IMPLEMENTATION OF SMART FARMING-BASED AGRICULTURAL POLICY IN TRENGGALEK REGENCY (STUDY ON THE DEPARTMENT OF AGRICULTURE AND FOOD IN TRENGGALEK REGENCY)

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ABSTRACT

Introduction: The role of the agricultural sector in Indonesia is crucial for both the society and the nation as it is closely linked to the national food needs. However, persistent issues in the agricultural sector, such as the quality of agricultural produce, fluctuating prices, and disjointed marketing, render farming unappealing to the younger generation. Government support factors through legal regulations aim to create programs for each local government (Pemda) to develop agriculture.

Theoretical Framework: One such program is smart farming in Trenggalek Regency, East Java. This research aims to analyse the implementation of the Smart Farming program in Trenggalek Regency using Grindle's (1980) theory of public policy implementation, integrated with a conceptual model to assess the effectiveness of the innovative farming program.

Method: The qualitative approach is directed toward describing, discovering, and analyzing phenomena with unique characteristics. The relevance of employing the qualitative approach is understood in that every issue involves various interrelated and specific phenomena.

Conclusion: Agricultural industry must be supported by younger generation, law, policies and modern technology. Various disciplines will lead agricultural industries to become flagship industry in Indonesia.

Keywords: public administration, public policy implementation, agriculture, smart farming.

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APLICAÇÃO DE UMA POLÍTICA AGRÍCOLA INTELIGENTE BASEADA NA AGRICULTURA EM TRENGGALEK REGENCY (ESTUDO DO DEPARTAMENTO DE AGRICULTURA E ALIMENTAÇÃO EM TRENGALEK REGENCY)

RESUMO

Introdução: O papel do sector agrícola na Indonésia é crucial tanto para a sociedade quanto para a nação, pois está intimamente ligado às necessidades alimentares nacionais. No entanto, questões persistentes no sector agrícola, como a qualidade dos produtos agrícolas, a flutuação dos preços e a desarticulação da comercialização, tornam a agricultura pouco atrativa para as gerações mais jovens. Os fatores de apoio do governo através de regulamentos legais têm como objetivo criar programas para cada governo local (Pemda) para desenvolver a agricultura.

Quadro teórico: Um desses programas é a agricultura inteligente na Regência Trenggalek, em Java Oriental. Esta pesquisa tem como objetivo analisar a implementação do programa Smart Farming na Regência Trenggalek usando a teoria de Grindle (1980) da implementação de políticas públicas, integrada com um modelo conceitual para avaliar a eficácia do programa agrícola inovador.

Método: A abordagem qualitativa é direcionada para descrever, descobrir e analisar fenômenos com características únicas. A relevância de empregar a abordagem qualitativa é entendida na medida em que cada questão envolve vários fenômenos inter-relacionados e específicos.

Conclusão: A indústria agrícola deve ser apoiada pela geração mais jovem, pela lei, pelas políticas e pela tecnologia moderna. Várias disciplinas levarão as indústrias agrícolas a se tornarem uma indústria emblemática na Indonésia.

Palavras-chave: administração pública, implementação de políticas públicas, agricultura, agricultura inteligente.

1 INTRODUCTION

In this era of globalization and free trade, various aspects of human life, including the agricultural sector, have been significantly influenced. Consequently, amidst the diverse developments, the agricultural sector emerges as a pivotal issue that demands attention and development. The substantial demand for high-quality, healthy, and environmentally conscious food products is inevitable. The demand for safe food products is not merely perceived as a constraint for the agricultural world in Indonesia; instead, it should be viewed as both a challenge and an opportunity for stakeholders in the agricultural sector. The increasing demand for quality agricultural products from society contrasts with the number of workers focusing on agriculture. Indicated in figure 1.1 below, namely,
Based on the provided information, there has been a 13% decline in the past 20 years in the number of workers in the global agricultural sector. In 2000, the global agricultural workforce amounted to 1.05 billion individuals. However, by 2020, the number of workers in the agricultural sector had decreased to 874 million. This trend can be attributed to suboptimal income issues within the agricultural sector, coupled with the attractiveness of other industries to the workforce. Another issue of concern is the crisis farmers face in Indonesia; according to data compiled by the Central Bureau of Statistics (BPS) in 2017, out of the 17 million national farmers, 83% fall within the 35-54 age group. This implies that the majority of farmers in Indonesia at present belong to the middle-aged and older demographic.

Meanwhile, farmers in the younger age group, ranging from <25-34 years old, number approximately 2.9 million. From the breakdown of data between the older and younger demographics, it can be concluded that a substantial disparity exists, giving rise to a generation gap among farmers. The pronounced contrast between the younger and older age groups also impacts the future regeneration of the farming population.

Furthermore, a global issue in agricultural sector development is the need for more government support for established agricultural policies. Temchavala (2015), Lencucha et al. (2020), and Sihidi and Roziqin (2020) have highlighted that governments, in general, need to be more attentive to the Sustainability of their designated agricultural policies. Various challenges arise, commencing with the implementation phase, where the government needs to promptly provide supportive measures to facilitate the execution of these policies. This also contributes to the government's limited involvement in stabilizing the prices of agricultural products in the market. Sihidi and Roziqin (2020) point out that the fluctuating levels of agricultural product prices are attributed to the fact that distributors still determine the prices.
Consequently, the purchasing prices offered to farmers are often exceedingly low and must correspond proportionally to the selling prices from distributors to consumers. Another issue that emerges is the quality of farmers in Indonesia, with the majority still adhering to traditional farming methods. The application of traditional methods is contingent upon weather conditions and the effects thereof. Based on observations, weather patterns tend to be unpredictable, leading to failures.

The Indonesian government has addressed the agricultural issues in Indonesia through Law Number 22 of 2019 concerning Sustainable Agricultural Cultivation Systems. In the existing regulation, the Indonesian government has stipulated its commitment to ensuring the sustainable availability of agricultural land as a source of employment and a decent livelihood for humanity. In Law No. 22 of 2019, it is emphasized that a sustainable development system needs to be cultivated in agricultural development through agricultural cultivation systems to achieve food sovereignty, taking into account ecosystem support, climate change mitigation, and adaptation to create an advanced, efficient, resilient, and sustainable agricultural system. However, another emerging issue is the implementation process of policies until they become programs can directly benefit farmers.

Theoretically, the elements in implementation, according to Grindle (1980), are divided into two elements. The first element is the policy content, consisting of the affected interests, types of benefits, the level of expected change, the policy implementation location, program implementers, and committed resources. The second element is the context of public policy, consisting of power, interests, and strategies of involved actors, characteristics of institutions or regimes, and compliance and responsiveness. However, statements related to the policy implementation elements expressed by Grindle (1980) above are deemed insufficient by Tummers et al. (2012), who states that, in addition to content and context factors, another factor is required, namely personality characteristics. Personality characteristics, also called individual characteristics, relate to how stakeholders implement a policy. This aspect is often overlooked in various literature discussing a change concept. Due to the theoretical gap mentioned above, the researcher will attempt to examine how the policy implementation conducted by the government in the context of agricultural policy aligns with the opinions of Grindle (1980) and Tummers et al. (2012). In assessing this policy process, attention
should be paid to the content of the policy, the implementation environment, and the personal characteristics of the implementer.

Trenggalek Regency, East Java, is a region with significant agricultural potential. Trenggalek Regency, situated in the province of East Java, has endeavored to implement various forms of innovation in the agricultural sector to enhance the economy, given its considerable agricultural potential.

Trenggalek Regency has agricultural potential, as highlighted by the Provincial Information and Communication Office of East Java (2011). According to their findings, Trenggalek Regency, based on its topography, possesses agricultural potential in terms of rice, vegetables, and fruits, which can serve as distinctive commodities for the region. According to data from the Department of Agriculture and Food of Trenggalek Regency (2021), several agricultural things are present in Trenggalek. In 2021, the rice crop covered an extensive area of 28,616 hectares, yielding approximately 169,372 tons of rice. The maize crop amounted to 132,306 tons in 2021, covering an area of 18,726 hectares. Additionally, there is potential in cassava cultivation, covering an area of 11,863 hectares and producing 285,804 tons of cassava.

One of the agricultural innovation programs implemented by Trenggalek Regency is the Smart Farming program, a continuation of the precision farming initiative. The Smart Farming program is a comprehensive initiative aligned with the mission of the Regent of Trenggalek for the period 2016 – 2021. One of the established missions is to enhance the development of the agricultural sector and provide protection to the community to realize a fair and prosperous trading system. Researchers have sought to introduce the concept of smart farming to support progress in the agricultural sector. Wolfert et al. (2015) visualize smart farming as an intelligent cycle of sensing and monitoring, thoughtful analysis and planning, and intelligent control over farming operations utilizing cloud-based event management systems. However, in many cases, this remains an ideal scenario. To achieve these objectives, several challenges and obstacles need to be addressed.

Smart farming extends the concept of precision agriculture, wherein existing tasks for management and decision-making based on data are enhanced according to context, situations, and location awareness. This concept can be associated with agricultural operations, farming logistics, food logistics, stakeholder networks, etc. Real-time assistance features are crucial for agile actions, particularly in cases of suddenly changing
operational conditions or other circumstances (weather or disease alerts). Additionally, these assistance features typically encompass intelligent support in implementing, maintaining, and utilizing technology. In the policy above, one strategy the Trenggalek Regency Government employs is implementing the intelligent farming program. This program serves as a strategy to fulfill the primary mission of the Trenggalek Regency Government. Smart farming is a strategy in the realization of Mission I, namely, "ensuring the advancement of micro, small, and medium-sized enterprises (MSMEs) and building an inclusive agricultural and fisheries trade system, promoting investment, creating job opportunities, and fostering new entrepreneurs oriented towards poverty alleviation and pesantren (Islamic boarding school) economic development."

2 PROBLEM FORMULATION

Based on the background above, the research problem can be formulated as follows:

1. How is the implementation of intelligent farming policy in Trenggalek Regency?
2. What is the performance outcome of smart farming implementation in Trenggalek Regency, and how does it impact the existing agricultural sector?
3. What is the recommended model for enhancing the performance of intelligent farming policy implementation in Trenggalek Regency?

3 LITERATURE REVIEW

3.1 EMPIRICAL STUDIES

Previous research supporting this study includes investigations conducted by Temchavala (2015); Murray W. Scown and Kimberly A. Nicholas (2020); Raphael Lencucha, Nicole E. Pal, Adriana Appau, Anne-Marie Thow, and Jeffrey Drope (2020); Iradhad Taqwa Sihidi and Ali Roziqin (2020); James Giles, Godefroy Grosjean, Jean-Francois Le Coq, Bernhard Huber, Vinh Le Bui, and Peter Laderach (2021); Melf-Hinrich Ehlers, Robert Huber, and Robert Finger (2021); Ibtihal Hidayah, Yulhendri, and Nora Susanti (2022); Ivon Cuadros-Casanova, Andrea Cristiano, Dino Biancolini, Marta Cimatti, Andrea Antonio Sessa, Valeria Yeraldin M. Angarita, Chiara Dragonetti, Michela Pacifici, Carlo Rondinini, and Moreno Di Marco (2022); Alan Matthews (2022);
Palme Thadey Kawishe and Ernest Theobald Mallya (2022); Ahmad C. Fathihin and Lailul Mursyidah (2023).

3.2 PUBLIC ADMINISTRATION THEORY

Administration is inseparable from the affairs of the state and is closely related to society. The term "administration" is derived from "to administer," which is defined as "to manage" (Nawawi, 1999:1). Etymologically, administration can be understood as the activity of managing information, people, resources until the achievement of goals consolidated within an organization. Gie (1999:14) explains that administration encompasses the entire arrangement of core tasks carried out by a group in collaboration to achieve specific objectives.

3.3 PUBLIC ADMINISTRATION PARADIGM

Over time, the paradigm of public administration has undergone significant development. The historical development of public administration begins with the emergence of Old Public Administration (OPA), which later evolved into the concept of New Public Administration (NPA). Subsequently, the New Public Management (NPM) concept emerges as a critique of the NPA concept. Following NPM and in line with the changing times, the concept of New Public Service (NPS) emerges, serving as both a critique and an enhancement of the NPM concept, which is considered to prioritize values in the private sector.

3.4 PUBLIC POLICY IN PUBLIC ADMINISTRATION

As Frederickson et al. (2012;165) articulated, the development of the early decision-making logic is explained as the most mature and fully evolved empirical information within public administration as an administrative behavior. From a behavioral perspective, policy implementation is viewed as a tool where actors, organizations, procedures, techniques, and resources are organized collectively to execute policies to achieve desired impacts or objectives (Sadhana, 2011). Implementing a policy as a public administration tool or an administrator's behavior or action is done rationally or factually but within limitations. Frederickson et al. (2012: 169) clarify that rationality involves rational efforts to define and prioritize values and goals, consider available and
possible alternatives in achieving objectives, and analyze alternatives to find the most sensible alternative.

Therefore, Maulana and Nungroho (2019: 95) assert that policy implementation represents approximately 60 percent, with the remainder being the formulation and evaluation process.

3.5 MODEL OF PUBLIC POLICY IMPLEMENTATION

The political process can be observed through decision-making involving various policy actors. In contrast, the administrative process is evident through the general executive actions that can be examined at a specific program level. Grindle (1980) emphasizes that policy implementation must consider both the content of the policy and the context of performance. The model introduced by Grindle depicts the decision-making process carried out by diverse actors, where the final output is determined by the policy's substance and the interaction among decision-makers in the political-administrative context. However, this perspective is reinforced by Tummers et al. (2012), who states that, in addition to content and context factors, another factor is needed: personality characteristics.

Personality characteristics, or traits, refer to how stakeholders execute a policy. This aspect is often overlooked in various literature discussing change concepts. Tummers et al. (2012) categorize these characteristics into two categories: rebelliousness and compliance with rules. Regarding rebellious characteristics in implementation, Tummers et al. (2012) and Dillard (2005) view this as a personality trait that can threaten their freedom. This is manifested through defensive, autonomous, and non-affiliative traits (Tummers et al., 2012; Dillard, 2005; Wall Brown, 1993). Therefore, stakeholders with these characteristics tend to reject any newly established policy due to the launched rebellion.

On the other hand, the following characteristic is compliance, where Tummers et al. (2012) interpret compliance as the obedient and accepting nature of stakeholders toward new policy changes. This characteristic tests stakeholders' beliefs in adhering to all provisions in the new policy.

Based on the above explanations, the researcher will attempt to explore the dimensions of policy implementation advocated by Grindle (1980) and Tummers et al. (2012), which divide the implementation dimension into three parts: content or substance
of the policy, context or implementation environment, and personality characteristics possessed by policy implementors.

3.6 CONCEPT OF AGRICULTURE

Agriculture is generally understood as a human activity encompassing cultivation, animal husbandry, fisheries, and forestry. The narrow definition of agriculture only includes the cultivation of food crops. However, a more comprehensive view recognizes that agricultural activities can yield crops and livestock to meet human needs. Using animals to aid farmers constitutes a significant aspect of the agricultural domain. In Indonesia, various types of agriculture are practiced by the farming community. These types are utilized by residents for cultivation purposes, contributing to their livelihoods as farmers.

1. **Swidden Agriculture System:** The swidden agriculture system needs to be developed due to minimal land cultivation and productivity that depends on the humus layer formed by the forest system. This system is commonly found in sparsely populated areas with expansive land.

2. **Backyard Garden System:** The backyard garden system is often observed in arid lands far from water sources. Land management in this system rarely involves highly intensive labor and infrequently employs animal power.

3. **Irrigated Rice Field System:** The irrigated rice field system is a sophisticated cultivation technique that maintains soil fertility. This is achieved through adequate irrigation and slow drainage processes. Rice fields represent significant potential in food production.

4. **Plantation System:** The plantation system has evolved due to the demand for export crops, encompassing both small-scale and large-scale plantations. Effective management in this system ensures the fulfillment of export requirements. Plantations involve the entire process from utilizing natural resources, human resources, production tools and machinery, cultivation, harvesting, processing, and marketing related to the cultivated plants on the plantation.
3.7 CONCEPT OF SMART FARMING

Technology in everyday life is no longer limited to the realm of computers. The progress of technology enables various complex processes to become simplified or even operate autonomously. In the realm of agriculture, computational technology is often leveraged as a means of environmental monitoring and risk management (Pathak et al., 2019). Monitoring and controlling the agricultural environment can be executed remotely using sensors, actuators, and the Internet. Some methods, such as irrigation, nutrient application, plant health monitoring, and others, can be automated using this technology. The concept of streamlining agricultural processes using computational technology is called intelligent farming.

In the intelligent farming system, farmers can make more informed decisions based on data obtained from sensors and data management software. This data assists farmers in monitoring and predicting crop conditions, optimizing the use of resources such as water, fertilizers, and pesticides, and improving overall production performance. In other words, smart farming is an integrated agricultural system that utilizes digital technology to enhance production processes and minimize environmental negative impacts. Besides enhancing efficiency and productivity in agriculture, smart farming also aids farmers in achieving better and more sustainable harvests in the future.

I visualized smart farming as a cycle of intelligent sensing and monitoring, thoughtful analysis and planning, and intelligent control over farming operations utilizing cloud-based event management systems. However, in many cases, this remains an ideal situation. Several challenges and obstacles need to be addressed to achieve these goals, as elaborated in the following sections.
Wolfret et al. (2015) identified several factors that need to be considered in the concept of intelligent farming:

1. **Data From Agricultural Equipment**: Modern agricultural equipment (e.g., tractors and greenhouses) contains numerous sensors and devices that generate large volumes of data.

2. **The Supply Chain Network**: Regarding information handling, to support communication among all stakeholders along the value chain, stakeholders must manage vast amounts of information to make sound economic and environmental decisions.

3. **Standardization**: Current agricultural information systems need more standardization, hindering efficient information exchange.

4. **Software Development**: Most agricultural food applications require interdisciplinary collaboration among various experts/services, making data exchange a critical success factor in decision-making. Collaborators may be distributed across different locations, using specialized systems to handle data.

5. **Focus and Culture**: All the issues above are significantly influenced by the diversity among agricultural companies concerning the type of farming, size, geography, cultural differences, etc. Additionally, differences in agricultural food supply systems significantly impact decision-making.
4 CONCEPTUAL FRAMEWORK

From the various discussions provided above, within the existing agricultural sector, there are several challenges faced. These include a decline in human resources in the agricultural sector in Trenggalek Regency. The second issue is the need to determine the value of agricultural products more, which also contributes to the reduction in the agricultural potential in Trenggalek Regency. Therefore, for the development of agriculture in Trenggalek Regency to be effectively, efficiently, and sustainably carried out, attention must be given to how established policies are implemented. This includes considerations related to the content of the policies, the implementation environment, and the characteristics of policy implementers.

![Conceptual Framework Smart Farming-Based of Farming Policy Implementation in Trenggalek Regency](source: Developed by author (Nurhadi et al, 2023)

5 RESEARCH METHODOLOGY

Research on the implementation of agricultural policies is a scholarly activity organized using specific types and strategies, ensuring the accountability and accuracy of the data obtained. Research is viewed from certain aspects that involve various types and strategies. Consistent with the view above, define the qualitative approach as a research procedure that produces descriptive data in the form of written and spoken words from individuals and observable behaviors. The qualitative approach is directed toward
describing, discovering, and analyzing phenomena with unique characteristics. The relevance of employing the qualitative approach is understood in that every issue involves various interrelated and specific phenomena.

The research location and informants in this study were selected from several places, including:

1. Regent of Trenggalek Regency
2. Department of Agriculture and Food Security of Trenggalek Regency
3. Department of Public Works and Spatial Planning of Trenggalek Regency
4. Department of Housing and Settlements
5. Department of Social Affairs of Trenggalek Regency
6. Farmer Groups in Trenggalek Regency
7. Farmer Group Joint Business Entities (Gapoktan)
8. Regional Development Planning Agency of Trenggalek Regency (Bappedalitbang)
9. Department of Agriculture of East Java Province
10. Department of Cooperatives and Trade of Trenggalek Regency
11. Department of Industry of Trenggalek Regency
12. Subdistrict Extension Center

This study employs data collection techniques through interviews – obtaining data in the field through direct questioning. In this research, interviews are conducted with the subjects under investigation. Secondly, through observation, which includes data related to events/efforts in agricultural policy to enhance food security. Documentation is another technique for collecting data by recording and utilizing information available in organizations related to the research objectives in the form of documents.

Then, concerning the research focus, it may evolve or change based on developments and findings during fieldwork. However, limiting the research focus before going to the field is intended to prevent researchers from getting entangled in issues beyond the problems and research objectives formulated earlier. The research focus is the determination of issues that are the center of attention in the study by examining the problems as follows:

1. Implementation of intelligent farming policies in trenggalek regency, consisting of:
   a. Policy implementation:
1. Content Policy (Grindle, 1980; Tummers, et al., 2012);  
2. Context Implementation (Grindle, 1980; Tummers, et al., 2012); and  
3. Personality Characteristic (Tummers, et al., 2012)  
b. Smart farming concept (Wolfret et al., 2015):  
1. Data From Agricultural Equipment  
2. The Supply Chain Network  
3. Standardization  
4. Software Development  
5. Focus and Cultural  
2. Performance results of Smart Farming implementation in Trenggalek Regency,  
including (Trenggalek Regional Regulation No. 2 of 2016):  
a. Sustainability and consistency;  
b. Productive;  
c. Participatory; and  
d. Accountable.  
1. Model of smart farming-based agricultural policy implementation in Trenggalek Regency, including:  
a. Existing model; and  
b. Recommended model  

After formulating the research focus, the next step is the data analysis process, a crucial stage in scientific research, as data analysis provides meaning to the data to solve research problems and achieve the researcher's ultimate objectives. Therefore, the researcher employs the interactive model that Miles, Huberman, and Saldana proposed, as it offers a suitable framework for analyzing the obtained data. Subsequently, the acquired data is organized into units, and data analysis is conducted for data related to the research focus. The following outlines the data analysis using the interactive model by Miles, Huberman, and Saldana (2014):
A data validation process is undertaken to reinforce the validity of the data collection results, necessitating examination techniques. The execution of examination techniques is based on specific criteria. According to Lincoln and Guba (1985), as cited by Moleong (1993), four criteria are employed: credibility, transferability, dependability, and confirmability.

6 CONCLUSION

The agricultural industry is a crucial sector that supports various aspects of community and national life. The challenge of the younger generation's reluctance to enter agriculture is a problem that must be addressed to ensure the Sustainability of the agricultural sector. Various policies from the central and regional governments, supported by laws as a legal foundation, represent one of the government's efforts to enhance agriculture. Constraints on public policy programs' effectiveness in the community remain significant. Modern technology, such as intelligent farming, is essential to improve the agricultural industry and make it attractive for future generations. Integrating various disciplines intrigues the agricultural industry and has significant potential to become a flagship industry in Indonesia.

IMPLICATIONS

This research is expected to contribute to the knowledge related to implementing policies and developing the agricultural sector by central and regional governments. Furthermore, the study aims to provide models and directions for policy development in the farming sector. This is intended to ensure that the goals of strengthening the agricultural sector, implemented by the government, align with the current developments, especially for the local government of Trenggalek Regency.
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