



ENVIRONMENTAL IMPACTS OF THE FOOD ESTATE POLICY IN GUNUNG MAS REGENCY, CENTRAL KALIMANTAN: A DPSIR ANALYSIS

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ABSTRACT

The implementation of Indonesia's Food Estate policy has generated growing concerns regarding its environmental sustainability despite its objective of strengthening national food security. This study analyzes the environmental consequences of the Food Estate program in Gunung Mas Regency, Central Kalimantan, using the Driving Forces–Pressures–State–Impacts–Responses (DPSIR) framework. A qualitative case study based on document analysis was conducted using policy documents, environmental reports, and previous studies. Results indicate that the policy's focus on large-scale agricultural expansion has generated environmental pressures through forest-to-cassava field conversion. Based on the reviewed documents, these pressures are associated with reported soil erosion risks, declining soil quality, disruption of upstream hydrological functions, and carbon emissions related to land clearing. The reviewed evidence also indicates that land conversion activities have been associated with downstream flooding events, low cassava productivity, and increased vulnerability to forest fires. The DPSIR analysis also shows that these environmental problems are closely linked to the policy design, particularly the site selection and implementation strategies. Based on the findings, this study suggests policy responses including a comprehensive policy evaluation, better site selection, gradual land development, land rehabilitation and integrated disaster mitigation measures. By systematically mapping the causal relationships between policy interventions and environmental change, this study contributes to evidence-based policy evaluation for balancing national food security objectives with environmental sustainability and local community welfare.

Keywords: Food Estate, environmental issues, DPSIR framework, deforestation, public policy.

ABSTRAK

Implementasi kebijakan Food Estate di Indonesia menimbulkan kekhawatiran yang semakin besar terhadap keberlanjutan lingkungan, meskipun tujuan awalnya adalah untuk memperkuat ketahanan pangan nasional. Studi ini menganalisis dampak lingku-

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-ngan dari program Food Estate di Kabupaten Gunung Mas, Kalimantan Tengah, dengan menggunakan kerangka *Driving Forces–Pressures–State–Impacts–Responses* (DPSIR). Penelitian dilakukan melalui studi kasus kualitatif berbasis analisis dokumen, dengan memanfaatkan dokumen kebijakan, laporan lingkungan, dan penelitian terdahulu. Hasil penelitian menunjukkan bahwa fokus kebijakan pada perluasan pertanian berskala besar telah menghasilkan tekanan lingkungan melalui konversi hutan menjadi perkebunan singkong. Berdasarkan dokumen dan laporan yang dianalisis, tekanan tersebut terkait dengan risiko erosi tanah, penurunan kualitas tanah, terganggunya fungsi hidrologis wilayah hulu, serta emisi karbon yang terkait dengan aktivitas pembukaan lahan. Dokumen yang dikaji juga menunjukkan adanya keterkaitan antara aktivitas pembukaan lahan dengan kejadian banjir di wilayah hilir, rendahnya produktivitas singkong, serta meningkatnya kerentanan terhadap kebakaran hutan. Analisis DPSIR turut menunjukkan bahwa berbagai persoalan lingkungan tersebut berkaitan erat dengan desain kebijakan, terutama dalam hal pemilihan lokasi dan strategi implementasinya. Berdasarkan temuan tersebut, studi ini merekomendasikan sejumlah respons kebijakan, di antaranya evaluasi kebijakan secara menyeluruh, perbaikan pemilihan lokasi, pengembangan lahan secara bertahap, rehabilitasi lahan, serta langkah mitigasi bencana yang terintegrasi. Melalui pemetaan sistematis atas hubungan sebab-akibat antara intervensi kebijakan dan perubahan lingkungan, studi ini berkontribusi pada evaluasi kebijakan berbasis bukti guna menyeimbangkan tujuan ketahanan pangan nasional dengan keberlanjutan lingkungan dan kesejahteraan masyarakat lokal.

Kata Kunci: Food Estate, Isu lingkungan, Kerangka DPSIR, Deforestasi, Kebijakan Publik

INTRODUCTION

Food security is a global issue that has been a concern for the past few decades. This concern is particularly relevant considering the growing global population, which is predicted to reach 9.15 billion by 2050 and requires an increase in global food supply of at least 60% by that year (Alexandratos & Bruinsma, 2012). Food is a basic need for humans that cannot be replaced. Food needs affect the economy, society, politics, and culture (Mukti, 2020). Food insecurity results in poor physical and cognitive growth, low productivity, and poverty (Zaman, 2023).

Indonesia is the fourth most populous country in the world with a population of approximately 280 million. There is a huge demand for food in the country and a need for about 31 million tons of food per year to meet the national consumption. In 2022, the Global Food Security Index ranked Indonesia 63rd out of 113 countries and the food security score has been stagnant since 2019. Furthermore, the Global Hunger Index 2023 placed Indonesia as the country with the second-highest level of hunger in Southeast Asia. Indonesia's food security trend declined during the pandemic and had not fully rebounded by 2022.

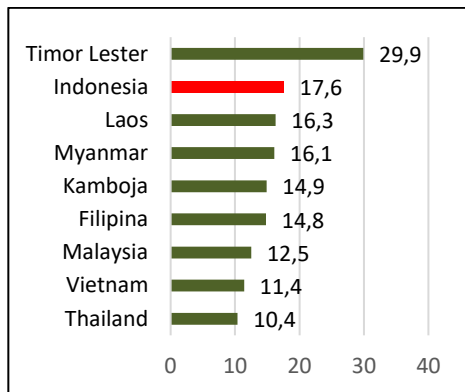


Figure 1. Hunger levels in ASEAN countries based on the Global Hunger Index (2023)

Although hunger is not solely caused by food shortages, but also by limited social, economic, and political access to food, the Indonesian government has taken preventive measures to mitigate potential future food crises through the development of food estates. This policy is one of the government's strategies to meet national food demand while strengthening the country's logistical reserves. A food estate refers to a large-scale agricultural area managed with the purpose of producing food to meet the needs of a particular region. The development of food estates is expected to serve as one of the solutions to Indonesia's food security challenges in facing potential crises in the future (Rasman et al., 2023).

One of the major implementations of this policy was the development of a food estate in Central Kalimantan. To transform Central Kalimantan into the National Food Barn, the government had

already been implementing extensive food production programs since 2018. In May 2020, the Government of the Republic of Indonesia announced its decision to establish a National Strategic Food Reserve in the form of a food estate in Central Kalimantan (Baringbing, 2021). Cassava was selected as the primary commodity for this development due to its high adaptability and productivity. In the same session, it was agreed that the food estate development would utilize forest land (Ministry of Defense, 2020). In 2020, food estate projects were also implemented in Merauke and Central Kalimantan, covering an area of 180,000 hectares.

Locating food production centers closer to consumers is believed to reduce food prices (Yestati et al., 2021). To realize this, food estates were designated as part of the National Strategic Programs through Government Regulation No. 109 of 2020. Furthermore, the Omnibus Law on Job Creation requires ministers, heads of agencies, governors and district heads/mayors to expedite licensing procedures, including permit and non-permit licensing, in support of the implementation of PSN. This provision allows for smoother land acquisition for food estates, including the possibility of allocating land from indigenous and local communities.

Nevertheless, the implementation of food estates is not without problems. It should be pointed out that the food estate project has implications not only for the agricultural sector but also for ecosystems and local communities. The project requires the use of natural forest areas, and therefore, land use changes resulting from human intervention must be carefully analyzed regarding potential negative impacts such as changes in hydrological cycles, soil degradation, and loss of biodiversity. A detailed understanding of these conditions is therefore necessary for a full evaluation.

One of the selected food estate locations is Gunung Mas Regency, Central Kalimantan Province, which is a dense forest area that extends northwards to the Kalimantan interior, from the provincial capital of Palangkaraya to the foothills of central Kalimantan. The Ministry of Defense has planned to build a food barn in this province which covers an area of 31,000 hectares in three regencies: 1,124 hectares in Pulang Pisau, 9,617 hectares in Kapuas, and 23,019 hectares in Gunung Mas. The land allocated for this project in Gunung Mas is spread across four sub-districts: Kurun, Mihing Raya, Rungan, and Sepang Simin. Kurun district has the largest area of 12,570.29 ha, followed by Mihing Raya (8,559.59 ha), Sepang Simin

(8,002.87 ha), and Rungan (4,666.40 ha). The forests in this region are rich in biodiversity, including the critically endangered Bornean orangutan. In recent decades, this species has declined by more than half in terms of habitat and population, and continued habitat loss is unsustainable. Therefore, the development of food estates needs to be thoroughly researched on the environmental problems associated with it to find solutions and improvements to be made by the government. While food security is a matter of concern, the environmental impacts of this program are also a matter of serious consideration.

Several studies have looked at the Food Estate program from different points of view. For instance, Baringbing (2021) pointed out the program's regulatory and environmental problems in Gunung Mas and Pulang Pisau; Yestati and Noor (2021) discussed the issue of protecting community rights in Central Kalimantan; and Surbakti et al. (2023) analyzed the inefficiency of program implementation in Gunung Mas. However, few studies have systematically mapped the causal chain of policy drivers, environmental pressures, ecological state changes, social-environmental impacts, and government responses, especially in Gunung Mas Regency.

This study seeks to fill this gap by

applying the DPSIR framework to arrange existing evidence into a single cause-and-effect structure. This study aims to map and analyze the reported causal relationships between food estate policy implementation and environmental concerns within the DPSIR framework based on available documentary evidence. Thus, the study is expected to contribute to the development of comprehensive policy strategies that address not only food provision but also the environmental factors affected by the program.

Based on the above background and research problems, this study addresses the following questions: (1) What are the driving forces behind environmental challenges in the food estate program (Driving Forces, Pressures)? (2) What are the impacts resulting from the program (State, Impacts)? (3) What sustainable policy recommendations can address future environmental challenges related to the food estate program (Responses)?

THEORETICAL REVIEW

1. Public Policy Evaluation

Public policy evaluation is a systematic activity that builds on the foregoing description by combining empirical evidence (whether objectives have been achieved, the magnitude of impacts, and any side effects) with normative assessment (how valuable,

equitable, or efficient those outcomes are according to agreed criteria) to determine whether a policy should be sustained, revised, or terminated. Evaluation differs from mere monitoring because it requires a value-based interpretation of evidence, employs both quantitative and qualitative methods, and takes into account ethical and legitimacy considerations when formulating recommendations. Evaluation bridges scholarship and policy practice, providing mechanisms for accountability and learning for policymakers, and serving as a tool to clarify the values and objectives underlying public interventions (Dunn, 2017).

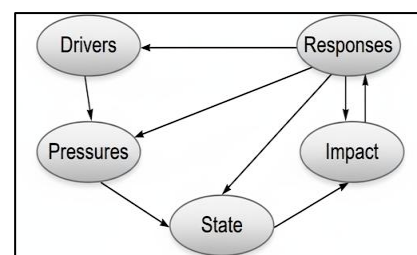


Figure 2. DPSIR Framework

2. DPSIR Framework

The DPSIR framework (Drivers, Pressures, State, Impact, Responses) has become one of the most used conceptual models for assessing public policies in the fields of environment and natural resources. This framework was initially proposed by the European Environmental Agency (EEA) in the late 1990s as an analytical model to organize information on the condition of the environment in a

systematic way (Smeets et al., 1999). DPSIR is structured as a cause–effect framework that explains interactions in socio-ecological systems starting from driving forces followed by pressures, state, impacts, and finally responses

All these components are defined as: (1) Driving Forces are factors that motivate human activities and satisfy basic human needs; (2) Pressures are immediate stressors generated by these driving forces that influence the state of the system; (3) State is the condition of the system at a certain point in time; (4) Impacts are modifications in the quality and functioning of the system caused by these pressures; and (5) Responses are actions taken by society or policymakers to address undesirable impacts (Smeets et al., 1999).

The strength of DPSIR is its ability to clarify the relationships between causes and effects of environmental problems and provide a framework for analysis of socio-ecological processes. For example, the relationship between driving forces and pressures in economic activities is strongly influenced by the eco-efficiency of the technologies and systems in use; greater eco-efficiency tends to reduce pressures from driving forces. Similarly, the degree of impacts on humans or ecosystems depends on the resilience and thresholds of those systems. Responses taken by society

or government depend not only on the existence of impacts, but also on the perception and assessment of such impacts, and the efficiency of these responses can also affect the course of driving forces (Smeets et al., 1999).

This framework has been widely used to identify connections between environmental change and socio-economic factors for evidence-based policymaking (Dzoga et al., 2020) and applied to specific ecosystem contexts. For instance, studies in mangrove ecosystems in Indonesia have shown that DPSIR can reveal multiple threats, from aquaculture expansion to land-use change, and simultaneously identify policy responses such as mangrove rehabilitation and community-based management (Quevedo et al., 2023). Likewise, the integration of spatial and social dimensions in watershed management in Bolivia has demonstrated that the DPSIR framework can be enriched with insights on environmental justice and social vulnerability, as policy responses tend to concentrate at the macro level and ignore the effects on vulnerable groups at the local scale (Agramont et al., 2022).

In this study, DPSIR is preferred over alternative approaches such as policy cycle analysis, environmental governance, political ecology, or sustainability assessment. These approaches emphasize

the stages of policymaking, institutional arrangements, or power relations, while the central problem of this research concerns the sequence of cause and effect that connects a national policy with local environmental change. DPSIR is therefore selected because it allows the researcher to trace the causal chain from policy drivers to environmental pressures, ecological state changes, social-environmental impacts, and corrective policy responses.

METHOD

This study employs a qualitative case study approach based on document analysis. A qualitative approach is commonly used to explore and understand social issues, uncover meanings, and explain why and how a phenomenon occurs (Creswell & Creswell, 2018), and it is considered appropriate here because the Food Estate program involves public policy, environmental change, and the livelihoods of local communities. Data were collected from policy documents and regulations on the Food Estate program, previous studies on its implementation in Central Kalimantan, environmental reports, in particular the report of Greenpeace (2022), and media investigations on conditions in Gunung Mas Regency. All of the data used are secondary data that are publicly available. The data were classified and analyzed

using the DPSIR framework, an acronym for Driving Forces, Pressures, State, Impacts, and Responses, so that information concerning policy and environmental conditions could be organized systematically. To maintain the credibility of the findings, information from one source was checked against other sources before being used in the analysis.

In interpreting the findings, this study distinguishes between documented environmental conditions, reported observations, and potential environmental risks. The analysis does not represent direct measurements of soil characteristics, hydrological changes, or greenhouse gas emissions. Instead, these environmental aspects are examined based on information reported in existing studies, institutional reports, and environmental investigations. This approach allows the study to evaluate how environmental concerns surrounding the Food Estate program have been constructed and documented within available evidence.

RESULTS AND DISCUSSION

1. Driving Force and Pressure

Food estate is not a new program under the current administration. The initiative has existed for decades and was first introduced by President Soeharto. In 1995, through Presidential Decree No. 82/1995, President Soeharto launched the

One Million Hectare Peatland Project in Central Kalimantan, widely known as the Mega Rice Project (PLG). However, this project was officially terminated in 1998 during President B.J.Habibie's administration through Presidential Decree No. 33/1998. The failure of PLG was mainly due to the lack of socio-ecological assessments of peatland ecosystems, which resulted in land degradation and incompatibility with the local socio-cultural conditions. Consequently, large-scale peatland damage triggered recurring forest fires, generating substantial socio-economic losses. These disasters have led to expensive mitigation, draining state finances and further impoverishing local communities (Nurindra, 2021).

Furthermore, the food estate goal to establish a national rice granary was never achieved; instead, much of the project site was later converted into oil palm plantations. Ironically, the project was financed with Reforestation Funds (Dana Reboisasi) amounting to IDR 1.7 trillion, originally intended for forest rehabilitation. The evidence of such diversion of funds was Presidential Decree No. 80/1999 allocating compensation payments to the affected communities and Presidential Instruction No. 2/2007, which set aside IDR 3.9 trillion for peatland rehabilitation—although the actual on-the-

ground implementation remained unclear. Later, the same region became a priority area for the Peatland Restoration Agency (BRG), yet government budget allocations have had little significant impact on long-term restoration (Nurindra, 2021).

The second stage of food security initiatives emerged during President Susilo Bambang Yudhoyono's administration with the Merauke Integrated Food and Energy Estate (MIFEE) in 2010. This program originated from Presidential Instruction No. 5/2008 on the 2008–2009 Economic Program Focus and Presidential Instruction No. 1/2010 on the Acceleration of National Development Priorities. MIFEE aimed to open 1.2 million hectares of agricultural land in Merauke, Papua, to strengthen national food and bioenergy reserves. However, the program proved unsuccessful: traditional sago forests were destroyed, and local communities lost access to essential food sources such as sago, fish, and wild game (deer, pigs) following extensive forest conversion.

Other programs included the Bulungan Food Estate in North Kalimantan (2011) covering 30,000 hectares to support transmigration in the Salim Batu Integrated City, and the Ketapang Food Estate in West Kalimantan (2013) which was expected to open up 100,000 hectares of rice fields. However, the results were minimal, with

only around 0.11% of the Ketapang target area being used. This is mainly caused by socio-cultural mismatch and lack of infrastructure (Nurindra, 2021).

The third stage took place under President Joko Widodo. In 2020, the FAO's Global Report on Food Crises warned of looming global food shortages coinciding with the COVID-19 pandemic. Jokowi announced the development of food estate as a national priority in anticipation of extended post-pandemic food crises. The program was formalized through the Ministry of Environment and Forestry Regulation No. 24/2020 on the Allocation of Forest Areas for Food Estate Development.

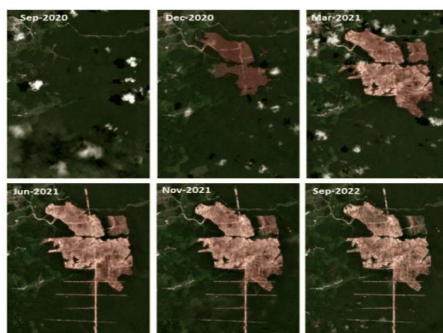


Figure 3. Satellite Imagery of Deforestation in Cassava Plantations in Gunung Mas
(Source: Greenpeace, 2022)

The implementation included:

1. Rice cultivation in Central Kalimantan (2020). The program covered 30,000 hectares, including 20,000 hectares of former PLG peatland restored through irrigation intensification, and 10,000 hectares of new farmland in Pulang

Pisau, a transmigration site. The government provided seeds, fertilizers, and agricultural machinery, with military personnel receiving brief training to serve as farmers. Interestingly, local transmigrants had already been practicing paddy farming for four decades, pointing to the long-term process needed to develop agricultural culture in new areas (Nurindra, 2021).

2. Cassava plantation in Gunung Mas (2021). The scheme, covering 31,000 hectares under the National Economic Recovery (Pemulihan Ekonomi Nasional/PEN) program, was to provide alternative carbohydrate reserves. The program was targeting foreign investment, including a potential collaboration with South Korea, to promote cassava as a substitute for wheat. However, around 15,000 hectares were involved in clearing natural forest. In 2022, only 760 hectares had been developed, releasing 77,000 tons of carbon from deforestation, increasing greenhouse gas emissions (Greenpeace, 2022).

3. State and Impact

The Pressures of the food estate program in Gunung Mas Regency have a significant impact on the land allocated for cassava plantations. Previously, the forest

was a source of local people's livelihoods, who used it to obtain timber for building houses, hunt for deer and wild boars, and collect traditional medicinal plants. All these sources of livelihood are now lost. This includes the four hectares of land that had been cultivated for generations with vegetables such as eggplants, long beans, winter melon, and rubber trees by local families. The loss of these customary rights has exacerbated the exploitation of peatlands, which were previously natural water regulators, causing droughts and, in turn, land fires (Pasaribu, 2023).

Degraded peatlands are highly prone to uncontrollable fires that not only damage the eco-hydrological functions of peat ecosystems but also worsen the socio-economic problems of communities that depend on forest resources for their livelihoods (Carmenta et al., 2021). In this regard, Marwanto and Pangestu (2021) emphasize that the development of the food estate program in the ex-PLG area of Central Kalimantan is at high risk of forest and land fires. This risk is related to the characteristics of peatland ecosystems that become very flammable after being drained and converted into agricultural land. Past records also show that such areas have experienced fires multiple times, a risk exacerbated by climate change and poor hydrological management.

Consequently, the potential for recurring fires is a serious and inherent threat to the sustainability of the food estate program in peatland regions.



Figure 4. Land Clearing Activities Within Forest Areas Designated As Food Crop Plantations For The Food Estate Project In Sepang Village, Gunung Mas Regency
(Source: Greenpeace, 2022)

According to interviews with residents of Tewai Baru Village by Greenpeace (2022), the land cleared by the Ministry of Defense was not suitable for planting cassava. The soil in the area was sandy, shallow, and highly susceptible to erosion when the vegetation cover was removed. The removal of vegetation accelerated surface runoff, which subsequently washed away the sandy topsoil. The inorganic fertilizers used in the area were quickly washed away by runoff and were poorly absorbed by the cleared sandy soils. This raises concerns for soil fertility and increases the risk of eutrophication in tropical aquatic systems such as in Kalimantan. In addition, the wetlands were clogged with a mix of coarse sediments and wood debris from the cleared areas, and local water flows were

disrupted. As a result, residents of Tewai Baru, Tampelas and Tanjung Karitak reported flooding as a result of this combination of factors, particularly in the Tambun and Tambakung Rivers, tributaries of the Kahayan River. These findings provide clear evidence of the significant impacts of forest clearing for plantations as experienced and reported by local communities (Greenpeace, 2022). Similar findings were reported by Surbakti et al. (2023) who showed that the Gunung Mas District Government was not involved in the planning or environmental assessment of the food estate program. In fact, the food estate area was developed in forest land that functions as a water catchment area and the headwaters of the Tambi and Tambun Rivers. The clearance of these forests without considering ecological impacts has triggered flooding that affected four villages in the surrounding area. In addition, the conversion of forest land has caused environmental degradation that harms local communities, such as the reduction of water availability for daily needs.

In addition, the plantation's location in the highlands further worsens the situation. Forests that once functioned to retain rainwater can no longer fulfill that role. The plantation site is located in the upstream area of the Kahayan River, so

deforestation in this region has caused flooding downstream. This is confirmed by an interview conducted by Pasaribu (2023) with residents in the downstream area (Tewai Baru Village), which stated that since the land clearing for the food estate, their area has frequently experienced flooding, causing material losses (Pasaribu, 2023).



Figure 5. Flooding in Tanjung Karitak Village, Gunung Mas Regency
(Source: Greenpeace, 2022)

Based on the reviewed documents, the environmental state associated with deforestation can be characterized by several reported conditions, including: (1) vulnerability to soil erosion and degradation; (2) concerns regarding declining soil quality due to nutrient loss; (3) reduced vegetation capacity for rainwater retention in upstream areas; and (4) carbon emissions associated with land clearing activities.

DISCUSSION

Based on the analysis using the DPSIR framework, the Responses component represents intervention efforts to address what occurs in the Driving Forces, Pressures, State, and Impacts. At this stage, responses may take the form of policies designed to anticipate the impacts of the food estate program, repair land degradation, reduce the pressures generated by the program, and halt or evaluate the driving factors behind the challenges it presents.

The food estate program does not stand alone; it is the result of accumulated conditions and political will of the current government. As the main driver of environmental challenges, the government should thoroughly evaluate the implementation of the food estate over the past three years. Such an evaluation must cover several crucial aspects, one of which is the selection of locations for the program. Field assessments have shown that inappropriate site selection can result in adverse impacts. The unsuitable soil conditions for the chosen crops not only reduce productivity, but also risk causing environmental damage. The government should return to the starting point and re-examine the existing studies on the condition of the land in Gunung Mas Regency. Poorly selected locations also put

local communities at a disadvantage, as evidenced by cases where the lands cleared did not support the optimal growth of certain crops. In addition, the implementation of the food estate program has significant environmental challenges. In this regard, the active participation of local communities in the planning and implementation processes is very important, because it can increase acceptance and support as well as help identify potential problems and challenges in the implementation.

In the food estate program which causes deforestation, the government has taken policy steps that reduce pressures on forests and the environment. The negative impact that can occur from the expansion of land for food estates must be realized, and concrete steps must be prioritized to reduce the pressure. One way is to start with a narrow plantation area then expand according to production needs gradually. This step is necessary to ensure environmental sustainability and reduce the damage that results from deforestation.

To reduce the impacts of pressures of cassava plantation, the government could encourage sustainable agricultural practices and land use efficiency. Policies could include use of eco-friendly farming techniques, use of organic fertilizers, and efficient use of water. The government

should also increase land rehabilitation programs as an alternative to expanding into new forest areas. The rehabilitation program is designed to restore soil productivity and decrease dependence on primary forest clearing by using unproductive or degraded land, thus reducing pressure on existing forest ecosystems.

The government should actively take part in policy design to implement preventive measures against the risks of flooding, forest fires and crop failures due to the food estate program. For flooding, water management and flood prevention should be carried out. One alternative is to build reservoirs to hold excess water before it reaches downstream areas, particularly because the ability of upstream forests to

hold water is lost. For the risk of forest fires, the government should establish monitoring posts in fire-prone areas. Given that the greenhouse effects in plantation zones are increasing, regular patrols, particularly in long dry seasons, are required to ensure rapid responses if a fire occurs. Finally, for the poor harvest and crop failure, the government should focus on improving the fertility of the soil. The nutrients of the soil can be improved with the collaboration of external stakeholders like universities and research institutions to ensure the sustainable agricultural productivity of these lands.

The overall results of the analysis are presented in Figure 6, and Table 1 summarizes the findings for each DPSIR component.

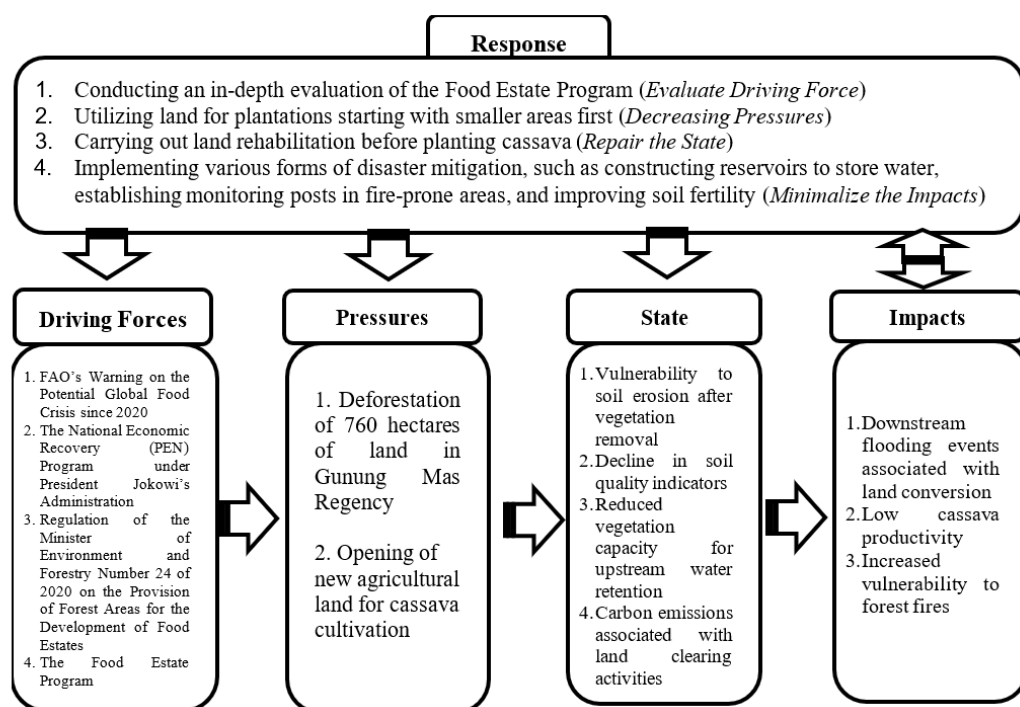


Figure 6. DPSIR Framework Analysis of Environmental Issues in the Food Estate Program

Table 1. Summary of the DPSIR Analysis of the Food Estate Program in Gunung Mas Regency

DPSIR Component	Key Findings	Evidence	Implications
Driving Forces	Anticipation of a food crisis, the National Economic Recovery (PEN) scheme, and regulations designating the Food Estate as a National Strategic Program	FAO (2020); Government Regulation No. 109 of 2020; Ministry of Environment and Forestry Regulation No. 24/2020	The policy design, particularly site selection and planning, needs to be evaluated
Pressures	Clearing of natural forest for the cassava plantation, covering about 15,000 ha of the 31,000 ha designated area	Greenpeace (2022)	Growing pressure on forest ecosystems and local livelihoods
State	Soil erosion vulnerability, concerns regarding soil quality decline, reduced vegetation-based water retention capacity, and carbon emissions from land clearing activities	Greenpeace (2022); Surbakti et al. (2023); the release of 77,000 tons of carbon from 760 ha of cleared land	Land rehabilitation is required
Impacts	Downstream flooding, low cassava productivity, and increased vulnerability to forest fires	Greenpeace (2022); Pasaribu (2023); Marwanto and Pangestu (2021)	Disaster mitigation needs to be strengthened
Responses	Policy evaluation, small-scale and gradual implementation, land rehabilitation, reservoir construction, fire monitoring posts, soil fertility improvement	Policy recommendations of this study	Corrective policies consistent with sustainable development

Source: Authors' Analysis

CONCLUSION

The analysis conducted demonstrates that the food estate program in Gunung Mas Regency, Central Kalimantan, generates significant environmental consequences. Through the DPSIR framework, several critical problems are revealed, such as deforestation, soil erosion, declining soil fertility, intensified greenhouse effects, flooding in downstream areas, low cassava productivity, and heightened forest fire risks. These findings underscore that environmental degradation cannot be separated from questions of human

development. As Amartya Sen (1999) puts it in *Development as Freedom*, real development must be about expanding human capabilities and freedoms, not curtailing them in ecological crises that endanger jobs, health and security.

In this sense, the government's responsibility goes beyond short-term economic gains. It requires evaluating the driving forces of the food estate program, particularly its design and implementation; reducing the pressures such as uncontrolled deforestation; restoring the state of degraded lands through systematic rehabilitation and sustainable agricultural

practices; and minimizing the impacts of disasters like floods, forest fires, and crop failures through anticipatory mitigation. These challenges are important to address, both for ecological resilience and for the real freedoms of local communities that depend on their environment for survival and welfare.

This study relies on secondary data and document analysis; therefore, the findings are dependent on the availability, quality, and methodological characteristics of existing reports. Some environmental issues identified in this study, including soil conditions, hydrological changes, and carbon emissions, require further field-based investigation to quantify their magnitude. Nevertheless, the document-based DPSIR approach provides value by systematically organizing fragmented evidence and identifying important areas requiring further evaluation. The analysis is also limited to one location, Gunung Mas Regency, and does not include primary data collected in the field.

Thereby, more research is needed to explore whether government responses are indeed in line with the tenets of sustainable development and capability expansion. Future studies should include field interviews with affected communities and program implementers, official spatial data, and comparative analysis with other

Food Estate locations. Without effective interventions, the food estate program risks narrowing rather than broadening the freedoms and opportunities of present and future generations.

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