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# Climate change impacts of forest conversion: Study on forest conversion for food estate/national food granary program in Central Kalimantan

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## ABSTRACT
**Background:** The Food Estate policy or national food granary program is a food development concept that is integrated with agriculture, plantations and animal husbandry, one of which is in the area of openings in natural forests covering an area of 156,000 ha in Central Kalimantan. This program is designed to prepare national food security in order to respond to the Food and Agriculture (FAO) Report on the threat of a global food crisis due to the impact of the Covid 19 pandemic. Changes in forest cover from previously green land to agricultural land will cause loss of forest cover in the form of vegetation or trees that have ecosystem services as carbon dioxide absorbers from the air. **Methods:** The impact of forest conversion is analyzed by conducting spatial analysis of land cover and calculating potential carbon stocks lost, as well as providing suggestions or solutions to problems or gaps from an economic, social, and political environmental perspective. **Findings:** From the results of literature studies, the government must learn from the experience of food estate projects on peatlands in the past where peatlands became thin and when the dry season arrived, the land would be flammable due to lack of attention to the biophysical aspects of the soil. **Conclusion:** In addition, economic and social aspects involve and assist the community in carrying out food security programs and agricultural technology sophistication. **Novelty/Originality of this Study:** This analysis provides a unique perspective on the climate change impacts of forest conversion for food estate programs, bridging the gap between national food security policies and environmental conservation imperatives.

**KEYWORDS**: forest conversion; food estate; climate change; national food granary program; peatland forest.

## 1. Introduction

The World Food Organization (FAO) in early 2020 warned the whole world that the Covid-19 pandemic would have a negative impact in the form of threats to food security and food crises. The warning was responded by Indonesia by implementing food estate policies in a number of provinces by utilizing land and converting forest areas (Susetyo, 2021; Lupascu et al., 2023). The Food Estate Program is a government initiative that aims to develop food in a region using integrated methods such as plantations, agriculture, and animal husbandry. One of the National Strategic Programs (PSN) 2020–2024 includes this policy program. Spread across five provinces, Food Estate will be constructed over an approximate total area of 1,700,000 hectares (ha). According to Finaka et al. (n.d), the five provinces are Papua (1,700,000 ha), Maluku (190,000 ha), East Kalimantan (10,000 ha),

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West Kalimantan (120,000 ha), and Central Kalimantan (180,000 ha). However, this policy is a debate because forestry science has provided answers to how forests can act as food granaries, namely through agroforestry or agroforestry. Indigenous peoples and communities around forests have practiced it by planting agricultural commodities and plantations in forests, between and under tree stands. The Job Creation Law Number 11 of 2020 also provides a solution to this problem, namely through multi-business forestry activities. This scheme not only uses forests for agriculture, but livestock, fisheries, and its own forestry business, namely non-timber forest products (Susetyo, 2021).

Food security is the state of having enough food, both in terms of quantity and quality, that is safe, diverse, nutritious, equitable, affordable, and does not conflict with local religions, cultural norms, or beliefs to allow people to live long, healthy, and productive lives (Misselhorn et al., 2012; Aberman et al., 2018; Keovilignavong & Suhardiman, 2020; Tembo et al., 2024). It extends to individual citizens as well. A food estate is a large-scale food business that consists of a number of operations done to meet human needs through the integrated production of food products through the use of capital, technology, and other resources (Lasminingrat & Efriza, 2020; Herrero et al., 2021; Fadillah et al., 20201; Marwanto et al., 2021; Yeny et al., 2023). These operations include food crops, horticulture, plantations, livestock, and fisheries in a forest area. Forest Area for Food Security, hereinafter abbreviated as KHKP, is a Forest Area specifically intended for the benefit of food security with the development of Food Estate (Kementerian Lingkungan Hidup dan Kehutanan, 2020).

Indonesia's national food security is ensured by the Food Estate land use policy, which is outlined in Minister of Environment and Forestry Regulation Number 24 of 2020. The goal of this initiative is to raise the added value of production in the local agricultural sector in order to provide low-cost food, jobs, and the growth of large-scale agricultural businesses. The government's legalization of food estate policies through the Job Creation Law has the ability to transform forest areas into agricultural land, as per multiple research and material reviewed for this study. The consequences of the implementation of this policy include environmental damage, increased conflict potential and land management that is not in accordance with the spatial plan owned by Central Kalimantan province as a whole. The government's priority in achieving food security is supported by ease of licensing because bureaucracy has been cut by the center so that the process is faster. This indicates that the process of clearing food granary land is very likely to violate forestry regulations and land management. The Ministry of Environment and Forestry released Minister of Environment and Forestry Regulation Number 24 of 2020 concerning the Provision of Forest Areas for Food Estate Development in order to address domestic food demands. The location of the Food Estate, which spans 180,000 hectares in Central Kalimantan, 1.2 million hectares in Papua, 120,000 hectares in West Kalimantan, 10,000 hectares in East Kalimantan, and 190,000 hectares in Maluku, was determined by the central government. The policy states that the area that can be used for the rice granary program can also be a protected forest area. This then raises the question, is the aspect of environmental protection also one of the government's priorities - considering that one of the points in the policy legalizes agricultural land that can also stand in forest areas that should be protected (Ayu, 2022).

On March 24, 2020, FAO stated that the world food crisis has the potential to occur due to countries' policies in implementing regional quarantines which will have an impact on supply chain disruptions. One of the government's quick responses in response to FAO's warning was to issue a plan to develop a food estate on land from a former peatland development project (PLG) in Central Kalimantan. The goal of the new paddy printing program is to prioritize efforts for the expansion and intensification of rice fields in order to sustain the demands of the country's food supplies, particularly rice. The National Strategic Project (PSN), as defined by Presidential Regulation No. 109/2020, has also incorporated this food estate development.

The Minister of Environment and Forestry's Regulation Number 24 of 2020 on the Provision of Forest Areas for Food Estate Development governs Indonesia's food estate

policy with regard to food security. Providing Forest Areas for Food Estate Development is done through the following mechanisms: A. Modifications to the designation of a forest area; or B. Establishment of the KHKP (Forest Area for Food Security). Through the use of a Forest Area release scheme, the following requirements must be met in HPK Areas (converted Production Forests) in order for a Forest Area to be designated as suitable for Food Estate development. Not in Forest Areas classified as Special Purpose Forest Areas, nor burdened with Forest Area Use licenses, Forest Utilization Permits, and/or other licenses from the Minister. After being taken out of their employment area, burdened with permits for the use of forests. Both ineffective and effective. Ineffective, whether or not they are located in regions set aside for land redistribution for agrarian reform.

In the meantime, production forest areas and/or protected forest areas may also be used in the process for identifying KHKP and forest areas for food security with the provision of forest areas for food estate development. (2) A protected forest area that no longer meets all legal requirements for protection under applicable laws and regulations is referred to as a protected forest area. 1) Has been forced to bear the management rights imposed by state-owned forestry companies. 2) Has, since been taken out of its job area, been encumbered with a forest use permit. 3) Have been set aside, burdened with social forestry licenses, or set aside for land objects of agrarian reform (TORA) through the adaptation of agrarian reform and people-oriented initiatives.

According to estimates of rice production and demand by the Logistics Affairs Agency (Bulog) and the Ministry of Agriculture in 2020, Indonesia's rice stocks will be safe. The status of rice stocks in 2020 can be seen in the Table 1.

Table 1. Rice stock according to estimates by Bulog and the Ministry of Agriculture

| Bulog | 2020 (Million tons) | | | | Status |
|---|---|---|---|---|---|
| | January | May | August | December | |
| Stock | 3.5 | 7.7 | 8.25 | 4.7 | Surplus |
| Production | 11.87 | 7.97 | 6.25 | | |
| Necessity | 7.61 | 7.49 | 9.99 | | |
| Ministry of Agriculture | 2020 (Million tons) | | | | Status |
| | January | May | August | December | |
| Stock | 5.94 | | | 6.11 | Surplus |
| Production | 30.26 | | | | |
| Necessity | 30.08 | | | | |

(Ministry of Agriculture Republic of Indonesia, 2020)

Bulog predicts that the final stock of rice in December 2020 will be surplus with a figure of 4.7 million tons. Meanwhile, based on the calculation of rice availability and demand in 2020 from the Ministry of Agriculture, with a population of nearly 270 million people and national rice needs of 111.58 kilograms/capita/ year, the total rice demand is estimated to reach 30.08 million tons. Meanwhile, the estimated national rice production in 2020 is predicted to reach 30.26 million tons, so that there is a rice surplus of around 175.87 thousand tons. Coupled with the initial stock in 2020 of 5.94 million tons, rice stocks at the end of 2020 will have a surplus of 6.11 million tons. By looking at the prediction of rice stocks from Bulog and the Ministry of Agriculture and predictions of rice demand in 2020, the national rice stock for 2020 should still meet the needs.

Indonesia's Food Security Index increased from position 65 in 2018 to rank 62 in 2019 (Figure 1). Three criteria are used to evaluate this index: availability, affordability, and food safety and quality. The ability of customers to purchase food is gauged by affordability. The country's ability to distribute food, the risk of supply disruptions, the sufficiency of its food supply, and research efforts to increase agricultural output are all gauged by availability. Nutritional standards and import monitoring are two aspects of food quality and safety that are related to one other. Based on these three factors, Indonesia's situation has started to become better year over year.

Although the value of Indonesia's food security index has increased, there are still records related to several Indonesian assessment points that still have values below

average according to GFSI data, namely: 1) Affordability - Low gross domestic product per capita - Access to finance for farmers remains difficult. 2) Availability - Public expenditure on agricultural research and development is lacking - Limited agricultural infrastructure - Corrupt practices in food distribution and subsidies to farmers are still common - High food loss. 3) Quality and safety - Low food diversity - Availability of micronutrients in less food - Less protein quality. In other words, the availability of food stocks is not the main focus that must be addressed, but the above points should be a priority in efforts to improve national food security.

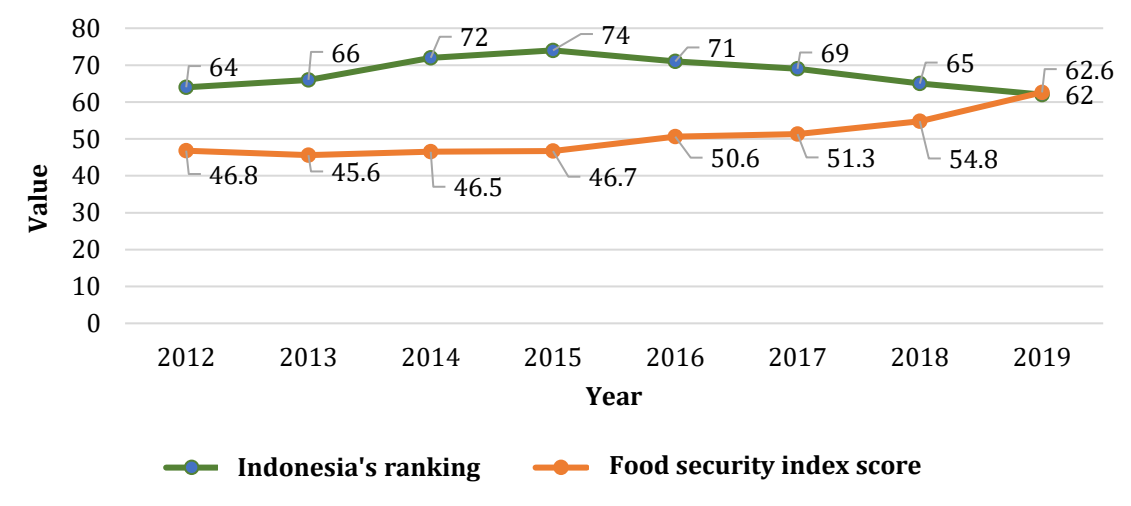


Fig. 1. Food security index Indonesia 2012 - 2019

## 2. Methods

The use of literature studies is the fundamental research methodology. Data are gathered from expert study findings as well as established policies, which are then subjected to spatial analysis of land cover and prospective carbon stock loss calculations. The study's emphasis and location were the areas of openings in Central Kalimantan's natural forests, which span 156,000 hectares. Numerous sources were analyzed for the research, particularly through a literature review. The literature used as a source for this research is undoubtedly closely related to the issue; it includes official reports from state entities as well as domestic and international periodicals on food security in Indonesia.

Reports from international organizations like the Food and Agriculture Organization (FAO) are another source of information, since the COVID-19 epidemic has affected food security worldwide. The study's case studies highlight instances where pandemics have spread over the world and endanger human security, particularly when examined from the standpoint of food security. There is no denying the connections between the aforementioned concepts of food security, national security, and human security; if one is disrupted, the others will suffer as well. Including the effects of forest conversion and the possibility of lost carbon stocks, which are areas of study that will concentrate on offering recommendations or answers to issues or gaps from a political, social, and economic standpoint.

## 3. Results and Discussion

### *3.1 Description of food estate plan in Indonesia*

In addition to the contentious problems surrounding the food estate program and the risk of forest and land fires, there is still confusion over the placement and scope of rice field printing. Some parties mention different figures for the area of rice field printing plans. The differences are: 1) Coordinating Minister for Economic Affairs, Airlangga Hartarto,

explained that his party was preparing 900,000 ha of land to support the program. 2) Syahrul Yasin Limpo, the minister of agriculture, reported that almost 600,000 hectares of land, divided into 200 ha of dry land and 400 thousand ha of peatland, had been prepared. 3) Then, at the end of May 2020, a document was circulated by the KLHS Cepat interim report from the Ministry of Environment and Forestry which stated that there were around 165 thousand ha of potential land above the former PLG for intensification and extensification of rice fields. 4) On June 16, the Minister of Public Works and Public Housing (PUPR), Basuki Hadimuljono, said that there is a potential land area of 165 thousand ha, which is alluvial area, not peat, on former PLG land in Central Kalimantan. 5) However, in a follow-up meeting discussing food estate on September 23, 2020, President Jokowi mentioned that food estate would be carried out in Central Kalimantan Province on an area of 148 thousand ha which already has irrigation networks for rice crops and 622 thousand ha of non-irrigated areas for cassava, corn and animal husbandry. The differences in food estate area plans in Central Kalimantan can be seen in Table 2.

Table 2. Food estate area plan in Central Kalimantan Province

| No | Source | Food estate area plan in Central Kalimantan (Ha) |
|---|---|---|
| 1 | Coordinating Minister for Economic Affairs | 900,000 |
| 2 | Minister of Agriculture | 600,000 |
| 3 | KLHS within MoEF | 165,000 |
| 4 | Minister of PUPERA | 165,000 |
| 5 | President of the Republic of Indonesia | 770,000 |

### *3.2 Results of forest function identification and forest conversion for food estate in Central Kalimantan*

Data analysis of indications of tree cover loss from 2020–2022 was carried out in 3 districts in Central Kalimantan, namely Pulang Pisau Regency, Kapuas Regency, and Gunung Mas Regency, which are included in the initial area of Food estate project development. This was done to see indications of threats in protected areas. The no go zone map, which is an indicative map of areas with high conservation value that need to be protected and avoided in the development of food estate projects, overlaps Pantau Gambut's indication of tree cover loss for the districts of Pulang Pisau and Kapuas. The no go zone map is created by analyzing three criteria: peatland with a depth of > 1 meter, peatland with primary and secondary forest vegetation, and peatland with a protected function.

The results are expected over the 2020–2022 period, there are signs of a decrease in the amount of tree cover in a number of villages across the three districts in some cases, this loss of tree cover even reaches an area of over 100 hectares, or 125 times the size of a football field. There are regions in Pulang Pisau and Kapuas regencies where there is a loss of tree cover that is classified as a no-go zone. This suggests that the Food Estate project is occurring in an area that needs to be preserved.

Table 3. Area of indication of tree cover loss per year in 3 districts (Area no go zone)

| Regency | Area of lost tree cover (Ha) | | | Total (Ha) |
|---|---|---|---|---|
| | 2020 | 2021 | 2022 | |
| Pulau Pisau | 1,110.06 | 354.60 | - | 1,464.66 |
| Kapuas | 561.33 | 351.45 | 0.53 | 913.31 |
| Gunung Mas | 1,025.46 | 459.54 | 102.59 | 1,587.59 |
| Total (Ha) | 2,696.85 | 1,165.59 | 103.12 | 3,965.56 |

Table 3 indicates that 3,965.56 hectares is the total potential indication of loss of tree cover in protected areas from 2020 to 2022 from 3 districts. Figure 1 illustrates the area (purple dot) that the image detected is in the no-go zone map area (green), which should be avoided and protected while developing food estate projects. There are still signs of declining tree cover in three districts as of 2021, but the area is not as vast as it was in

2020—roughly 293.67 hectares—with Tumbang Nusa village in Pulang Pisau Regency having the largest area, covering 113.49 hectares. Like Garung Village, Tumbang Nusa Village's identification findings are included in the no-go zone map region.

The data period used in 2022 is just January–March, therefore indicators of tree cover loss in the three districts are typically limited. To view all indications of tree cover loss in 2022, analysis using the most recent data is required through the end of 2022. In the settlement of Tewai Baru in Gunung Mas Regency, the biggest land removal occurred in 2020. The spatial visualization results demonstrate that areas in Tewai Baru village (during the period of January to March) are shown to lose tree cover (yellow dots), with an estimated size of 17.14 ha distributed over multiple places.

Satellite Photo Pantau Gambut carried out additional verification to see locations indicated by tree cover loss through satellite images to see the appearance of photos of land cover change from these locations. Data indicating tree cover loss in Pulang Pisau, Kapuas, and Gunung Mas districts was found through data indicating tree cover loss. Consequently, there were alterations to the landscape in a few places that suggested a reduction in the amount of tree cover. Tree cover loss data can be used to detect signs of land clearance in forested or highly vegetated areas, and satellite imagery can be used to confirm these findings (showing hints of land clearing in strongly vegetated areas).

The picture verification results show that the observed location's scenery has changed over the course of four years (2019–2022). It is evident that in 2019, formerly vegetated land started to be cleaned; this was indicated by green patches that massively and systematically became brown. Figure 2 shows the drastic reduction in tree cover in Sepang Kota Village, Gunung Mas Regency. The clearance of this property began in 2019 and will go until 2022. The purpose of the land is still unknown, but the clearing shown in this satellite image appears to be quite harmful and puts the current peatland ecosystem in jeopardy.


Fig. 2. Satellite image verification results regarding indications of tree cover loss in Sepang Kota Village, Gunung Mas Regency

Figure 3 shows the reduction of tree cover in Tumbang Nusa Village due to land clearing for rice crops. The land is still vegetated as of the beginning of 2020, as indicated by the green markings, and by the end of the year, it has opened up and become a rice field region. Tumbang Nusa Village's land clearing is also included in the "no go zone," or "green," which is an area that shouldn't be used or opened for food estate operations.

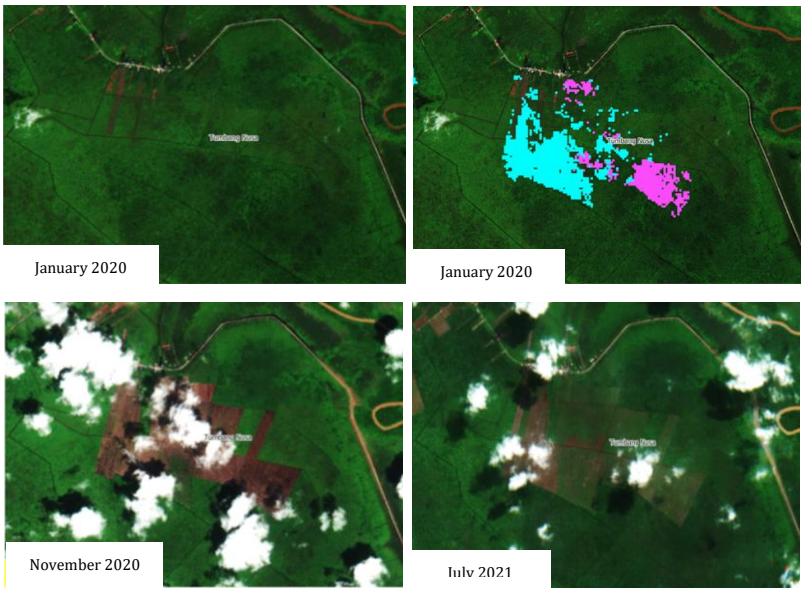


Fig. 3. Satellite image verification results regarding indications of tree cover loss in Tumbang Nusa Village, Pulang Pisau Regency

Thus, a large number of heavily vegetated regions were transformed into rice fields. Satellite photos from 2019 that showed green land appeared, and from 2021 to 2022, the land turned brownish and arranged like rice fields (Figures 4 and 5). In order to ensure that land management in the area does not harm the current peatland ecosystem, even though many rice field extensification coordinate areas are not included in the no go zone (green area), the government and academics need to conduct additional studies and provide oversight during their implementation in the form of monitoring and evaluation.

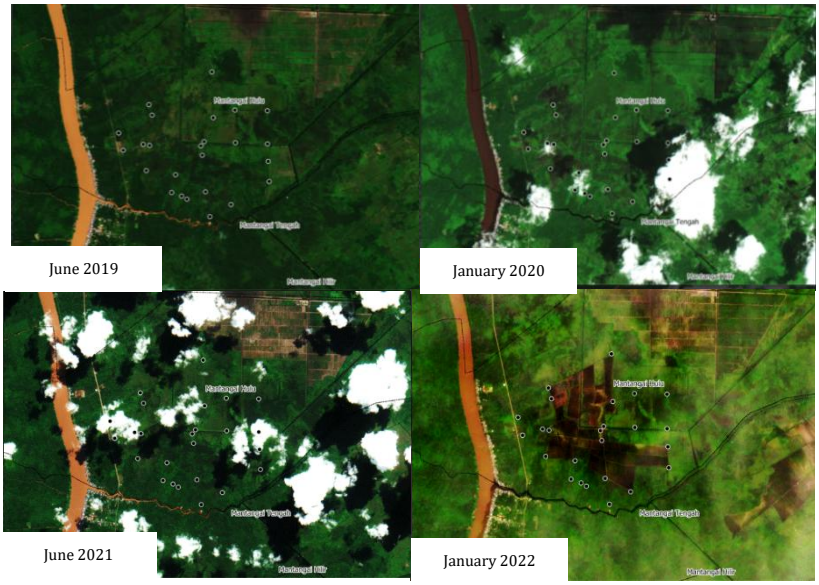


Fig. 4. The outcome of verifying the coordinates of the rice field extension objective in Mantangai Hulu Village, Kapuas Regency, using satellite imagery

Based on the analysis's findings, more field research and confirmations are required to determine what exactly goes on in the field—particularly in regions where there has been a decrease in tree cover—and whether or not the building of this food estate project has

resulted in deforestation. Since the community will be the ones to bear the consequences of actions that harm the environment and the peat ecosystem, the Food Estate project's implementation must continue to be carefully monitored in order to prevent harm to the surrounding peat ecosystem and environmental sustainability.

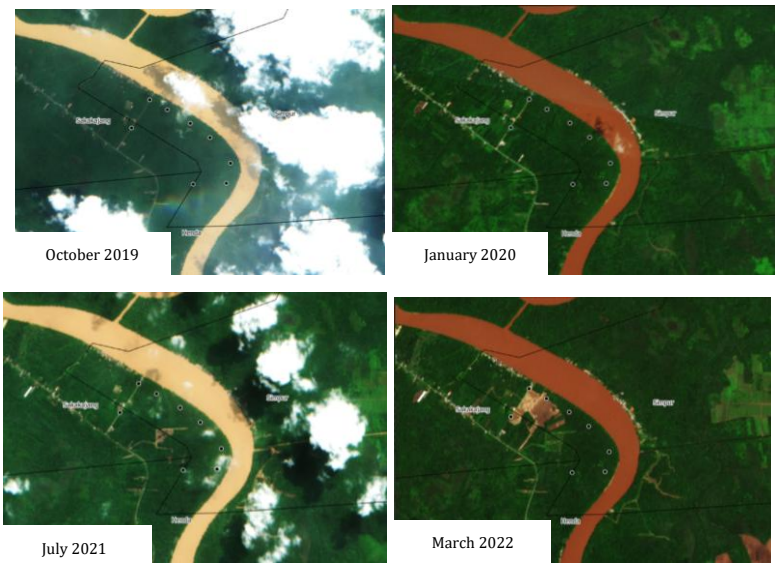


Fig. 5. The outcomes of the verification of the coordinate point for the target position of the rice field extension in Simpur Village, Pulang Pisau Regency, using satellite images

### *3.3 Results of spatial calculations of land cover change potential for lost carbon stocks*

The world's forests actually absorb enough annual fossil energy at the present rate in a century (Kirschbaum et al., 2024). The World Food Organization recorded a forest area of 4.06 billion hectares until 2020 (FAO, 2020). The amount of emissions it can absorb is equivalent to 861 billion tons of carbon dioxide ($CO_2$). The problem is that deforestation emissions continue to rise from year to year (Chiriacò et al., 2024). Since 2000, the beginning of the 21st century, forest cover has been lost by as much as 10%. This deforestation makes emissions evaporate into the atmosphere. Therefore, deforestation is the main cause of the climate crisis due to global warming. A recent study states that carbon emissions pumped into the atmosphere in the last five years have doubled compared to the first five years of the 21st century (Labaran et al., 2022). Calculations in tropical forests alone, including in Indonesia with high-resolution satellites, found that the average emissions released due to tropical deforestation are as much as 0.14-1.39 billion tons per year. The most carbon released (70%) comes from the biomass of bottom plants, 20% roots, and the rest from stems and branches. This means that the emissions released are not only due to deforestation, logging, but land clearing so that not only forest cover is lost, but forests and all their biodiversity. In 2001-2005 the average emission release due to tropical deforestation was 0.16-0.97 billion tons. Meanwhile, in 2015-2019 deforestation emissions amounted to 0.13-1.99 billion tons. This means that deforestation rates have increased in the last two decades (Susetyo, 2021).

As to Presidential Regulation Number 109 of 2020, the National Food Estate Improvement Program is one of the government's National Strategic Programs, according to WRI (2022). Despite the program's goal of preserving national food security, a number of studies find that the food estate method is ineffectual and fails to address the underlying causes of the issue. Due to its development on land that was formerly intended for peatland development (PLG), which was unsuccessful during the Suharto era, the food estate initiative in Central Kalimantan has gained attention. Peatlands are crucial for both mitigating and adapting to climate change. Twenty times as much carbon can be stored in these ecosystems as in mineral soils or tropical rainforests. Peatlands are rich in biodiversity and contain roughly 10% of the freshwater reserves on Earth. Peat, however,

is extremely prone to disturbance. Because peat naturally has a relatively acidic pH, low fertility, and frequent flooding, peatlands are classified as marginal land (Yuwati et al., 2021).

Approximately 57 gigatons of carbon, or 20 times the carbon found in typical mineral soils, are stored in Indonesia's peatlands. If peatlands are drained or used for other purposes, the carbon stocks they contain will be released into the atmosphere. Actually, almost 30% of the carbon in the planet is stored in peat. Peatlands store more carbon than any other type of land or plant, even though they make up only 3% of the planet's total land area. Up to 550 gigatons of carbon, or 42% of all the carbon stored in the soil, can be kept in peatlands that are still almost entirely natural. Peatlands are thought to store up to 57.4 gigatons of carbon and cover 13.43 million hectares in Indonesia alone.

Peatlands are still being turned into plantations and industrial zones, though. The majority of these processes release peat's carbon stores into the atmosphere by draining, burning, and deforestation. Furthermore, deteriorated peat will dry out and catch fire, intensifying the release of carbon stocks into the atmosphere. For example, it is predicted that burning peatlands to make way for oil palm plantations releases up to 427.2 tons of carbon per hectare. The fact that 63% of global carbon emissions are thought to originate from damaged peatlands is therefore not shocking.

According to Presidential Regulation No. 109/2020, one of the government's National Strategic Programs is the National Food Estate Improvement Program. Despite the program's goal of preserving national food security, a number of studies find that the food estate method is ineffectual and fails to address the underlying causes of the issue. The reason the Central Kalimantan food estate program is gaining attention is because it was built on land intended for peatland development (PLG), which was unsuccessful during the Suharto era. Peatlands are crucial for both mitigating and adapting to climate change. Twenty times as much carbon can be stored in these ecosystems as in mineral soils or tropical rainforests. Peatlands are rich in biodiversity and contain roughly 10% of the freshwater reserves on Earth. Peat, however, is extremely prone to disturbance. Because peat naturally has a relatively acidic pH, low fertility, and frequent flooding, peatlands are classified as marginal land. It does not, however, preclude the potential that this area will be developed into a food estate. The precise location of the former PLG area to be utilized for this program has not been disclosed by the government. All that is being circulated is a broad location. The lack of specific information, however, makes it challenging for academics and civic society to assess the dangers of peatland and forest conversion. This information gap may make it more difficult to supervise how land is developed on peatlands and may lead to disputes between program participants and local populations.

The results of an analysis of three different types of peat areas that should be avoided when developing food estates are as follows: peatland in the medium to very deep depth category (> 1 meter) is not advised for use as agricultural land due to its low load resistance. This soil is also heavily reliant on the mineral layer beneath it to supply the nutrients that plants require due to its low fertility rate. Conversely, peat contains greater carbon reserves the deeper it is. The potential for carbon loss increases if peat, which has a depth of 12 meters and can store carbon stocks of over 22.3 Gt, is turned into agricultural land. To put it briefly, the deeper the peat, the less opportunity there is for growing food crops.

The second category, peat swamp forest vegetation, is one of the three essential elements—along with peat soil and water—that contribute significantly to the preservation of this ecosystem. Hydrological equilibrium and the integrity of the peat soil will be preserved in a peat swamp forest with intact plants. The first step in using peatland for agriculture is typically site preparation, which involves creating drainage canals and removing the natural flora found in peat swamp forests. The decomposition of peat soil, groundwater sinking, greenhouse gas emissions, and peat subsidence are the initial signs of the degradation of peatlands. In open peatlands devoid of vegetation, measured carbon emissions were 62.25 tons of $CO_2$/ha/year, which is the same as burning over 26,000 gasoline bottles. At 56–200 tons of carbon/hectare, native peat swamp vegetation has a high biomass density that is 40 times greater than rice soil carbon reserves and nearly equal to

primary forest on mineral fields. Peat loses its inherent capacity to absorb water and store carbon when drainage activities result in the loss of native vegetation in peat swamp forests. In these circumstances, peat turns dry and extremely flammable when it comes into contact with sparks, releasing not just carbon but also other greenhouse gasses like methane, which is twenty-one times more dangerous than carbon dioxide.

The conservation and cultivation functions of peat ecosystems are distinguished by PP No. 71 of 2014 jo. PP No. 57 of 2016 respecting Peatland Ecosystem conservation and Management. The preservation of water systems, their equilibrium, and the sequestration of carbon in peat areas are all aspects of the protective function. When this function is compromised, the environment is more susceptible to deterioration, which increases the likelihood of fire disasters. The conditions under which peat protection can be transformed into cultivation are not regulated by Indonesian laws and regulations. Nonetheless, at least 30% of all peat hydrological units (KHG) must be established as peat ecosystem regions with a protected function by the government. Peatlands with protected functions, both inside and outside of forest areas, must therefore continue to be protected. These restrictions apply to food estate strategies that alter forest areas without taking into account their protected functions. There are two approaches that can be used, according to Minister of Environment and Forestry Regulation Number 24 of 2020 concerning the Provision of Forest Areas for Food Estate Development: either by designating forest areas for food security (KHKP) or by making amendments to the designation of forest areas. Forest regions that are peatlands with protected functions are nevertheless included in the criteria in both approaches. Peatland may therefore be opened with a protected function for food estate operations. Production forest areas (KHP) and other use areas (APL) are examples of regions where this strategy may lead to the conversion of protected peat ecosystems outside of protected forest areas. Based on WRI's estimate, protected peatland in ex-PLG areas amounts to about 883,475 hectares, of which 92% is in conservation and protection forests, 4% is in production forests, and 4% is in non-forest areas.

Data on the possible carbon stocks lost in the area can be computed using all of the data from the geographical study of peatlands and the data above. Table 4 shows the total quantity of carbon stocks that could be lost in three districts of the Central Kalimantan Province's Food Estate region.

Table 4 shows that measured carbon emission data on bare open peatlands (62.25 tons $CO_2$/ha/year; data source: MoEF in Wetlands International, 2018) can be used to estimate the probable loss of carbon stocks. From 2020 to 2022, it is estimated that the total potential loss of carbon absorption in Pulau Pisau Regency is 91,175 tons of CO2/ha/year. From 2020 to 2022, it is estimated that the total potential loss of carbon absorption in Kapuas Regency is 56,853 tons of CO2/ha/year. From 2020 to 2022, it is estimated that the total potential loss of carbon absorption in Gunung Mas Regency is 98,827 tons of CO2/ha/year. From 2020 to 2022, it is estimated that the total potential loss of carbon absorption in 3 districts is 246,846 tons of CO2/ha/year.

Table 4. Potential carbon stocks lost in food estate areas of Central Kalimantan Province

| Regency | Measurable carbon emissions on open peatlands without vegetation (tons $CO_2$ /ha/year) | Area of Lost Vegetation Cover (Ha) | | | Potential loss of carbon sequestration (tons $CO_2$/ha) | | | Total area of vegetation cover lost (ha) | Total Potential Loss of Carbon Sequestration (tons $CO_2$ /ha/year) |
|---|---|---|---|---|---|---|---|---|---|
| | | 2020 | 2021 | 2022 | 2020 | 2021 | 2022 | | |
| Pisau Island | MoEF in | 1110.06 | 69,101.2 | 354.6 | 22,073.85 | - | - | 1464.66 | 91,175.0 |
| Kapuas | Wetlands | 561.33 | 34,942.8 | 351.45 | 21,877.76 | 0.53 | 32.99 | 913.31 | 56,853.5 |
| Mount Mas | International | 1025.46 | 63,834.9 | 459.54 | 28,606.37 | 102.59 | 6,386.23 | 1587.59 | 98,827.4 |
| Total (Ha) | (2018) | 2696.85 | 167,878.9 | 1165.59 | 72,557.98 | 103.12 | 6,419.22 | 3965.56 | 246,856.1 |

*3.4 Problems arising from environmental economic, social and political perspectives*

Problems from an existing economic perspective Weak capital and technology in the agricultural sector, especially in the food crop subsector, is one of the obstacles to increasing Indonesia's food production. This is due to government limitations in providing budgets which result in many areas of services which cannot be handled optimally by the government so that the private sector is involved to meet needs that have not been addressed without taking over government responsibility, one of which is the Food Estate Program (Asti et al., 2016). President Joko Widodo then made the decision to impose widespread social restrictions (PSBB) on March 31, 2020 in an effort to halt the COVID-19 outbreak. The Government Policy is an application of Health Quarantine Law Number 6 of 2018. The law states that the Minister of Health sets this PSBB after consulting with the regional heads and the head of the COVID-19 Task Force. In various areas, particularly DKI Jakarta Province, the epicenter of the COVID-19 pandemic in Indonesia, the application of PSBB has shown to be highly effective in slowing the rate of COVID-19 spread.

However, the benefits of PSBB are also accompanied by the emergence of follow-up impacts in the form of disruption of the economic cycle. This happens because during the PSBB period, people's space and mobility are limited. The implementation of health protocols in the form of physical distancing (maintaining distance) makes economic activities both in the production, distribution, and consumption processes experience restrictions. One of the chains of economic activity that has a serious impact is food commodities. Food production, distribution, and consumption are interrupted; they either decrease or cease entirely. This situation disrupts community food availability, access, use, and stability.

President Joko Widodo responded to the problem by designating the Ministry of Defense as the spearheading agency in fortifying the country's food reserves via the Food Estate initiative. Despite this, COVID-19 has not yet caused a shortage of staple foods. Food-related activities, including production, distribution, and consumption, have not been significantly impacted by travel restrictions or shifts in consumer demand brought on by the closing of eateries and educational institutions as well as financial losses. However, trade flows for basic goods like wheat and rice have slightly disrupted as a result of export limitations imposed by numerous countries (Sianipar and Tangkudung, 2020).

It is explained that the ex-PLG area planned in the food estate program has a long history of tenure conflicts and has not been fully resolved until now. If the land claims and layered ownership status remain unresolved, it is certain that land conflicts will occur, leading to the abandonment of the project. The availability of labor for the Central Kalimantan food estate program is another crucial concern. Another is the involvement of the local population, as farmers and local communities are only now beginning to feel the effects of the program. Land management rights for local residents' access to food and shelter will be lost if food estates are planned without first involving farmers and the community. Suraya also stated that growing rice needs a lot of labor.

If the area of the food estate is 30,000 ha, it will take around 4,080,000 working days (HOK). Even if equipment and mechanics are used effectively, this activity will still require 2.8 million HOK with increasing production costs. It is likely that labor will be brought in the transmigration program to work on existing land. Planning for the arrival of transmigrants must also be carefully prepared, because if not, migrants will find it difficult to adapt to local culture so it is feared that it will cause conflicts between local communities and migrants. In addition, the limited knowledge of transmigrants related to sufficient skills for agriculture in wetlands will cause other problems that cause the abandonment of managed land due to failure in its management.

The locations of the food estate projects were decided upon in May 2020, and Gunung Mas Village and Pulang Pisau Village were among them. The initiative was implemented with the assistance of Defense Minister Prabowo Subianto. Prabowo has been assigned to oversee the construction of a 178-hectare food estate in the Central Kalimantan districts of Pulang Pisau and Kapuas. The argument that food security is a component of state security

is used to support the military's involvement. Actually, the 1 million hectare rice field project involving the Indonesian National Army (TNI) has received a red note from the Audit Board (BPK). Military scholar Khairul Fahmi of the Institute for Security and Strategic Studies (ISES) determined that Jokowi made a mistake by giving Prabowo instructions (Setyaningrum, 2020). Nonetheless, the President has the authority to direct his ministers to collaborate with other ministries. Prabowo is regarded as capable of doing this given that he led the HKTI twice, from 2004 to 2015, and that other ministries, such as the PUPR and SOEs, were involved.

## 4. Conclusions

The national food granary program, also known as the Food Estate Policy Program, spans 156,000 hectares in Central Kalimantan and is less economically, socially, and environmentally effective technically. It results in the loss of forest cover, or vegetation and trees that provide ecosystem services like absorbing carbon dioxide from the atmosphere. The impact of forest conversion is also significant, and there is a significant risk of carbon stock loss, which creates issues or gaps from the perspectives of social, environmental, and economic politics.

The knowledge gained from previous food estate projects on peatlands derived from biophysical soil characteristics as well as economic and social factors—namely, involving and supporting the community in implementing food security initiatives and advanced agricultural technologies. Where more attention is needed to review the characteristics of peatlands, including peatlands that are prone to drought and do not return to wetlands or irreversible drying when they have been processed by other types of agriculture, this can cause water absorption in peatlands to decrease, peatlands easily decrease or subsidence, meaning that peatlands that have been processed do not pay attention to the depth of peatlands the land layer will be thinner and more flammable, Also low carrying capacity or bearing capacity of land, low nutrient content and limited number of microorganisms.

Peatlands can be planted, but they must pay attention to safeguards as much as possible by paying attention to bio-physical aspects such as peatlands must remain wet, use the best fertilizer, and water flow must be considered. Furthermore, the community is involved in and supported by economic and social factors in the implementation of food security initiatives and the advancement of agricultural technology. Peatland for food estate should be done on a small land first, so as not to damage the ecosystem if it fails. Peatlands must be cultivated on condition based on environmental safety and sustainability and modern forests based on technology. Supposedly, in the development of food security should not only plant cassava and rice, it should diversify crops which include poultry and red meat. And last but not least, indigenous peoples or local communities must have equal opportunities in peatland management to meet their needs.

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