

Adaptive Management Strategy in Agricultural Human Resources Development to Support Food Self-Sufficiency in Gowa District

Agus Suarman^{1✉} Syurwana Farwita Samuddin²

✉^{1,2}Universitas Indonesia Timur

Abstract

The urgency of this research lies in the critical importance of developing adaptive and innovative agricultural human resources to achieve sustainable food self-sufficiency in Gowa Regency. This study aims to identify and implement effective adaptive management strategies in enhancing farmers' capacity to become more responsive to the dynamics of modern agriculture. The research employs a qualitative approach, with data collected through interviews, documentation, field observations, and Focus Group Discussions (FGD), which were analyzed using NVivo 12 Plus to identify themes and inter-variable relationships. Data validity was ensured through source and methodological triangulation. The findings of this study indicate that the implementation of adaptive management in agricultural human resource development in Gowa Regency is on the right track to support food self-sufficiency; however, it continues to face a number of constraints at each stage of the process. Needs identification, adaptive planning, and program implementation are underway, yet remain limited in terms of coverage, innovation, and data integration. Monitoring and evaluation are conducted, though not yet optimal due to the limited number of extension workers and inadequate information systems. Strategic adjustments are hampered by bureaucratic processes and budget constraints, while inter-actor collaboration has yet to reach its full potential. Therefore, the effectiveness of adaptive management can only be optimized when reinforced by the integration of information technology, enhancement of extension workers' capacity, expanded access to training, and more intensive multi-actor synergy.

Keywords: Human resources, adaptive management, food self-sufficiency

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✉ Corresponding author :

Email Address : aggusss2022@gmail.com

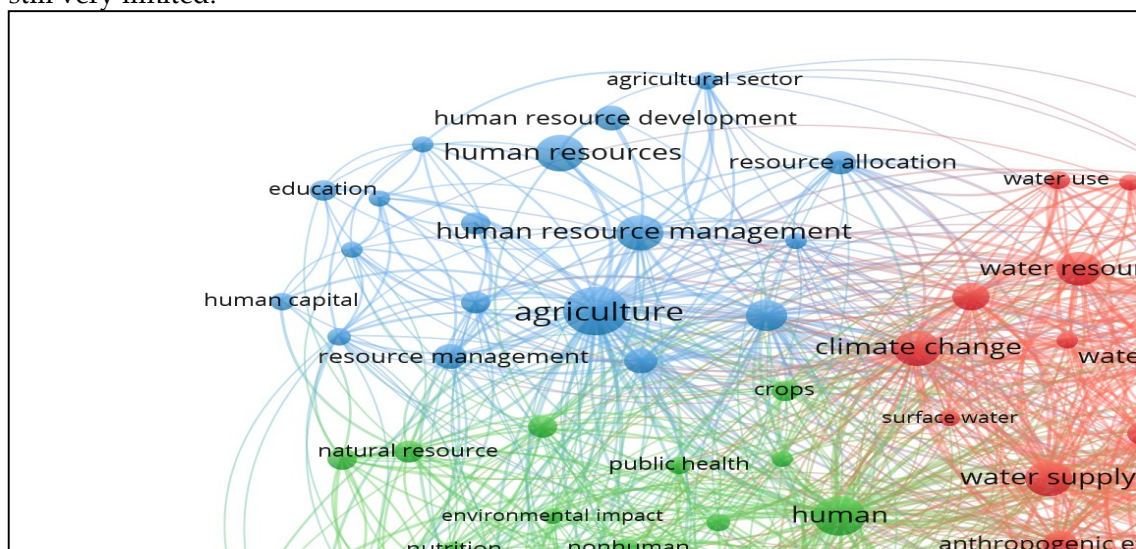
INTRODUCTION

The background of this research is seen from food self-sufficiency which is one of the strategic goals in agricultural development in many countries. (Tleuberdinov et al., 2025), including in Indonesia (Hatta et al., 2023), Especially in Gowa Regency. Gowa Regency has great agricultural potential, with thousands of hectares of rice fields and a well-developed irrigation system. (Yuniarsih et al., 2021). However, in recent years, agricultural productivity has stagnated due to a lack of development of qualified agricultural human resources (HR). Data from the Central Statistics Agency (BPS) in 2023 showed that the education level of farmers in Gowa Regency was still dominated by elementary school graduates, with 8,968 farmers (BPS, 2023), resulting in low adoption of

modern agricultural technologies. Therefore, developing agricultural human resources is crucial to ensuring sustainable food self-sufficiency in this region. In various academic studies, agricultural human resource development has become a major focus in management studies (Tilt et al., 2024). The development of the agricultural sector does not only depend on physical factors such as land and water, but also on the quality of human resources involved in it (Poláková et al., 2024).

In addition, other research also shows that increasing farmer capacity through training and education can crucially increase agricultural productivity (Chapagain et al., 2025). Food self-sufficiency is not only determined by the availability of land and technology, but also by the quality of the human resources who manage it (Kliuchnyk et al., 2024). Strengthening farmers' capacity through appropriate training and education can improve their skills in implementing agricultural innovations, thereby contributing directly to achieving sustainable food self-sufficiency. Meanwhile, agricultural human resource development policies implemented in various countries have shown positive results. One study found that countries with high investments in farmer training experienced increased productivity compared to countries without similar policies (Marty et al., 2024). In Indonesia, information technology-based agricultural extension programs have been implemented in several regions with quite good results. (Purnomo & Kusnandar, 2019).

In the context of management, a collaboration-based approach between the government, academics, and the private sector is one solution that can be implemented to improve the quality of agricultural human resources (Smyth et al., 2021). The policy model developed by Zarafshani, emphasizes the important role of vocational education in agriculture to bridge the existing skills gap (Zarafshani et al., 2020). In Gowa Regency, the implementation of this policy is still limited to conventional programs that do not fully accommodate the needs of modern farmers. Therefore, this study aims to assess the effectiveness of agricultural human resource development policies and formulate more optimal strategies to support food self-sufficiency. The results of a bibliometric analysis search in March 2025 found 213 articles relevant to the topic of agricultural human resources (HR), but studies that specifically use an adaptive management approach are still very limited.



Gambar 1. Pemetaan tema penelitian terkini

Sumber: Diolah peneliti dengan Vosviewer, 2025

The novelty of this research lies in the comprehensive application of an adaptive management approach to agricultural human resource development, a practice that has not been widely studied specifically in the context of food self-sufficiency in Gowa Regency. Furthermore, this research integrates a continuous learning cycle that is responsive to field dynamics, thus providing a more adaptive and contextual human resource development model than previous studies.

The approach used in this research focuses on the concept of adaptive management as a dynamic framework for developing agricultural human resources (HR) in Gowa Regency. Adaptive management is an iterative and responsive management approach (H. Dai et al., 2025), which allows flexible decision-making in the face of uncertainty and environmental change (X. Dai et al., 2025). In the context of agricultural human resource development, this approach emphasizes the importance of continuous learning through a cycle of planning, implementation, monitoring, evaluation, and periodic policy adjustments (Wang et al., 2022). With this approach, farmer capacity development is carried out based on an analysis of actual conditions, evaluation of policy impacts, and gradual strategy improvements to be more adaptive in facing the challenges of food self-sufficiency.

The problem-solving strategy in this research refers to the application of adaptive management steps in developing agricultural human resources (Chen et al., 2023). These include: first, identifying farmer problems and needs through mapping local conditions and stakeholder analysis so that human resource development programs can be tailored to specific needs. Second, adaptive planning by designing flexible training and capacity building programs that can accommodate changing agricultural conditions (Eriksson et al., 2023). Third, ongoing implementation and monitoring to evaluate program effectiveness and identify obstacles in the field. Fourth, evaluation of results and feedback to measure target achievement and identify areas for improvement (Ayambire & Pittman, 2021). Finally, dynamic strategy adjustments based on evaluation results ensure that agricultural human resource development policies remain relevant and effective in supporting food self-sufficiency in Gowa Regency.

The adaptive management approach to solving agricultural human resource development problems emphasizes an iterative cycle that includes identifying problems and needs through mapping local conditions and stakeholder analysis, allowing programs to be tailored to specific contexts. Next, adaptive planning is carried out by designing training programs that are flexible and responsive to changing conditions in the field. The implementation phase is followed by ongoing monitoring to measure effectiveness and identify obstacles during implementation. The monitoring results are then thoroughly evaluated as a basis for feedback, which is used to dynamically adjust strategies so that human resource development policies and programs remain relevant and effective in supporting the goal of food self-sufficiency in Gowa Regency. This process is cyclical and continuous, allowing for rapid adjustment to uncertainties and environmental changes.

Based on this background, the problem formulation in this study is: (a) How is the application of adaptive management strategies in the development of agricultural human resources in Gowa Regency? (b) To what extent can adaptive management strategies increase the capacity of farmers in supporting food self-sufficiency in Gowa Regency? (c) What are the strategic steps in effective adaptive management for the development of agricultural human resources in Gowa Regency? The implications of this study are expected to provide more effective recommendations in the development of agricultural human resources based on adaptive management to support food self-sufficiency in Gowa Regency. In addition, the results of this study can also be a reference for stakeholders in designing programs to increase the capacity of farmers that are sustainable and adaptive to changes in the agricultural environment.

METODOLOGI

This study uses a qualitative approach to analyze agricultural human resource (HR) development policies in support of food self-sufficiency in Gowa Regency. This method was chosen to gain a deeper understanding of the effectiveness of implemented policies, as well as the obstacles and opportunities in their development. Data collection was conducted through in-depth interviews, documentation, field observations, and Focus Group Discussions (FGDs). Key informants in this study included the Gowa Regency Agriculture Office, which is responsible for formulating and implementing agricultural HR development policies; farmer groups and agricultural extension workers, who have direct experience with the impacts of policies and have experience in implementing agricultural technology and innovation; and academics and agricultural experts, who can provide critical perspectives on agricultural HR development policies.

This study involved 12 key informants purposively selected based on their strategic roles and direct involvement in agricultural human resource development in Gowa Regency. Purposive sampling was used to ensure the information obtained was relevant, in-depth, and aligned with the research focus. Data collection instruments included semi-structured interview guidelines, field observation guides, and documentation formats to track policies and practices in the field.

Data analysis was conducted using NVivo 12 Plus to identify patterns, themes, and relationships between variables in agricultural human resource development policies. The analysis techniques used included data reduction, data presentation, conclusion drawing, and verification. To ensure data validity, this study employed triangulation of sources and methods, where data from interviews, documentation, observations, and focus group discussions (FGDs) were compared and confirmed to obtain more accurate results. With this approach, this study is expected to produce evidence-based and relevant policy recommendations to improve the capacity of agricultural human resources in Gowa Regency.

HASIL DAN PEMBAHASAN

Achieving food self-sufficiency in Gowa Regency depends not only on the availability of land and agricultural infrastructure, but also on the quality of the human resources (HR) managing the sector. The main challenges faced are the low level of farmer education and limited adoption of modern technology, resulting in stagnant agricultural productivity. In this context, the application of an adaptive management strategy is relevant because it offers a responsive, iterative, and flexible framework for developing agricultural human resources. This approach allows for continuous learning and strategic adjustments based on field dynamics, thus providing more effective and contextual solutions to support food self-sufficiency.

Table 1. Implementation of Adaptive Management Strategy in Agricultural Human Resource Development in Gowa Regency

Adaptive	Form of Implementation	Conditions in Gowa Regency
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Management Stage		
Identify needs	Mapping of farmer conditions, education levels, and access to technology	Dominated by elementary school graduates (8,968 farmers) and low adoption of modern technology (BPS, 2023)
Adaptive planning	Designing flexible training according to local conditions and farmers' needs	Extension program based on farmer groups, but still conventional in nature
Program implementation	Training, extension, field schools, and agricultural technology assistance	Implemented in several sub-districts, not yet evenly distributed throughout the region
Continuous monitoring	Monitoring training results, farmer participation levels, and impact on agricultural productivity	Conducted annually by extension workers, but evaluation data has not been fully integrated
Evaluation and feedback	Evaluation of program success and identification of barriers	Limited evaluation, feedback is not optimal due to limited human resources for extension workers
Strategy adjustment	Policy improvements, collaboration with academics, the private sector, and local stakeholders	Still needs to be strengthened, especially in cross-sector integration and IT utilization.

Sumber: Dokumentasi peneliti, 2025

The application of adaptive management strategies in agricultural human resource development in Gowa Regency is carried out through an iterative management cycle. The first step is to identify farmer problems and needs through mapping local conditions, which indicates low levels of education and adoption of modern agricultural technology. (Alfadillah et al., 2024; Fatmawati et al., 2018). Second, adaptive planning is carried out by designing training and mentoring programs based on the real needs of farmers, such as land management skills, technology utilization, and agricultural diversification. (Alfadillah et al., 2024; Tajuddin, 2024). Third, program implementation is carried out through outreach, field schools, and vocational training, although its reach is still limited. (Hamid, 2018). Fourth, ongoing monitoring is conducted to measure the effectiveness of program implementation, for example through productivity evaluations and farmer participation. Fifth, evaluation and feedback are used to address program weaknesses, such as the lack of extension workers. Finally, strategies are dynamically adjusted to ensure agricultural human resource development policies remain relevant and effective in supporting food self-sufficiency.

The implementation of adaptive management strategies in agricultural human resource development in Gowa Regency conceptually follows the essential stages, from needs identification to strategy adjustment. However, findings indicate that each stage faces limitations in its implementation. In the needs identification stage, for example, 2023 BPS data confirms that the majority of farmers have low levels of education, with 8,968 being primary school graduates. This situation demonstrates that farmers' basic capacity to accept and adopt modern agricultural innovations remains very limited. This low level of agricultural literacy presents a crucial initial challenge in developing a human resource development program.

The next stage, adaptive planning, is designed to address specific farmer needs based on the identification results. However, the program implemented in Gowa Regency remains conventional, employing traditional farmer group extension methods. The lack of innovation in training design means this approach is ineffective in encouraging farmers to be more responsive to changes in the dynamic agricultural environment. However, adaptive management demands flexibility and the ability to adapt to technological developments and local conditions.

During the implementation phase, training and mentoring have been conducted, for example through field schools and technical extension programs. However, their coverage is still limited to a few sub-districts, thus not being able to reach all areas of Gowa Regency. This uneven distribution demonstrates a gap in the distribution of knowledge and skills among farmers. This situation has the potential to create inequities in access to capacity building, thus preventing the goal of human resource development to support food self-sufficiency from being achieved evenly.

Furthermore, ongoing monitoring, which should be a key driver of adaptive management, is also not functioning optimally. While monitoring is conducted annually by extension workers, the data obtained is not comprehensively integrated, making it difficult to use as a basis for strategic decision-making. Consequently, the evaluation and feedback processes fail to provide adequate information on program effectiveness. This is exacerbated by the limited number and capacity of agricultural extension workers, which slows down the process of addressing obstacles in the field.

Limitations in previous stages resulted in weak strategic adjustments at the final level. Adaptive management emphasizes a dynamic learning cycle, but in Gowa Regency, policy adjustments are still partial and not supported by strong cross-sector collaboration. Collaboration between the government, academia, the private sector, and farming communities could be a key factor in strengthening the quality of agricultural human resources. Therefore, it can be critically concluded that the implementation of adaptive management in Gowa Regency is not yet comprehensive. To be more effective, it is necessary to increase the capacity of extension workers, expand training coverage, integrate information technology-based monitoring and evaluation systems, and strengthen synergy across actors to support sustainable food self-sufficiency.

The application of adaptive management in agricultural human resource development has had a significant impact on increasing farmer capacity, particularly in supporting the achievement of food self-sufficiency in Gowa Regency. This approach enables a more responsive, flexible, and sustainable development process because it involves a cycle of planning, implementation, monitoring, evaluation, and strategy adjustments based on real-world conditions. Thus, adaptive management not only improves farmers' technical skills but also strengthens their ability to adapt to the dynamics of modern agriculture and global challenges such as climate change, market changes, and technology.



Gambar 2. Dampak Adaptive Management

Sumber: Diolah peneliti dengan Nvivo 12 Plus, 2025

The impact of implementing adaptive management on farmer capacity development is significant, particularly in supporting the achievement of food self-

sufficiency. This approach enables farmers to continuously learn, adapt, and respond to the increasingly complex dynamics of the agricultural environment. Through sustainable adaptation mechanisms, farmers rely not only on traditional experiences but also enrich their knowledge and skills with relevant innovations. This makes farmers better prepared to face challenges, both technical and non-technical.

One of the real impacts can be seen in the increase in technical skills and technology adoption (Waryat & Nurjanani, 2022). Through adaptive management-based training, farmers are introduced to new techniques such as integrated land management, the use of modern irrigation systems, and the use of technology-based agricultural tools. This learning process allows farmers to move away from traditional methods and become more open to integrating technology that can increase productivity. These changes directly contribute to increased agricultural yields while reducing the risk of crop failure.

Furthermore, adaptive management also strengthens farmers' decision-making capacity. Through routine monitoring and evaluation practices, farmers are directly involved in analyzing agricultural data, identifying problems, and formulating improvement strategies. This involvement trains them to think critically, use information appropriately, and be more responsive to changing environmental and market conditions. With these skills, farmers become not only implementers but also strategic actors, able to independently control the direction of their farming operations.

Another significant impact is increased production efficiency and agricultural sustainability. An adaptive approach encourages farmers to be more selective in their use of inputs such as fertilizers, pesticides, and water. By implementing environmentally friendly innovations, agricultural productivity can be achieved without damaging the ecosystems that support their livelihoods. This long-term, oriented practice creates a balance between increasing agricultural yields and conserving natural resources, which in turn strengthens national food security.

Finally, adaptive management helps strengthen collaboration and social networks among farmers. Interactions between farmers, extension workers, local governments, academics, and the private sector create synergies that expand access to information, capital, and markets. This collective support puts farmers in a stronger position to face competition and support food self-sufficiency. Thus, adaptive management is not only a technical strategy but also a social instrument that fosters solidarity and empowers farmers in facing future food challenges.

Developing agricultural human resources (HR) in Gowa Regency requires a dynamic and responsive approach to changes in the environment, technology, and market needs. Adaptive management is a crucial strategy because it allows for a continuous cycle of learning, evaluation of results, and policy adjustments to suit the local context (Jackson et al., 2010; Tran et al., 2025). Through this approach, farmers' technical capacity is not only enhanced, but also strengthened in decision-making, collaboration, and innovation to address challenges in the agricultural sector. The implementation of adaptive management in Gowa is expected to increase agricultural productivity, create sustainable farming practices, and support the achievement of food self-sufficiency.



Gambar 3. Langkah-Langkah Strategis Adaptive Management dalam Pengembangan SDM Pertanian di Kabupaten Gowa

Sumber: Diolah peneliti dengan Nvivo 12 Plus, 2025

The first stage in implementing adaptive management is problem identification. At this stage, mapping agricultural human resource needs is crucial because it provides a clear picture of farmers' skills, access to technology, and the environmental challenges they face. Gowa Regency, for example, is still dominated by farmers with low levels of education and limited access to modern technology. This emphasizes that proper planning must be based on a thorough understanding of farmers' social, economic, and ecological conditions. Without accurate mapping, agricultural human resource development strategies will tend to be ineffective.

The next stage is adaptive planning, which emphasizes the development of training and mentoring programs tailored to the local context. The strength of this planning lies in the multi-stakeholder participation of farmers as the primary actors, extension workers, local governments, and academics. However, challenges often arise from a lack of coordination between actors and a dominant top-down approach from the government. Therefore, adaptive planning must ensure an open and inclusive dialogue mechanism so that the programs developed truly address farmers' needs on the ground, rather than simply formal policies.

Program implementation is the third stage that determines the success of adaptive management. Through training, technology transfer, and field practice, farmers gain new technical skills as well as hands-on experience in implementing innovations. Unfortunately, implementation in Gowa is often hampered by limited extension resources and uneven program distribution across sub-districts. This situation highlights the need for a more structured strategy to ensure equal access to training for all farmers. Otherwise, the capacity gap between regions could widen and hinder collective productivity improvements.

The fourth stage is monitoring and evaluation. Continuous monitoring is a crucial foundation of adaptive management because it allows for regular assessment of program effectiveness. In Gowa Regency, evaluations are generally conducted annually, but limitations in data integration often result in suboptimal evaluation results. The main criticism at this stage is the weakness of the data-based documentation and analysis system, which tends to make improvement decisions subjective. Therefore, the application of information technology in monitoring can be a solution to ensure data is more accurate, measurable, and usable in the strategic decision-making process.

Strategy adjustments emerge as a logical consequence of the evaluation results. This stage requires flexibility in modifying or adding new strategies according to farmer needs and local dynamics. Unfortunately, this flexibility is often hampered by rigid bureaucracy and limited budget resources. This situation creates a dilemma: adaptation is necessary,

but its implementation is often hampered by administrative procedures. A possible criticism is the need for more flexible policy design, with room for innovation that can be implemented quickly without having to navigate lengthy bureaucratic processes.

The final stage is strengthening collaboration, which is key to the program's sustainability. Adaptive management cannot be effective without synergy between stakeholders, including farmers, government, academics, the private sector, and local communities (Ni & Chen, 2024). However, this collaboration still faces obstacles in the form of weak coordination and divergent sectoral interests. If managed well, multi-actor collaboration can expand farmers' access to information, capital, and markets. Thus, collaboration not only strengthens farmers' economic position but also creates a more resilient agricultural ecosystem that supports food security and self-sufficiency.

SIMPULAN

The findings of this study indicate that the application of adaptive management strategies in agricultural human resource development in Gowa Regency has significant potential to support food self-sufficiency. However, its implementation still faces several limitations at each stage. Needs identification has successfully mapped the low level of farmer education and minimal adoption of modern technology, as recorded by the Statistics Indonesia (BPS) in 2023. However, this mapping has not been fully integrated into a truly responsive program design. Adaptive planning has been implemented through farmer group extension, although it remains conventional and lacks innovation, thus failing to empower farmers to navigate the increasingly complex dynamics of the agricultural environment. Implementation of training programs, field schools, and mentoring programs is ongoing, but coverage is uneven, creating capacity gaps between regions.

Routine monitoring and evaluation are conducted, but the lack of an integrated data system and limited extension staff mean that the resulting information is less than optimal for decision-making. Consequently, the evaluation and feedback phase only produces partial improvements that are insufficient to comprehensively address field challenges. Strategy adjustments are also hampered by bureaucracy and budget constraints, even though adaptive management demands flexibility and a rapid response to change.

Furthermore, strengthening collaboration between stakeholders—between government, academics, the private sector, and farming communities—has not been optimally implemented, thus creating a robust agricultural ecosystem. Overall, this study confirms that the implementation of adaptive management in Gowa is on the right track, but its effectiveness will only be optimal if each stage is strengthened by information technology-based data integration, capacity building for extension workers, expanded access to training, and more intensive multi-actor synergy. Thus, adaptive management can truly become a key strategy for improving the quality of agricultural human resources and ensuring sustainable food self-sufficiency in Gowa Regency.

Practical recommendations from this study include the need for the Gowa Regency government, along with relevant institutions, to strengthen the capacity of agricultural human resources by providing digital technology-based training programs, increasing the number and quality of agricultural extension workers, and strengthening multi-actor collaboration so that adaptive management

strategies can be more responsive to local dynamics. Furthermore, the integration of a data-based monitoring system is necessary to ensure more effective evaluation and adjustment of strategies.

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