RESILIENCE AND INCLUSION IN AGRICULTURAL EXTENSION FOR FOOD SECURITY IN THE DIGITAL ERA

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ABSTRACT

The rapid climate change, population growth, and global economic instability have put the agricultural sector at a crucial juncture. These challenges necessitate agricultural extension to focus not only on technical knowledge transfer but also on strengthening human resource capacity to cope with stress and adapt to changes. Resilience and inclusion are key components in addressing these challenges. Resilience enables farmers and agricultural leaders to withstand pressures, while inclusion ensures that all community members, including vulnerable groups, can participate and benefit from innovations. The digital era offers technologies that can significantly enhance agricultural productivity and efficiency. However, adopting these technologies requires high resilience and adaptability among farmers and agricultural leaders. This article aims to analyze the role of resilience and inclusion in agricultural extension and how it can enhance food security in the digital age.

Keywords: *Resilience, Inclusion, Agricultural Extension, Food Security, Digital Era*

A. INTRODUCTION

Rapid climate change, population growth, and global economic instability have brought the agricultural sector to a crucial juncture. These challenges require agricultural extension services to focus not only on transferring technical knowledge but also on strengthening human resource capacity to cope with stress and adapt to change. Resilience and inclusion are key components in addressing these challenges. Resilience enables farmers and agricultural leaders to persevere amidst pressure, while inclusion ensures that all members of the agricultural community, including vulnerable groups, can participate and benefit from innovation.

The digital age brings technologies that can significantly improve agricultural productivity and efficiency. Technologies such as the Internet of Things (IoT), artificial intelligence, and big data analytics offer new solutions to long-standing challenges in agriculture. For example, IoT can be used to monitor soil and weather conditions in real time, providing the data necessary for informed decision-making. However, the adoption of these technologies requires a high level of resilience and adaptability from farmers and agricultural leaders.

Furthermore, inclusion in the agricultural sector cannot be overlooked. Inclusion ensures that all groups within the agricultural community, including women, people with disabilities, and minority groups, have equal access to

resources and technology. This not only improves social justice but can also spur innovation and productivity by leveraging diverse perspectives and experiences.

This issue is compelling because it combines various interrelated aspects: digital technology, food security, climate change, and social inclusion. Digital technology has great potential to revolutionize the agricultural sector and improve food security. However, this technology will only be effective if supported by resilient and inclusive human resources. Furthermore, this issue emphasizes the importance of a holistic approach to agricultural extension, which includes training on resilience and inclusion, in addition to technical skills.

One of the main gaps in the adoption of digital technology in the agricultural sector is unequal access. Many farmers in remote areas still lack adequate access to this technology, creating a gap between those who can leverage digital technology to increase productivity and those who are left behind. Furthermore, there is a conflict between the need to increase agricultural productivity and the importance of maintaining sustainable agricultural practices. The drive to increase agricultural yields often leads to overexploitation of natural resources, which can ultimately damage the environment and reduce long-term resilience. In this regard, inclusion plays a crucial role by ensuring that all stakeholders in agriculture, including smallholder farmers, women, and minority groups, are involved in decision-making and have equal access to resources and technology.

An approach that integrates resilience and inclusion in agricultural extension is highly relevant in addressing current challenges in the agricultural sector. This approach not only helps farmers and agricultural leaders cope with stress and pressure but also ensures that all members of the agricultural community can contribute to and benefit from existing innovations. Therefore, effective agricultural extension must include training on resilience and inclusion, in addition to technical skills.

This article aims to analyze the issues and root causes of problems in the agricultural sector in the digital age, and to identify the leadership roles needed to address these challenges. The specific objectives of this article are:

1. To identify the key challenges facing the agricultural sector in the digital age, including climate change, economic uncertainty, and access to technology.
2. To analyze how resilience and inclusion can help address these challenges and improve food security.
3. To provide practical guidance on developing resilience and inclusion skills among farmers and agricultural leaders through training and extension.
4. To highlight the role of leadership in creating a more equitable, resilient, and sustainable agricultural system that can provide long-term benefits for the entire community.

B. CONCEPT

Resilience

Resilience is the ability of an individual or community to adapt and remain productive amidst stress and change. In agriculture, resilience is crucial because farmers frequently face challenges such as climate change, fluctuating market

prices, and natural disasters. The concept of resilience in agricultural extension involves developing skills and strategies that help farmers manage stress and capitalize on opportunities amidst uncertainty (Rutter, 1993).

Inclusion

Inclusion in the agricultural sector ensures that all community members, including vulnerable groups such as women, people with disabilities, and minority groups, have equal access to resources and technology. Inclusion not only improves social justice but can also spur innovation and productivity by leveraging diverse perspectives and experiences (Bass & Avolio, 1994).

Digital Technology in Agriculture

Digital technologies such as the Internet of Things (IoT), artificial intelligence (AI), and big data analytics offer new solutions to long-standing challenges in agriculture. IoT can be used to monitor soil and weather conditions in real time, providing the data necessary for informed decision-making. However, the adoption of this technology requires a high level of resilience and adaptability from farmers and agricultural leaders (Cohen & Levinthal, 1990; Mohamed et al., 2021).

Gender Equality and Social Inclusion (GEDSI)

Gender equality and social inclusion are essential components in advancing inclusion in the agricultural sector. Inclusive leaders can create an environment where all members of the farming community feel valued and have equal opportunities to participate. This includes addressing biases and stereotypes that may hinder the participation of certain groups (Moata & Bunga, 2023).

Transformational Leadership

Transformational leadership focuses on developing an inspiring vision and motivating positive change. In agriculture, transformational leaders can motivate farmers to adopt more sustainable and innovative agricultural practices and ensure that all members of the farming community are actively involved in decision-making processes (Bass & Avolio, 1994).

Gender-Based Awareness Model

The gender-based awareness model aims to raise awareness of the important role of women in the agricultural sector and reduce gender inequality. This approach involves education, economic empowerment, and increased access to resources and information. This model has proven effective in raising awareness about children's rights and the negative impacts of child labor, as well as increasing women's participation in agricultural activities (Ningsih, 2011).

Agricultural Digitalization: Opportunities and Challenges

Agricultural digitalization offers significant opportunities to increase the efficiency and productivity of the agricultural sector. However, the implementation of this technology faces various challenges, including a lack of adequate digital infrastructure and digital literacy among farmers. Therefore, intensive training and education programs are needed to help farmers adopt digital technology and utilize it optimally (Gaol, 2023).

Capacity Building and Reskilling

Capacity building and reskilling are crucial to ensure that farmers can benefit from digital technology and modern agricultural practices. Intensive and

continuous training programs are needed to help farmers adopt new technologies and increase their productivity. This includes training in land management, pest/disease control, and fertilization, as well as post-harvest activities, marketing, and distribution (Moata & Bunga, 2023).

Sociocultural Influences in Agricultural Development

Sociocultural influences are highly influential in determining farmers' behavioral patterns and attitudes toward adopting new technologies. Traditional beliefs and strong social norms often act as barriers to necessary changes in modern agricultural methods. Therefore, a more participatory and inclusive approach is needed to ensure that farmers feel ownership and commitment to the proposed changes (Leonard et al., 2017).

Developing Resilience and Inclusion in Agricultural Extension

The concept of self-resilience is a key focus in efforts to address the stress and pressure faced by farmers and agricultural leaders. In a constantly changing world, the ability to adapt and recover from adversity is crucial. Agricultural extension that integrates the concept of resilience can help farmers remain calm and focused in the face of climate change, market price fluctuations, and other unexpected challenges (Rutter, 1993).

The role of digital technology in improving the efficiency and effectiveness of agricultural extension cannot be overstated. The use of agricultural applications, geographic information systems (GIS), and e-learning platforms can provide timely and relevant support to farmers. However, to adopt these technologies, farmers need adequate digital skills, and agricultural extension services must play a role in providing the necessary training (Cohen & Levinthal, 1990).

Furthermore, the concept of gender equality and social inclusion (GEDSI) emphasizes the importance of inclusive leadership in advancing inclusion in the agricultural sector. Inclusive leaders can create an environment where all members of the agricultural community feel valued and have equal opportunities to participate. This includes addressing biases and stereotypes that may hinder the participation of certain groups. For example, women often have more limited access to agricultural resources and training than men. By promoting inclusive leadership, we can ensure that women also have equal opportunities to contribute to and benefit from agricultural innovations (Bass & Avolio, 1994).

Implementing Resilience and Inclusion Modules in Agricultural Extension

Implementing resilience and inclusion modules in agricultural extension can be done in various ways. First, resilience training can help farmers develop skills to manage stress and pressure. Techniques such as mindfulness, time management, and prioritization can be used to help farmers face unexpected challenges and remain productive. For example, research shows that mindfulness can reduce stress and improve overall well-being (Kabat-Zinn, 1990).

Second, digital skills training can help farmers adopt technologies that can increase productivity and efficiency. The use of soil sensors and automated irrigation systems can help farmers manage water resources more efficiently. E-learning platforms can provide access to the latest information on sustainable agricultural practices and technological innovations. For example, the use of big

data for soil analysis can help farmers determine the right timing for planting and fertilizing, which can increase crop yields (McKinsey & Company, 2020).

Third, inclusive leadership in agricultural extension can ensure that all members of the agricultural community feel valued and engaged. This includes addressing bias and discrimination, as well as creating an environment that supports the active participation of all groups. For example, mentoring and coaching programs can help women and minority groups develop leadership skills and feel more confident in contributing (Goleman, 1995).

Integrating resilience and inclusion in agricultural extension demonstrates that this approach is a crucial step in ensuring future food security. By developing resilience skills, farmers can be better prepared to face challenges and remain productive. By adopting digital technologies, they can increase productivity and manage resources more efficiently. And by promoting inclusive leadership, we can ensure that all members of the farming community have equal opportunities to participate and benefit from existing innovations.

This approach has implications for creating a more resilient and sustainable agricultural sector. By developing resilience skills, farmers can better cope with climate change and market fluctuations. By adopting digital technologies, they can increase productivity and manage resources more efficiently. And by promoting inclusion, we can ensure that all members of the farming community have equitable access to resources and opportunities.

In the long term, this approach can help create a more equitable and sustainable agricultural system, benefiting the entire community. Therefore, investing in developing resilience and inclusion skills in agricultural extension is a strategic step that can bring long-term benefits to the agricultural sector and society as a whole.

Thus, this article is expected to provide comprehensive and practical insights into how the agricultural sector can adapt and thrive in the digital age through the integration of resilience and inclusion in agricultural extension.

C. METHOD

This research used the Systematic Literature Review (SLR) technique. An extensive search of peer-reviewed articles, conference papers, and other relevant studies was conducted through databases such as Scopus, Web of Science, and Google Scholar.

D. RESULTS AND DISCUSSION

Problem Analysis and Root Causes

Based on recent research, digitalization in the agricultural sector offers significant opportunities to improve food security in the digital era. Technological advances such as the Internet of Things (IoT), big data, and artificial intelligence (AI) have brought about significant transformations, enabling more efficient resource management and increased production yields (Gaol, 2023). However, achieving sustainable food security requires an inclusive and adaptive approach to agricultural extension.

Research shows that one of the main challenges to agricultural digitalization is the lack of adequate digital infrastructure in rural areas. Miftahul Azis and Esty Asriyana Suryana (2023) revealed that poor infrastructure limits farmers' access to digital technology, hampering the implementation of precision agriculture and smart farming solutions. Reliable and affordable internet access is key to advancing the agricultural digital economy (Ilyas, 2022), yet many farmers still struggle to obtain it.

In addition to infrastructure, farmers' digital literacy is also a significant obstacle. Fatmasari et al. (2015) showed that farmers' decision-making independence is significantly influenced by their behavior and ability to seek information related to farming. Many farmers are unfamiliar with new technologies and face a steep learning curve when adopting digital technologies. The lack of training programs from the government and the private sector exacerbates this situation.

Partnerships between the public and private sectors are also crucial in facilitating the development and implementation of innovative solutions tailored to the needs of the agricultural sector (Sjaf et al., 2021). However, this collaboration is often hampered by differing visions and goals between the parties involved. Blok and Gremmen (2018) noted that corporatization and industrialization in the agricultural sector can give rise to ethical and social conflicts.

Cultural challenges also pose a barrier to the implementation of digital technology in the agricultural sector. Paradigm shifts in agricultural work practices and management require time and adaptation, which is challenging for many farmers. Leonard et al. (2017) stated that technology-based decision-making requires changes in mindsets and work cultures that have long been embedded in farming communities.

To address these issues, a comprehensive and inclusive approach to agricultural extension is needed. This approach should include intensive digital training and education, adequate infrastructure development, and strong partnerships between the government, the private sector, and the agricultural community. Policy recommendations include increased investment in digital infrastructure, the development of specialized higher education programs in agriculture and technology, and incentives for the adoption of digital technologies in the agricultural sector (Katzir, 2020; Rose and Chilvers, 2018).

Research also shows the crucial role of gender inclusivity in agricultural development. Women play a key role in agricultural activities, but are often hampered by unequal access to resources and training. Moata and Bunga (2023) emphasize that the power of gender equality and inclusive partnerships can be key to addressing various challenges in the agricultural sector in East Nusa Tenggara. They found that men still play a significant role in agricultural activities, but both men and women remain weak in post-harvest activities, marketing, and distribution.

Women's empowerment in agriculture not only increases productivity but also ensures sustainable natural resource management. Research by Rietveld et al. (2020) suggests that differences in gender participation in agricultural activities

may be due to the type of activity and the masculine nature of agricultural work, which is more suitable for men. However, empowering women through training and equal access to resources can increase their participation throughout the agricultural value chain.

This study also found that a gender-based awareness model for farming families was effective in minimizing child labor in Malang Regency (Ningsih, 2011). This model uses mass, group, and individual approaches to raise awareness about the negative impacts of child labor and children's rights. Awareness campaigns through radio and television broadcasts, brochures, and community activities have proven effective in reaching multiple targets and raising public awareness.

Furthermore, capacity building through upskilling and reskilling is essential for young people in post-harvest activities, marketing, and distribution, which have historically been suboptimal. Training, mentoring, and micro-learning programs can help improve the skills of young people and women in land preparation, pest/disease control, and fertilization technologies (Moata and Bunga, 2023).

Sociocultural Influences in Agricultural Development

In the Indonesian context, sociocultural influences are highly influential in determining farmers' behavior patterns and attitudes toward adopting new technologies. Traditional beliefs and strong social norms often act as barriers to necessary changes in modern agricultural methods. Sjaf et al. (2021) emphasize the importance of understanding local social and cultural dynamics to design effective interventions in agricultural extension.

Research shows that many farmers rely more on inherited knowledge than on modern technology due to factors of trust and distrust in new technologies. Research also finds that farmers often feel marginalized and excluded from decision-making processes related to agricultural policy (Leonard et al., 2017). Therefore, a more participatory and inclusive approach is needed to ensure that farmers feel ownership and commitment to proposed changes.

An effective extension program must consider the needs and aspirations of farming communities and actively involve them throughout the process, from planning to implementation. The use of participatory approaches such as Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) can help identify key issues and develop solutions tailored to the local context (Sjaf et al., 2021).

Gender-Based Awareness-Raising Model

The gender-based awareness-raising model aims to increase awareness and understanding of the important role of women in the agricultural sector and reduce existing gender inequalities. This model involves a holistic approach that encompasses education, economic empowerment, and increased access to resources and information.

Ningsih (2011) developed a gender-based awareness-raising model for farming families to minimize child labor in Malang Regency. This model includes three main approaches: mass, group, and individual. The mass approach involves the use of mass media such as radio, television, and brochures to reach a wide audience. The group approach involves community activities such as group

discussions, training, and seminars. The individual approach involves home visits and personal counseling to provide direct support to farming families.

This model has proven effective in raising awareness about children's rights and the negative impacts of child labor. Furthermore, this model also helps increase women's participation in agricultural activities by providing training and better access to resources. This increased awareness not only reduces child labor but also improves the overall welfare of farming families.

Digitalization of Agriculture: Opportunities and Challenges

Digitalization of agriculture offers significant opportunities to improve the efficiency and productivity of the agricultural sector. Technologies such as IoT, big data, and AI can help farmers manage their land more efficiently, optimize water and fertilizer use, and increase yields. However, the implementation of these technologies also faces various challenges, particularly related to infrastructure and digital literacy.

Gaol (2023) emphasized that implementing IoT-based agricultural systems can improve resource efficiency and reduce environmental impacts. However, a major challenge in implementing this technology is the lack of adequate digital infrastructure, especially in rural areas. Many rural areas in Indonesia still have limited internet access, which hinders the adoption of digital technology.

Furthermore, farmers' digital literacy is also a major obstacle. Many farmers are unfamiliar with new technologies and face difficulties in using them. Therefore, intensive training and education programs are needed to help farmers adopt digital technology and utilize it optimally.

Gender Inclusivity in Agriculture

The role of gender inclusivity in agriculture is crucial to achieving sustainable food security. Women play a key role in agricultural activities, but are often hampered by unequal access to resources and training. Moata and Bunga (2023) found that although men still play a significant role in agricultural activities, both men and women remain underrepresented in post-harvest activities, marketing, and distribution.

Women's empowerment in agriculture not only increases productivity but also ensures sustainable natural resource management. Research by Rietveld et al. (2020) suggests that differences in gender participation in agricultural activities may be due to the type of activity and the masculine nature of agricultural work, which is more suitable for men. However, empowering women through training and equal access to resources can increase their participation throughout the agricultural value chain.

Women's empowerment programs in agriculture should include training in land management technology, pest/disease control, and fertilization. Furthermore, these programs should also include training in post-harvest activities, marketing, and distribution to ensure women's participation throughout the agricultural value chain.

Capacity Building and Reskilling

Capacity building and reskilling are crucial to ensure that farmers can utilize digital technology and modern agricultural practices. Intensive and sustainable

training programs are needed to help farmers adopt new technologies and increase their productivity.

Moata and Bunga (2023) emphasize the importance of upskilling and reskilling programs for youth in the agricultural sector. Upskilling programs can include training in land preparation technology, pest/disease control, and fertilization. Meanwhile, reskilling programs can include training in post-harvest activities, marketing, and distribution.

These training programs must be supported by the government and the private sector to ensure that farmers have adequate access to resources and information. Furthermore, these training programs must include a participatory approach that actively involves farmers throughout the entire process, from planning to implementation.

The Role of Agricultural Extension Workers in Developing Women Farmers' Groups

The role of agricultural extension workers is crucial in developing women farmers' groups (KWT). Agricultural extension workers serve as facilitators, educators, and liaisons between farmers and agricultural technology and information (Suwarningmas et al., 2017). Effective agricultural extension can improve farmers' knowledge and skills, and help them adopt more efficient and sustainable agricultural practices.

Suwarningmas et al. (2017) found that the role of agricultural extension workers in developing women farmers' groups encompasses various aspects, including education, information dissemination, facilitation, consultation, supervision, monitoring, and evaluation. Agricultural extension workers are expected to be agents of change, capable of altering farmers' behavior and improving their welfare.

In the case of the Kace bean processing sector in the Karang Sari and Merta Sari KWTs, agricultural extension workers successfully helped the groups improve the quality of their processed products and expand their marketing reach. Agricultural extension workers acted as educators by providing training on the Kace bean processing and packaging process. They also act as information disseminators by disseminating innovations and the latest information on efficient agricultural techniques.

As facilitators, agricultural extension workers assist the Karang Sari and Merta Sari KWTs in marketing their products and facilitate access to resources such as capital and communication tools. As consultants, they provide advice and input on how to improve the quality and selling value of processed products. Furthermore, their role as supervisors, monitors, and evaluators helps ensure that production processes run smoothly and meet established standards.

Collaboration with Community Service Programs

Collaboration with community service programs (abdimas) is also a crucial factor in increasing the capacity and skills of women's farming groups. The KWT Kenanga Abdimas program in Gunung Salak Village, West Selemadeg District, Tabanan Regency is a successful example of this collaboration (Sukanteri et al., 2020). This program aims to utilize under-utilized yard space for family food production, improve the quality of human resources, particularly female farmers,

in processing agricultural produce into home-based products, and expand the marketing capabilities of the Kenanga KWT industrial products.

The methods used in this Abdimas program include surveys and outreach, intensive training and mentoring of home-based industry groups to produce marketable, high-quality products. Results from this program demonstrate increased group mobility, member engagement in developing group activities, more organized administrative management, and group members' ability to process post-harvest products.

The Community Service Program also helps the Kenanga Farmers Group (KWT) increase interest in agricultural processing and expand their product marketing. The training provided covers post-harvest processing techniques and the production of processed products such as steamed cakes, cakes, and fried foods from purple sweet potatoes, cassava, and taro. Furthermore, the program improves members' skills in managing group administration and improving group management.

The Role of Leadership in Addressing Problems/Obstacles

Effective leadership is crucial in addressing problems and obstacles faced in the agricultural sector. Inclusive and participatory leadership can help build trust and commitment among farmers and ensure that implemented policies and programs align with their needs and aspirations.

Leadership in the agricultural sector must be able to address various challenges, including lack of infrastructure, digital literacy, and access to resources. Effective leadership must be able to develop a clear vision and comprehensive strategy to address these issues.

Furthermore, effective leadership must be able to build strong partnerships between the government, the private sector, and farming communities. These partnerships are crucial to facilitate the development and implementation of innovative solutions tailored to the needs of the agricultural sector.

Inclusive leadership must also be able to accommodate the needs and aspirations of all groups, including women and youth. Inclusive leadership must be able to develop empowerment programs that include training and equal access to resources for all groups.

In facing the challenges of digitalization, effective leadership must be able to encourage the adoption of digital technology through intensive training and education programs. Effective leadership must be able to build farmers' capacity to use digital technology and leverage it to increase agricultural productivity and sustainability.

In conclusion, effective leadership in the agricultural sector must be able to address the various challenges and constraints faced and develop a comprehensive vision and strategy to achieve sustainable food security. Inclusive and participatory leadership is crucial to ensure that all groups are involved and contribute to achieving this goal.

E. CLOSING

Conclusion

Agriculture in the digital era faces significant challenges affecting food security, such as climate change, population growth, and global economic instability. Although digital technologies such as IoT, AI, and big data offer solutions to increase productivity, their adoption is hampered by poor digital infrastructure, uneven internet access, and low digital literacy among farmers. Traditional approaches to agricultural extension that under-emphasize resilience and inclusion are also major obstacles. Resilience enables farmers to adapt to environmental and economic changes, while inclusion ensures equal access to resources and technology for all members of the farming community, including vulnerable groups.

Developing resilience and inclusion skills through structured training and extension is crucial. Stress management techniques, prioritization, and adaptation to climate change can help farmers remain productive. Training on gender equality and empowerment of vulnerable groups through mentoring and coaching is also needed. Inclusive and visionary leadership can drive the adoption of digital technologies and sustainable agricultural practices, creating equitable and resilient agricultural systems. Overall, an approach that integrates resilience and inclusion in agricultural extension is highly relevant to addressing the sector's challenges and ensuring sustainable food security.

Recommendations

Addressing this issue requires a comprehensive approach that encompasses digital infrastructure development, improved digital literacy, and the promotion of gender inclusion. First, investment in digital infrastructure development in rural areas must be increased to ensure equitable and affordable internet access for all farmers. Second, digital training and education programs must be expanded to improve digital literacy among farmers. The government and the private sector need to collaborate in providing training that covers the use of digital technology, resource management, and sustainable agricultural practices. Third, promoting gender inclusion must be a priority in all agricultural programs. Empowering women through training and equal access to resources can increase their participation throughout the agricultural value chain. Furthermore, agricultural extension should integrate training on resilience to help farmers develop adaptive and stress management skills in the face of climate change and market fluctuations. With this comprehensive and inclusive approach, the agricultural sector can become more resilient and sustainable, ensuring greater food security in the digital age.

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