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Application of Defense Science in Dealing with Ecological Damage in Indonesia

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Abstract
Based on the various indices, Indonesia's ecological status is in a low - medium environmental condition and has sufficient potential for ecological damage. However, the way governments have dealt with ecological damage so far has been very limited, fragmented, and overlapping. On the other hand, various government policies so far have not adequately incorporated the defense and security paradigm. This research has novelty because research related to the application of defense science in responding to ecological damage has never been done in Indonesia. This research is supposed to reveal the inhibiting and supporting factors of defense strategy so that ecological damage as a non-military threat can be countered so that the security of the nation and the integrity of the state can be defended. This research is a qualitative study that attempts to build meaning about a phenomenon based on the views of the interviewees. The data collection methods used are interviews and document studies. The results of the analysis of several ecological indices from 2018 to 2020 showed that there has been a decline in the quality of ecosystems in several regions. This condition in the long term can threaten the existence of humans and other living organisms. This very high risk must be faced by creatures that live outside conservation areas, of which there are only about 30% in Indonesia. Based on that point, it can be said that Indonesia is encountering potential Ecological Damage which is also a defense threat. The threat of Ecological Damage will affect national defense if the Government does not take the proper actions. Therefore, the intervention needed at the present is not enough with only an environmental science or sustainable development approach. Defense Science must be applied to contribute to solving this problem because it can increase national readiness that can encourage awareness of all sectors. The realization of the application of defense science in overcoming ecological damage is through central government defense management which includes planning, institutionalization, direction, coordination, and supervision between relevant ministries.

Keywords: Application of Science, Defense Science, Ecological Damage,

Introduction

According to the 2021 Ecological Threats Report (ETR) indicator, Indonesia is ranked 139 out of 178 countries with a score of 4 (high) indicating the high potential for ecological threats. ETR is the ecological indicator from The Institute for Economics and Peace (IEP) that measures the severity of ecological threats objectively with indicators of population growth speed, clean water risk, food risk, temperature anomalies, and natural disasters. The other indicator, Environmental Performance Index (EPI) from Yale University, Indonesia was ranked 164th out of 180 countries with a score of 28.2 out of 100 (low) indicating that many ecological problems in Indonesia have not been handled properly. The EPI measures the ability of countries in the world to meet internationally set sustainability targets for specific environmental issues through 40 criteria within the scope of climate change mitigation, ecosystem vitality, and a healthy environment. In relevant to the ETR and EPI, the Governor of Indonesia's National Defense Institute (Lemhannas) in his Scientific Oration in May 2022 on Indonesia's Geopolitics 5.0, alluded to Indonesia's high Ecological Insecurity Index which indicates that Indonesia is vulnerable to ecological damage.

The various indices above are not just numbers, but can also be found in real phenomena. Researchers captured the phenomenon of ecological damage that has several impacts on the defense and security sector. Keep in mind that the ecological damage is global and does not recognize state administrative boundaries, so the phenomena in one country can have a domino effect on other countries (Amoros, et al., 2021). The following are the results of the researcher's identification of the impact of the ecological damage phenomenon that could potentially and has already occurred in Indonesia:

1. Ecological damage changes the security paradigm. Robert Falkner (2013) in his book The Handbook of Global Climate and Environment Policy states that the issue of ecological damage as a cause and effect of climate damage has become a security discourse as climate security. Mansavage (2014) notes that climate change brings the consequences of superpower military involvement in natural resource conservation efforts and continues to prepare with strong resilience measures to face these ecological dynamics. In Indonesia, the shift in the concept of security has been evidenced by the inclusion of environmental issues as part of defense threats in the 2015 Indonesian Defense White Paper and the 2021 State Defense Policy.
2. Ecological damage becomes a multiplier of non-military threats. Llyod J. Austin (2021) argues that climate change (due to ecological damage) is a national security issue that becomes a threat multiplier. Retter, et al. (2021), added that apart from being a threat multiplier, it also triggers resource tensions. Austin (2021) states that if there is no effort to overcome the ecological damage, it will weaken military capabilities, damage infrastructure, and defense installations, and hamper innovation and economic growth. This is evident in Indonesia, where ecological damage

has caused disruptions to defense infrastructure and vital state objects. For example, the ecological damage that causes climate change and reduces rainwater infiltration has resulted in flooding at several airports such as Halim Perdana Kusuma Airfield in 2020, Ahmad Yani Semarang Airfield in 2021, and Soekarno Hatta International Airport in 2021. In addition, flooding also submerged the Presidential Palace in 2002, 2013, 2015, and 2020 and submerged the Military Complex in Aceh.

3. Ecological degradation increases the chances of urban warfare. Ecological damage due to human population growth that exceeds land availability drives deforestation and forest conversion. Based on the 2021 Land Cover Quality Index, there are only 9 provinces in Indonesia whose forest area is more than 30% of the total provincial area. Forests as a war mandala in a guerrilla strategy will disappear into settlements or monoculture plantations. This makes the chances of urban warfare very high in 24 Provinces.
4. Ecological damage triggers regional border disputes. The retreat of coastlines due to land subsidence as a result of overdevelopment (Manik and Marasabessy, 2010) and rising sea levels will reduce the area of state territory and even trigger state border disputes (Siburian, et al., 2020).
5. Ecological Damage threatens the safety of the nation. Florian and Lehnerz (2015), academics from the University of Luxembourg, note that the actual impacts of ecological damage are very real, such as an increase in the incidence of disasters (especially hydrometeorological disasters such as floods and landslides), poverty, food shortages and limited food diversification, water shortages, emerging and increasing infectious diseases, reduced habitable land, high levels of toxic ground-level ozone, and extensive economic damage. The National Disaster Management Agency (BNPB) in 2021 noted that 62.3% of disasters in Indonesia were hydrometeorological disasters.

The problems above are very real threats to Indonesia's defense. However, government efforts to overcome ecological damage have been partial, sectoral, and overlapping. Widowati and Chamdani (2018) and Muhajir et al. (2019) found overlapping regulations in environmental management. The disharmony of regulations in the Forestry Law, the Environmental Protection and Management Law, and the Coastal Zone and Small Islands Management Law lead to wasteful costs and ineffective governance, which results in the phenomenon of ecological damage every year. This fact is proof of the weakness of existing management.

On the other hand, various government actions so far have not adequately incorporated the defense and security paradigm. This has led to the target of restoring environmental quality rather than increasing the ability of the environment to support national interests, including national defense. Ecological damage has made national resources (human resources, natural resources, and

artificial resources) unable to be utilized optimally for the benefit of the state. In fact, according to the Indonesian National Army Staff and Command School (Seskoad TNI), national resources are managed so that they are ready and suitable for use when needed by the state. This argument is in line with empirical evidence that shows the ability of a nation to build excellent and respected defense forces is only a nation supported by optimizing the strength of resources that ultimately support national defense (Seskoad TNI, 2019).

Based on the explanation above, ecological damage is strongly correlated with Indonesia's defense interests. Therefore, researchers are encouraged to research the application of defense science in overcoming ecological damage. The problems discussed in this paper are the analysis of ecological conditions and the defense efforts in dealing with them. This research has novelty because research related to the application of defense science in responding to ecological damage has never been done in Indonesia. This research is expected to reveal the important role of defense science in resolving ecological damage as a non-military threat so that the security of the nation and the integrity of the state can be defended.

Methodology

This research is a qualitative study. Creswell (2016) asserts that researchers in qualitative research will try to build meaning about a phenomenon based on the views or opinions of participants or sources. While this research design uses qualitative analytics which according to Sugiyono (2016) serves to explain the solution to a problem by revealing a description of the object. Thus, qualitative analytical research does not emphasize generalization, but instead on meaning.

According to Creswell (2016), the data collection process in qualitative research can be done through several techniques, including 1) interviews, both structured and unstructured; 2) observation or observation; 3) documentation; 4) visual materials; 5) as well as various efforts to record or record information in the field needed in research. In the context of this research, the data collection methods used were interviews, observation, and documentation.

The researcher conducted in-depth interviews using interview guidelines but did not specify specific details (semi-structured). Interview guidelines were made to avoid unnecessary information. Interviews were conducted with figures who are competent and have the authority to provide information. The interviewees came from the Ministry of Defense, the Ministry of Environment and Forestry, the Ministry of National Development Planning, the Coordinating Ministry for Human Development and Cultural Affairs, and the Coordinating Ministry for Maritime and Investment Affairs.

While in the observation method, the researcher conducts non-participants because the researcher cannot be directly involved in the activities that are of concern to the researcher. This research will observe the activities of the research subjects and the implementation of related policies.

The last method is documentation study. Researchers reviewed several

documents in the form of legal products (legislation and internal regulations), annual reports, activity reports, books, and other available documents. Once collected, these various documents will be analyzed to produce information that supports primary data.

Theories

Defense Science

Humans have a basic need in the form of a sense of security from all worries and threats as stated by Abraham Maslow and al Ghozali. In defense philosophy, maintaining the need for security encourages humans to think about seeking various knowledge to understand why to survive, survive from what, survive from whom, and how to survive (Oktavian, 2019). In the context of the sustainability of a country's existence, defense is one of the indispensable and important factors in ensuring the survival of a country (Gumilar, 2015). This condition is the basis that the science of defense is a very important and essential thing to be learned by all people in the world.

Defense science emerged from the development of military science and war science applied in the development of military organizations, strategies, and tactics aimed at achieving the national interests of a country. Over time, defense science has evolved to create a concept of science that responds to the development of a more dynamic and complex strategic environment, both within the national, regional, and global scope.

Furthermore, according to Tippe (2016), defense science reflects the behavior of the state to maintain and develop the sustainability of the country concerned. The Latvian Ministry of Defence (2012) said, that the fundamental strategic principle of national defense is to minimize the potential for threats to national security. In line with this definition, Indonesia through Law No. 3 of 2002 concerning National Defense provides an understanding that national defense is all efforts to defend the sovereignty of the state, the territorial integrity of the Unitary Republic of Indonesia, and the safety of the entire nation from threats and disturbances to the integrity of the nation and state.

This defense science includes all knowledge related to aspects related to security on a national scale that are inherent in the objectives of organizing the national defense. In essence, defense science is an interdisciplinary science that consists of various sciences such as defense strategy, defense management, defense economics, national security, and defense technology. Defense Science is studied and developed to protect and defend national interests, win wars, and reduce post-war damage. Based on the description above, it can be concluded that defense science is a discipline that studies the behavior of the state to maintain its existence from various threats.

Non-Military Defense

Mely Caballero-Anthony, et al (2006) suggested the concept of security as

a multi-interpretative concept that is not dominated by defense or war as the main concept but also opens space for a broader concept that includes a combination of military and non-military threats. In line with this understanding, security according to Barry Buzan and Hansen (2009) in The Evolution of International Security Studies is an effort to secure (prevent something from being threatened): whether it is a country, individual, ethnic group, environment or even the sustainability of the planet itself. Buzan and Hansen also mention five security sectors: military, political, economic, social, and environmental. From the two definitions above, it can be concluded that security is a condition that is deliberately created to protect an object from various dimensions and types of threats to maintain its existence. So if it is associated with state security or national security, the definition becomes "a condition that is deliberately created to protect the state from various dimensions and types of threats to continue to exist and achieve its goals".

The broadening of the meaning of security as above has occurred in Indonesia since the Reformation era. This broadening provides space for the non-military concept to develop in addition to the exclusivity of the military concept, which at that time was still the dominant approach of the state in all aspects of the life of the nation and state. The environment is considered one of the security issues only if the issue poses existential threats to the country's defense objectives. The real manifestation of this paradigm shift is the alignment of military threats with non-military threats in the 2008 and 2015 Defense White Papers, Presidential Regulation No. 8 of 2021 concerning the 2020-2024 State Defense General Policy, Minister of Defense Regulation No. 19 of 2016 concerning Guidelines for the Implementation of Non-Military Defense, as well as in various other defense documents.

In the Guidelines for the Implementation of Non-Military Defense, environmental threats (including ecological crises) is part of non-military threats with a public safety dimension. In dealing with these environmental threats, there are prevention, prosecution, and recovery strategies. The implementer of the strategy is the Ministry of Environment and Forestry and other related agencies outside the defense sector. Meanwhile, the Ministry of Defense functions as a director and supporter to realize national vigilance and complement the substance of the strategy. The guideline also explains that the Ministry of Environment and Forestry serves as the main element, while other agencies including the Ministry of Defense serve as other elements. These two elements both carry out the development and development of strength, capabilities, and non-military forces.

Results and Discussion

An Overview of the Strategic Context of Indonesia's Ecological Conditions

In this study, the results of data collection obtained by researchers include primary data and secondary data. Primary data is obtained from the process of interview activities with informants and observation. Meanwhile, secondary data

was obtained from documents provided by informants and during observations. The results of the interview and observation activities were used as the main basis for the research and were supported by secondary data to complement the results of the research conducted considering the limitations of primary data due to limited informants and research time.

Furthermore, researchers process the data that has been collected by systematically/structured grouping and categorizing. The results of the data processing will then be given meaning. Data of interest to researchers will be tested by estimating the validity of the data through the triangulation method on the techniques and data sources found.

The Ministry of Environment and Forestry states that the measure of environmental condition assessment in Indonesia is the Environmental Quality Index (IKLH). Currently, IKLH is being developed by adding region-specific variables such as budget factors, and policies, so that it can describe the efforts of each region to maintain the environment. In addition to IKLH, the Ministry of Environment and Forestry (MoEF) is also developing a Response Index to determine regional efforts to overcome environmental damage that occurs. Bappenas informants explained that Bappenas uses IKLH released by MoEF as a reference for environmental quality at the national and regional levels.

IKLH as a measure of ecological conditions only represents the abiotic condition of the environment in a province. However, abiotic conditions cannot change by themselves without any cause from biotic activities (living things). The abiotic conditions are divided into water quality, air quality, land quality, and seawater quality. Each abiotic quality is assessed by a measure of the elements contained in nature. For example, in air quality, the standard of assessment is the presence of NO2 and SO2 elements. The results of the calculation of these two elements become the Air Quality Index which is the basis for determining the predicate of a province.

The IKLH calculation formula has been adjusted several times to improve the representation of ecosystem quality. The results of document studies related to changes in IKLH parameters that have been carried out are as follows:

Table 1
2018 and 2020 IKLH Document Study Results

Document Study Results	Parameters 2018	Parameters 2020	Weight	Monitoring Point
Water Quality Indeks Calculation Changes	DO, Fecal Coliform, COD, pH, BOD, NH3-N, TP, TSS, NO3-N, and TDS (10 parameters)	TSS, pH, DO, BOD, COD, Total Phosphate, NO3, and Fecal Coli (8 parameters)	**2018:** 30% **2020:** 34%	**2018:** 629 locations **2020:** 704 locations

Changes in Land Quality Indeks Calculations	Area of land cover and its changes, condition of land cover, conservation of riparian ecosystems, habitat conditions, the cover of shrubs and swamp thickets, green open spaces, botanical gardens, and biodiversity parks.	**2018:** 40% **2020**: 13.3%	No changes
Air Quality Indeks Calculation Changes	SO2 and NO2 (represents emissions of gasoline-fueled vehicles and diesel-fueled industries)	**2018:** 30% **2020:** 42.8%	**2018:**1676 locations **2020:**2091 locations
Addition Calculation of Seawater Quality Index	TSS, DO, Oils and Fats, Total Ammonia, and Ortho Phosphate	**2020:** 9.9%	**2018:** 797 locations **2020:** 797 locations
IKLH Predicate Change			
2018		**2019**	
1. Very good: IKLH>80 2. Good: 70<IKLH<80 3. Fairly Good: 60<IKLH<70 4. Poor: 50<IKLH<60 5. Very Poor: 40<IKLH<50 6. Alert: 30<IKLH<40		1. Very Good: IKLH>90 2. Good: 70<IKLH<90 3. Medium: 50 < IKLH < 70 4. Bad: 25 < IKLH < 50 5. Very Bad: IKLH<25	

Another measure that can be used to assess ecological conditions is greenhouse gas (GHG) emissions. GHG emissions are the result of the activities of living things such as humans and livestock that can affect abiotic quality. In the 2018 Greenhouse Gas Index Calculation Report (IGRK), the results of the national Greenhouse Gas Inventory calculation showed an emission level of 1,637,156 Gg CO2e, an increase of 450,928 Gg CO2e compared to the 2000 emission level. In 2019, greenhouse gas emissions increased to 1,866,552 Gg CO2e, with the largest contributors being the energy sector and forest and land fires. The gas emissions decreased significantly in May 2020 to reach 90-95% in air and sea transportation, and 34.2% in land transportation due to restrictions during the Covid-19 pandemic. Based on the results of the document study, the following environmental threshold data and current conditions were obtained:

Table 2
Results of the Study Document Thresholds of Ecological Abiotic Components

National Standard				
No	Index Type	Safe Standards (Good Predicate)	Rating result	Information
1	Water Quality Index (IKA)	Score 70	**2018:**score of 3 Provinces < 70 **2020:**score of 24 Provinces < 70	decrease
2	Air Quality Index (IKU)	Score 70	**2018:**score 1 Province < 70 **2020:**score 1 Province < 70	stagnant
3	Land Quality Index (IKL)	Score 70	**2018:**score of 17 Provinces < 70 **2020:**score of 22 Provinces < 70	decrease
4	Seawater Quality Index (IKAL)	Score 70	**2018:**score of 12 Provinces < 70 **2020:**score of 18 Provinces < 70	decrease
5	Environmental Quality Index (IKLH)	Score 70	**2018:**score 71.67 **2020:**score 66.52	decrease
6	Greenhouse Gas Index (IGRK)	680.324 Gg CO2e	**2018:**1,637,156 Gg CO2e **2019:**1,866,552 Gg CO2e	increase
Global Standards (in Indonesian NDC)				
No	Emission Producing Sector	Base Year 2000 (GgCO2e)	2019 Assessment Results	Information
1	Emissions in the Energy sector	317,609	638,808 Gg CO2e	increase
2	Forestry sector emissions	500,019	924,853 Gg CO2e	increase
3	Emissions in the Industrial Process and Product Use (IPPU) sector	42,883	60.175 Gg CO2e	increase
4	Waste field emission	64,832	134,119 Gg CO2e	increase
5	Agricultural Emissions	99,314	108,598 Gg CO2e	increase

Greenhouse gas thresholds are also closely linked to carbon emissions. Carbon emissions result from various activities of living things. If not controlled, this gas can damage air quality and increase the earth's temperature in the long term. The Directorate General of Climate Change Control explained that uncontrolled greenhouse gas emissions could be the cause of global temperature rise. The United Nations Framework Convention on Climate Change (UNFCCC) calculates that global temperatures will increase by 1.5 degrees Celsius in 2030 if there are no efforts to reduce gas emissions. The UNFCCC Convention is only the basis for negotiating multilateral solutions to stabilize the concentration of Greenhouse Gases (GHG) in the atmosphere at a level that does not harm the earth's climate. This GHG concentration stabilization is targeted to be achieved within a certain period so that the earth's ecosystem has enough time to adapt to the changes that will occur. GHG stabilization also aims to ensure food production and economic development of countries can run sustainably.

Meanwhile, the Directorate General of Climate Change Control states that the losses caused by Ecological Damage due to climate change are long-term, and cannot be felt real-time time. This means that the negative impact of greenhouse gas emissions in general is a predictable worst-case scenario (potential loss). The agriculture, forestry, and land use sectors are the sectors that most frequently record disasters, such as forest and land fires and floods.

The measure of ecological quality can also be seen from spatial management. Changes in natural habitats into artificial habitats are a sign of ecosystem disturbance. This is because the transfer of function activities will damage the environment for certain economic or social interests. Therefore, efforts to maintain natural habitats through conservation need special attention.

The Directorate General of Conservation of Natural Resources and Ecosystems stated that currently, the MoEF is in charge of managing 22 million hectares of terrestrial conservation land and 5 million hectares of marine conservation areas. Management of marine conservation areas is carried out jointly with the Ministry of Maritime Affairs and Fisheries. In addition, the MoEF also manages around 500 conservation areas (nature reserves, wildlife reserves, and national parks). Of the total conservation land, the MoEF is tasked with carrying out ecosystem restoration for 1.8 million hectares of damaged forest ecosystems. In the National Medium-Term Development Plan, the MoEF must succeed in repairing an ecosystem of 200,000 hectares per year.

In addition to managing 27 million ha of conservation areas, MoEF also provides data and information on 43 million ha outside conservation areas. The provision of this data and information is related to the potential for high biodiversity outside the conservation area. The results of the inventory and verification of 17 million ha outside conservation areas in 2020-2021 show that around 10.845 million ha (63.79%) have a high biodiversity score. The biodiversity is in production forest areas, protected forests, other use areas, and other areas.

The MoEF notes that Indonesia currently has 490 land conservation areas

with a total area of around 22.5 million hectares and 76 coastal and marine conservation areas covering an area of 13.5 million hectares. With the large area and several conservation areas, it turns out that there are still a lot of important biodiversities (ecosystems, species, and genetics) that are still outside the conservation areas. This condition can be seen in the presence of endangered wildlife habitats. MoEF estimates that around 80% are still outside the conservation area system. This condition is worrying because development pressure on biodiversity continues to increase, especially outside conservation areas which are considered to have lower priority than conservation areas.

The MoEF noted that there was an increase in the area of conservation areas in Indonesia by around 10-15% for Terrestrial Areas and 3-7% for Marine Areas in the 2000-2020 period. Nonetheless, habitat loss, damage, and fragmentation are still high in forest areas and other ecosystems with high biodiversity richness. This shows that the existing conservation area has not been able to protect all the species in it. In conservation areas throughout Indonesia, there are at least 1.8 million hectares (7% of the Total Area of Conservation Areas) which are open land which indicates ecosystem damage or degradation. The damage that occurred was caused by overlapping conservation area land tenure with land used and cultivated by the community, illegal loggers,

Damage to nature in conservation areas and areas outside conservation areas with high biodiversity value can be caused by natural influences such as floods, tsunamis, volcanic eruptions, and earthquakes, for example,e what happened in Central Sulawesi and West Nusa Tenggara in 2018. In addition, Natural damage can occur due to human influence, due to changes in the landscape from forest areas to open areas such as agricultural land, plantations, or illegal mining which results in reduced water absorption into the soil. This is evidenced by the findings of the 2020 IKL which do not yet reflect control of deforestation in Indonesia. On the other hand, the national plantation area has increased, triggered by the expansion of oil palm plantations, which was originally 12.485 million hectares in 2000 to 34.733 million hectares in 2019.

In addition to data and information through MoEF, researchers also collect information about the status of ecological conditions in Indonesia from other ministries and agencies. Researchers had the opportunity to have a direct dialogue with the Governor of Lemhannas regarding ecological security in Indonesia on September 26, 2022. The Governor explained that in the Geopolitics 5.0 approach, one of the pillars that are the main factor is the ecological pillar. Currently, according to Lemhannas's research results, ecological conditions in Indonesia are generally in the low to moderate range. This is a result of the ongoing development process that uses a lot of natural resources. Ecological capacity is one of the specific issues that must be corrected to ensure the nation's life in the future.

In line with the statement above, the Coordinating Ministry for Maritime Affairs and Investment stated that the current damage to Indonesia's ecology can be proven by damage to the native habitat of animals. Damage to the original

habitat was triggered by the entry of foreign species into the Indonesian habitat (alien species invasion). Such as predatory catfish, arapaima fish, golden snail, and Toraja cork invaded the habitat of Lake Sentani, and Java tilapia invaded Toba's endemic fish. The entry of these foreign species from legal activities (trading, brought by ships, research in Indonesia) and illegal (illegally imported). Destruction of native habitats by foreign species will harm Indonesia because it has the potential to cause extinction.

The Directorate General of Pollution Control and Environmental Damage defines environmental damage as direct and/or indirect changes to the physical, chemical, and/or biological characteristics of the environment that exceed the standard criteria for environmental damage. While the standard criterion for environmental damage is a measure of the limit of changes in the physical, chemical,l and/or biological properties of the environment that the environment can tolerate to continue to preserve its functions.

The Directorate General of Conservation of Natural Resources and Ecosystems provides an understanding of ecosystem damage (Ecological Damage) meaning ecosystems that are not original. Ecosystems that are not native have the potential to disrupt the balance of the life cycle of the organisms in them. This can result in the extinction of these organisms. The Directorate General of Conservation of Natural Resources and Ecosystems added that the cause of ecosystem damage was human activity (anthropogenic point of view). It is undeniable that every human activity will disrupt the ecosystem. If the activity exceeds the carrying capacity and capacity of the environment, then the tolerance limit of the ecosystem to maintain its authenticity will be exceeded. This condition is called ecosystem damage. The Directorate General of Pollution Control and Environmental Damage supports this statement by stating that every time there is a human settlement, the ecology will experience disturbances that can have an impact on environmental damage. The Directorate General of Pollution Control and Environmental Damage also mentions that there are natural factors that cause ecological damage, such as natural disasters

Furthermore, the Directorate General of Pollution Control and Environmental Damage states that human activities that have the potential to damage the environment are due to the use of natural resources that are unsustainable and exceed standard criteria. Meanwhile, the Coordinating Ministry for Human Development and Cultural Affairs (CMHDCA) stated that the cause was a development that neglected ecological history, causing environmental damage and being dangerous to humans. Disaster vulnerability due to Ecological Damage can occur due to errors in space utilization. The Kemenko PMK informant also stated that there was no collective awareness of stakeholders and the community in prioritizing ecological aspects.

Another human activity is defense activity. Defense activities are also at risk of ecological damage. The Directorate General of Defense Strategy said that defense activities can damage the environment, such as when simulating chemical

weapons at sea, thereby disrupting marine biota. The Directorate General of Pollution Control and Environmental Damage added that defense activities in the defense industry have the potential to pollute the environment. This is a consequence of metal processing for defense equipment and B3 waste. However, all of these activities already have environmentally safe standards. Within these limits, pollution will be controlled. In addition, the Coordinating Ministry for Maritime Affairs and Investment informant thinks that several developments in Indonesia have had an impact on ecological damage. For example, the construction of toll roads that have not considered wildlife crossing bridges. The informant for the Coordinating Ministry for Maritime Affairs and Investment also mentioned international attention to Indonesia's steps in carrying out development in conservation areas. For example, the construction of a tourist track on Rinca Island, Komodo National Park, was not approved by the International/IUCN.

The Directorate General of Defense Potential said that disruption to the ecology would undermine the existence of natural resources needed by the main components of defense. The Directorate General of Climate Change Control states that climate change can disrupt the balance of ecosystems (ecological systems). This is also due to an increase in the earth's temperature of 1.5 degrees or more so which can cause a sea level rise of around 2.4 m in 2030. In the long term, the Directorate General of Climate Change Control states that climate change also causes a food crisis, energy crisis, and water crisis. The informant of the Directorate General of Climate Change Control added that other impacts are the uncertainty of seasons and extreme weather. This condition triggers a hydrometeorological disaster which has an impact on human ecological disturbances. Kemenko PMK informants agreed that Ecological Damage is a cause of natural disasters that are detrimental to human development and physical development. If the government does not intervene in the environment, the economic, social, and ecological losses will be greater. For example, floods will occur more frequently and more widely, investment costs for development will increase, and Indonesia will be vulnerable to food and water crises.

The UNFCCC (in the statement of the Directorate General of Climate Change Control) said that there is loss and damage and displacement as a result of climate change which threatens the archipelagic nation. Bappenas informants noted that there are at least four islands that are in danger of disappearing due to various environmental crises (ecological damage and climate crisis). The four islands are Kelor Island, Sentut Island, Sword Island, and even Bali Island. This number does not include unnamed small islands in the outer regions of Indonesia.

Another impact mentioned by Bappenas is that ecology provides feedback to the economy. Bappenas also mentions several environmental issues in the future that will be considered for development, namely climate change, pollution, and biodiversity. Therefore, Bappenas has developed a development model that pays attention to carrying capacity and capacity. Economic transformation to pursue economic growth while paying attention to the green economy paradigm. The

green economy is a continuous process in every economic activity.

The Directorate General of Conservation of Natural Resources and Ecosystems explained that Indonesia has an identity as a mega biodiversity country. As a national identity, its existence must be maintained. Biodiversity is also a potential natural resource that can be utilized for national interests. In addition, when the forest is gone, it will cause the loss of military training locations for guerrilla warfare. On the other hand, guerrillas also need forest resources, both for food and medicine. Conversely, by raising the issue of conservation as part of the defense, natural resource management will be better.

Ecological Damage as a National Defense Threat

The Directorate General of Pollution Control and Environmental Degradation states that the measure for assessing ecological conditions in Indonesia is the Environmental Quality Index (IKLH). Meanwhile, the Directorate General of Climate Change Control states that environmental quality, especially air quality (which is broader in Climate), can be seen from the quantity of greenhouse gas emissions which is calculated by the Greenhouse Gas Index (IGRK). Both of these indices can be used as a reference to determine ecological conditions quantitatively. Even so, it is necessary to ensure the level of validity of the two indices represents the current quality of ecosystems in Indonesia.

Assuming that the two indices have good accuracy for assessing an ecological condition quantitatively, the researcher analyzed the status of the current ecological condition in Indonesia. In the 2018 Calculation Report (IGRK), the results of the calculation of the national GHG inventory show an emission level of 1,637,156 Gg CO2e, an increase of 450,928 Gg CO2e compared to the 2000 emission level. This emission level is lower than the emission calculation using the business as usual (BAU) scenario.) Whereas in 2019, greenhouse gas emissions increased to 1,866,552 Gg CO2e. The emission level is still under the BAU scenario, namely 1,911.40 million tonnes of CO2e. This shows a reduction in national emissions (cumulative of the five sectors) of 9.63% of the 2019 first-scenario emission reduction target.

In terms of each emission-producing sector, it is known that the energy and agriculture sectors have been able to meet the target of reducing GHG emissions from the first scene in 2019. In the energy and agricultural sectors each managed to achieve a reduction of 132.4% and 175.87%. Meanwhile, the industrial, waste, and forestry sectors still require more intensive efforts to be able to meet the target of reducing GHG emissions from emissions in the first scenario in the year concerned. The industrial sector still recorded a -191.85% achievement of the first scenario target. This shows that there was no reduction in GHG emissions in the industrial sector in 2019, even though the mitigation action efforts carried out by the Ministry of Industry amounted to 2.69 million tons of CO2e, but this action is not enough to make actual GHG emissions (inventory results) below BAU, so extra efforts are needed by the Ministry of Industry to carry out mitigation actions other

than in the cement industry. The forestry sector still recorded -a 55% achievement of the first scenario target due to the devastating forest and land fires in 2019. Meanwhile, the waste sector recorded a 45.98% achievement of the first scenario target. This shows that mitigation efforts in the waste sector are not yet optimal. It should be noted that the above calculations use assumptions and error tolerance because there is still no well-documented data on various mitigation actions carried out in the waste sector nationally.

The Directorate of Climate Change Mitigation explained that uncontrolled greenhouse gas emissions could be the cause of global temperature rise. The UNFCCC calculates that global temperatures will increase by 1.5 degrees Celsius in 2030 if there are no efforts to reduce gas emissions. While the Informant Dit. The IGRK MPV states that the losses caused by Ecological Damage due to climate change are long-term, and cannot be felt in real-time. This means that the negative impact of greenhouse gas emissions in general is a predictable worst-case scenario (potential loss).

In the quantitative analysis based on IKLH, researchers get a description of environmental conditions based on the results of document studies that have been processed in table 4.5. In the table, it can be seen that environmental quality degradation has occurred as follows:

a. The results of the Water Quality Index (IKA) decreased. In 2018, 3 provinces were recorded as having a poor rating (IKA value <60). Whereas in 2020, with the same value threshold, 24 provinces were recorded. This decrease can be influenced by the addition of 75 monitoring points in 2020.
b. The results of the Land Quality Index (IKL) have decreased. In 2018, 17 provinces were recorded as having a bad rating – alert (IKL value <70). Whereas in 2020, there will be 21 Provinces with a Moderate – Poor rating.
c. The results of the Air Quality Index (IKU) were stagnant. From 2018 to 2020, there was only 1 province with a fairly good rating (IKU <70), namely DKI Jakarta. The index results remained stagnant despite the addition of monitoring points from 1676 points to 2091 points.
d. The results of the Sea Water Quality Index (IKAL) decreased. In 2019, 12 provinces were recorded as having a moderate rating (IKU value <70). Whereas in 2020 with the same value threshold, there are 18 Provinces. There is no change in the number of monitoring points.

Even though the four IKLH components above stated that there was stagnation and decline, the IKLH value increased. In 2018 the IKLH score was 66.55, while in 2020 it was 70.27. The increase was recognized by the Ministry of Environment and Forestry due to a change in weighting calculations.

Based on the results of the analysis above, it is stated that the ecological condition of Indonesia is currently experiencing damage to ecosystems in various

places. MoEF's active efforts to restore ecosystems and control pollution are indications of damage to these ecosystems. Ecosystem conditions that are not original, in the long run, can threaten the existence of organisms including humans. The risk is very high for organisms outside the conservation area.

On this basis, it can be said that Indonesia has the potential for Ecological Damage and even the crisis has occurred in several places. Actual ecological damage will only occur if ecosystem damage has resulted in a scarcity of natural resources, both in the form of flora and fauna, as well as proper abiotic conditions. While potential Ecological Damage is ecosystem damage that leads to the destruction of the existence of organizations and environmental abiotic factors.

Application of Defense Science to Overcome Ecological Damage

Taking into account the results of the analysis and interpretation of the data above, it can be stated that the ecological condition in Indonesia is currently at an alarming level. Referring to the concept offered by Kovalenko and Natalya (2018) and Pihkala Panu (2020), the conditions described by the quality of conservation areas and IKLH can be considered Ecological Damage. Environmental damage or Ecological Damage is stated as a threat to national defense in Article 4 paragraph 3 of the PSDN Law and Presidential Regulation No. 8 of 2021 concerning the General Policy of National Defense.

Ecological Damage as a defense threat is the same as terrorism and the infiltration of deviant ideologies. Ecological Damage Threats are potential and cannot be recognized in a short time. However, if this potential threat becomes actual, the recovery process will take a long time. In addition, the threat of Ecological Damage is also a cross-cutting issue that involves many sectors, so the handling must be strategic.

Environmental issues have also attracted global attention. The nations are trying to prevent a bad future for planet Earth which will become uninhabitable (uninhabitable). The appropriateness of the earth as a place to live is a human right, equivalent to the right to life and protection. Global environmental issues have also colored diplomacy between countries. UNFCCC every year to oversee the commitments of all countries in climate control. If Indonesia does not participate in this commitment, there will be a potential loss of green investment from foreign companies accompanied by global exclusion. Even though it doesn't have a significant effect, Indonesia's international interests will be disrupted.

Furthermore, in the context of defense, the informants agreed that a country needs defense efforts against ecological damage to existing. Signals of Ecological Damage as a defense threat have been listed in Presidential Decree Number 8 of 2021 concerning the General Policy of National Defense for 2020-2024. Ecological Damage is implicitly included in the dimension of public safety. Ecological Damage has become an actual threat that must be faced with a defense strategy. Actual threats are threats that are happening and may develop in the future. Ecological Damage can be an actual threat because the phenomenon has happened

a lot in Indonesia.

The Ministry of Defense considers that Ecological Damage will undermine the existence of natural resources required by the main components. This is supported by the MoEF which states that there is a potential for an increase in the earth's temperature by 1.5 degrees Celsius (even more), causing a sea level rise of around 2.4 m in 2030. Bappenas notes that there are at least four islands that are threatened with disappearance due to various damages. Ecology and climate crisis. The four islands are Kelor Island, Sentut Island, Sword Island, and even Bali Island. This number does not include unnamed small islands in the outer regions of Indonesia.

In the long run, the MoEF also stated that climate change would result in a food crisis, an energy crisis, and a water crisis. This crisis has an impact on the uncertainty of seasons and extreme weather. This condition triggers a hydrometeorological disaster which has an impact on human ecological disturbances. Kemenko PMK and the Coordinating Ministry for Maritime Affairs and Investment stated that Ecological Damage is a cause of natural disasters that are detrimental to human development and physical development. If the government does not intervene in the environment, the economic, social, and ecological losses will be greater. For example, floods will occur more frequently and more widely, investment costs for development will increase, and Indonesia will be vulnerable to food and water crises.

At present, the required intervention is not only with an environmental science approach or a sustainable development paradigm, but also needs to use a defense paradigm. Researchers believe that strategic defense management can increase emission reductions as well as improve environmental quality based on existing ecological indices. This is because the defense paradigm can increase national vigilance which can encourage awareness of all sectors. This is because the defense is the key to achieving the security and stability of a nation as a development capital. Thus, to deal with the threat of Ecological Damage, strategic defense management can be an alternative solution. more specifically, The MoEF recommends that the defense sector utilize products from conservation areas so that they can participate in conservation efforts together. There is still a lot of potential for biodiversity that has not been studied, so there should still be wide opportunities for its utilization from what is known at this time

As a defense threat, it is necessary to identify the causal factors so that appropriate countermeasures can be taken. Based on the results of the analysis and interpretation above, the most dominant cause of Ecological Damage is human activity. Researchers formulate in more detail some of the factors causing the ecological damage. One of these factors comes from the mindset that comes from the understanding of anthropocentrism which is still adhered to by the majority of the Indonesian population. The manifestation of this understanding is the low awareness of living in harmony with nature, the low alignment of the authorities towards nature, and the low human capacity to manage nature sustainably. The

results of this analysis are in line with research by Muthmainnah, et al. (2020) that Ecological Damage is caused by modern rationality with an anthropocentric mindset that goes hand in hand with industrialization and capitalization. This process causes distributive inequality, namely human domination over other humans, as well as human domination over nature. If this crisis is allowed to continue, it will become a threat to present and future generations.

Related to human behavior, researchers see management weaknesses as a cause of less-than-optimal environmental management, which leads to ecological damage. The three main factors are monitoring and evaluation weaknesses, regulatory weaknesses, and coordination weaknesses. Weaknesses in monitoring and evaluation stem from the quality of indicators that do not accurately represent ecological conditions. The use of these indicators is an excuse for tolerating environmental damage for the sake of economic and political interests. Minimum quality standards are applied so that light pollution is acceptable. Even though nature does not necessarily have a response that is the same as the tolerance measure set by humans. The debate over the size of the indicator is also unavoidable. Climate Action Tracer (in Maqoma, 2022) states that the NDC target set by Indonesia is critically insufficient, meaning that if all countries adhere to the same target, global warming will be worse than doing nothing. However, the NDC target is still used as a reference for the government. This is a small example of the weakness of the indicators used in Indonesia. In the end, there was a hidden effect that accumulated over some time and turned into an Ecological Damage time bomb. In addition, there is also a limited number of competent evaluators. As a result, evaluation results as input for the formulation of sustainability strategies are less accurate. However, the NDC target is still used as a reference for the government. This is a small example of the weakness of the indicators used in Indonesia. In the end, there was a hidden effect that accumulated over some time and turned into an Ecological Damage time bomb. In addition, there is also a limited number of competent evaluators. As a result, evaluation results as input for the formulation of sustainability strategies are less accurate. However, the NDC target is still used as a reference for the government. This is a small example of the weakness of the indicators used in Indonesia. In the end, there was a hidden effect that accumulated over some time and turned into an Ecological Damage time bomb. In addition, there is also a limited number of competent evaluators. As a result, evaluation results as input for the formulation of sustainability strategies are less accurate.

Next is the problem of regulation which stems from the low implementation of regulations, regulations that are not synchronized, regulations that have not been socialized, and too many regulations that make actors less focused on solving ecological problems. H. Kartodihardjo (2008) explains that currently, development occurs by utilizing natural resources by various sectors armed with the truth of their respective laws. These sectoral regulations do not allow holistic management of natural resources due to the limited carrying capacity of each sector. On the other hand, ecology cannot be divided into administrative areas and institutional

jurisdictions. So that regulations that are out of sync, partial, and too many will exacerbate environmental governance.

Finally, coordination weaknesses stem from partial coordination, overlapping authorities, and sectoral egos. In conditions of weak institutions and weak regulations, coordination must be a solution so that government functions can continue. The problem of coordination is still a problem that was conveyed by almost all informants. Coordination has not run effectively.

These factors are the root cause of ecological damage that still occurs even though various programs have been launched and trillions of budgets have been spent. The damaged ecological conditions become one of the factors that shape the dynamics of the strategic environment that affect defense. According to Makmur Supriyatno (2019), the environmental dimension is a strategic context that must always be considered in strategic environmental analysis. Not without reason, environmental damage can trigger social problems that lead to state instability. David Wallace-Wells (2019) mentions that most wars are caused by a lack of natural resources. Wells also mentioned climate change as one of the triggers for social conflict. Floods, landslides, clean water crises, and even extreme weather are accumulations of ecological damage caused by humans over a long period.

To answer the above challenges, the role of defense science can be further highlighted. One of the applications of defense science is Defense Management. The Defense Management process to face the threat of ecological damage begins with planning. Planning refers to the dynamics of the strategic environment, ecological conditions, national resources, national goals, sustainability targets, defense objectives, and evaluation results. While the output of planning is targets, objectives, and indicators as well as programs.

In the planning process, the Ministry of National Development Planning / Bappenas is authorized to coordinate policy planning and budgeting by prioritizing the defense paradigm in the formulation of indicators and programs in the field of environmental management. In this case, Bappenas needs to refer to the National Resources Management Law (PSDN Law) and the National Defense General Policy. Policy and program planning can be in the form of a Master Plan or National Action Plan. The preparation of the action plan is followed by the division of tasks between agencies and the establishment of a joint secretariat. This mechanism is considered effective in resolving an issue because it has a clear direction.

In the planning process, the Ministry of Defense plays an important role in determining the policy direction and targets to be achieved. Through the Directorate General of Defense Strategy and the Directorate General of Defense Potential, the Ministry of Defense conducts socialization to open defense insights for related Ministries. As stipulated in the Minister of Defense Regulation No. 19 of 2016 concerning the Implementation of Non-Military Defense, the socialization is so that relevant agencies can determine prevention, prosecution, and recovery strategies according to the interests of non-military defense.

Next is the Organizing Process. The main function of organizing is to

distribute the authority and targets set in the planning. In the context of this research, the institutional arrangement refers to the PSDN Law, which divides the organization into main and supporting components. MoEF serves as the coordinator of the supporting component to facilitate natural resource needs for the TNI as the main component. Meanwhile, in the context of enforcement, based on the Regulation of the Minister of Defense No. 19/2016 on the Implementation of Non-Military Defense, MoEF as the main element in handling the threat of ecological crisis can determine which ministries/institutions are other elements to carry out planning or carry out enforcement strategies. The role of the Ministry of Defense in this process is to provide consideration for the development of the necessary non-military defense posture through the Directorate General of Defense Potential.

Next is the briefing stage. In the briefing, MoEF and the Ministry of Defense together provide guidance and direct both K/L to be in one goal to overcome the threat of ecological crisis. Briefings by the two ministries can be in the form of drafting guidelines, determining standards, implementing technical guidance, and program assistance. Furthermore, as an output of the briefing results, the two ministries must include the achievements in the performance report and action plan report.

Referring to the Guidelines for the Implementation of Non-Military Defense, MoEF in the briefing phase also needs to conduct guidance on the strength, capability, and degree of non-military forces. Capacity building is intended not only as a development of deterrence, but also endurance. Therefore, the MoEF collaborates with related agencies to foster early vigilance capabilities, state defense capabilities, science and technology (science and technology) capabilities, moral capabilities, social capabilities, and support capabilities for the implementation of national defense. As for the development of non-military forces, MoEF also needs to map out policies that require the support of military forces. The implementation of this briefing is closely related to coordination between relevant ministries.

The next process is coordination. Researchers found that coordination between MoD and MoEF has not involved technical work units (at the Directorate General level). This model of coordination has not been able to solve the problem, because technical units that have the authority and control of the problem are not involved in the policy-making discussion process.

The cross-sectoral coordination process as above needs to apply the principles of Collaborative Governance Ansell and Gash (2007). Some of these principles are built on mutual understanding and commitment. These principles will work if they fulfill three conditions: First, equal initial conditions. Equal initial conditions mean that coordination between MoD and MoEF must be carried out by officials who have equivalent mastery of the substance, have equal authority, and have qual position. Coordination will not work if the coordination participants consist of leaders and staff, even if the staff is delegated authority.

Second, active facilitative leadership. MoD and MoEF need to be equally willing to establish a good relationship and be proactive in communication. Inequality on either side will cause coordination to stall and end up fruitless. Third, adequate design institutions to collaborate. MoD and MoEF need to both have business processes that support organizational effectiveness such as a tactical and straightforward correspondence bureaucracy.

The last process is supervision. The supervision function when referring to the Guidelines for the Implementation of Non-Military Defense is divided into internal and external supervision. Internal supervision is carried out by each K/L to ensure that management is carried out according to procedures to achieve targets. Meanwhile, external supervision is carried out by the parliament or the House of Representatives. This supervision is carried out to ensure and evaluate all actors carrying out their duties and as a strategy testing phase. If the results of monitoring and evaluation state that a strategy has no significant effect, then in the next planning period, the strategy needs to be replaced with another strategy. If a strategy is declared successful, it will be developed so that the results are more optimal.

In the inter-ministerial supervision process, fellow technical or executive institutions do not have the authority to assess, control, or supervise other agencies. Therefore, this oversight task is generally delegated to the Coordinating Ministry. In order for the Coordinating Ministry to be effective, and targeted, the Coordinating Ministry must understand and follow the Strategic Defense Management process from the beginning. As an output of oversight, the Coordinating Ministry needs to release an evaluation report and strategy recommendations for the next period. Oversight can also be interpreted as regulation enforcement, hence the need for specific standards and competencies for evaluators and verifiers.

Conclusions and Recommendations

The concept of national defense is inseparable from non-military threats, one of which is the environment. The results of the research show that the ecological condition in Indonesia is experiencing a crisis (because it is below the safe threshold). Ecological damage is caused by four main factors, namely, human resource and apparatus weaknesses, coordination weaknesses, regulatory weaknesses, and monitoring and evaluation weaknesses. Ecological Damage as an external strategic context which is a non-military threat needs to be faced with a strategic defense management approach through planning, institutionalization, direction, coordination, and supervision between relevant ministries.

Based on the results of the research that has been done, the researcher provides the following suggestions:

1) For the Ministry of Defense of the Republic of Indonesia:
    1) It is necessary to immediately define Ecological Damage as a non-military threat and formulate a Non-Military Defense Action Plan.

2) Determining/Inventorying the need for Natural Resources which are considered a crisis in support of Military Defense and Non-Military Defense
3) Building coordination with the MoEF with the Strategic Defense Management scheme.

2) For Others Central Government:
   a. MoEF:
   1. Maximizing all organizational resources
   2. Identifying the type and level of disturbance in ecosystem conservation areas is important for national defense
   3. Encouraging local governments to fulfill a minimum of 30% ecosystem conservation

   b. The Coordinating Ministry for Maritime Affairs and the Coordinating Ministry for PMK needs to improve the functions of interoperability, control, and synchronization of environmental and defense policies.
   c. The Ministry of Finance needs to consider the long-term financial interest resulting from maintaining a healthy ecology.
   d. Bappenas needs to use the Defense paradigm in the process of policy planning and sustainable development

3) For Academics. It is necessary to carry out further research to deepen the stages of Strategic Defense Management and to determine strategic measurements.***

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