performance is essential to ensure a resilient and sustainable agri-food system for the future.

Our study analyzes the determinants of Indonesia's agricultural sector performance during 1981–2021, focusing on agricultural production and its economic value. Using the Autoregressive Distributed Lag (ARDL) model, we examine the short- and long-term relationships between key factors, including agricultural land area, fertilizer usage, economic growth, and greenhouse gas emissions as a proxy for climate change.

> *Sustainable agriculture in Indonesia requires an integrated approach strengthening land resources, ensuring fertilizer availability, and fostering inclusive economic growth.*

The findings indicate that agricultural land area and economic growth significantly affect the agricultural sector in the long run. In the short term, agricultural land area, economic growth, and fertilizer usage are key factors. Interestingly, climate change, measured by greenhouse gas emissions, did not show a significant negative impact on agricultural decline at the aggregate level. These results highlight the importance of strategic government policies to support a productive, resilient, and sustainable agricultural sector.

Key Lessons

This study highlights several important lessons. Agricultural land area and economic growth are major determinants of agricultural performance in the long run. In the short run, fertilizer usage also plays a significant role. Although climate change did not have a statistically significant negative impact in this study, its potential risks remain and require continuous attention. Government policies should focus on maintaining agricultural land, ensuring adequate fertilizer supply, and promoting economic sectors that support agricultural sustainability.

Looking Ahead

To secure Indonesia's food system in the face of climate change, strategic and inclusive policies are essential. Collaboration among government, researchers, and stakeholders is needed to enhance innovation, protect agricultural resources, and strengthen the resilience of the agricultural sector for future generations.

Reference

Syachbudy, Q. Q., Syaukat, Y., Achsani, N. A., & Hidayat, N. K. (2025). Factors Determining the Performance of the Indonesian Agricultural Sector in the Era of Climate Change. Jurnal Ilmu Pertanian Indonesia (JIPI), 30(3), 490–499.