Historical study of peat protection policy to prevent forest and land fires in Indonesia (1990-2020)

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Abstract. This study aims to analyze Indonesia's peat ecosystem protection policy in handling forest and land fires (karhutla). The qualitative research method employs a historical approach relating to the policies of the Republic of Indonesia's government, including general policies and implementation policies. The limitation of the research is for three decades, namely 1990-2020. The primary data was collected through interviews, and the secondary data was collected through library research techniques and online data retrieval. The study's findings show that, although forest and land fires have been occurring for a long time, specific protection regulations only began in the early 1990s. Following that, there was a shift in policy orientation from utilization to sustainable development. Indicators of achievement of policy implementation are seen through the area of burned land and the number of fire hotspots. It decreased in the last half-decade or post-karhutla in 2015 after going through policy corrections and actions, which changed the working paradigm of forest and land fire control from extinguishing prevention.

1. Introduction
The occurrence of forest and land fires in Indonesia cannot be separated from the devastation of peat ecosystems, especially due to the expansion of land-based industries such as agriculture, plantations, forestry, development to infrastructure [1]. According to Goldamart and Seibert [2], traces of forest and land fires were first found in East Kalimantan between 17,510-350 BC. Forest and land fires continued throughout the twentieth century, causing disasters that harmed the environment and the local and national economies [3]. Due to the disparity in management and protection viewpoints and the misuse of the land, peat has become the world's most sensitive and vulnerable ecosystem.

Many actors and factors have contributed to the persistence of forest and land fires. One of which is the inconsistency between policies and their implementation in the field [4]. In addition, the ineffectiveness of formal government institutions [5], the limited space for the task force team to extinguish hotspots [6], lack of coordination between multi-institutional institutions that have the responsibility for handling forest and land fires [7], lack of efforts to reduce the gap between strict regulations related to the environment and providing incentives to farmers to clear land without burning [8], and the classic problem, where many people are still unaware of government policy related to peat ecosystem restoration [9] caused by the lack of access to public policy information [10].

Although the policy is not the only correlation between the successes of handling forest and land fires, the government's political steps by issuing policies are fascinating to be analyzed to make peat management run better. Moreover, the government has issued many regulations related to protecting peat ecosystems [11], but forest and land fires still pose a threat to the community. Based on the
background, this study will investigate numerous policies issued by the government on a national scale, including general policies and implementing policies relating to peat management for forest and land fire control in Indonesia. The data presentation employs a qualitative methodology with policy content analysis using a historical perspective and a review of the literature [12]. The study focuses on three decades of policy (1990 to 2020) and examines policy outputs such as the amount of burned land [13] and the number of hotspots [14] over that period.

2. Method
The qualitative normative research method uses a historical approach, referring to the government's national policies of the Republic of Indonesia, in the form of general policies and implementation policies. Research studies are limited to three decades, from 1990-2020. Primary data was obtained through interviews, while secondary data was obtained through library research and online retrieval. Data presentation was conducted every decade or every 10 years to see the direction of Indonesia's peat use and protection policies.

3. Result and discussion
3.1. Peat protection and management policy
Policy for peat protection and management of fires in peatlands is complicated to extinguish compared to other types of land [15]. Fires in deep peatlands can cause dangerous carbon (CO2) emissions in the atmosphere [16], which can have an impact on human health [17]. Meanwhile, there are still differences of opinion in the technical policy setting, such as the occasional mention of peat regions, which impact the consequences of policies and the legality of the use or conservation of peat itself [18]. The following is a series of policies to protect peat ecosystems from forest and land fires in Indonesia over a three-decade period from 1990-2020.

3.1.1. Period 1990-2000. The policy to tackle forest and land fires is not a new thing in Indonesia. Even the control fire policy has existed since the colonial period (1890 to 1938), including community efforts independently to localize the spread of hotspots or the gordel weg system [19]. However, in Indonesian positive law, the government only issued a policy following the massive fires in 1982-1983 that destroyed over 3.6 million forests and land in East Kalimantan, and subsequent incidents in 1987 in the western part of Sumatra, Kalimantan, and East Kalimantan. East Timor, covering an area of 66,000 ha, was burned again in 1991 at the same location, encompassing an area of 500,000 ha [11]. Table 1 various government policies to protect peat to control forest and land fires in Indonesia in the period 1990-2000.

3.1.2. Period 2001-2010. Given the enormous potential and specific factors of Indonesia's peatlands, the government specifically developed a strategic framework for peatland management during this period. Table 2 presents data on government policies to protect peat to control forest and land fires in Indonesia in the period 2001-2010.

3.1.3. Period 2011-2020. In this period, Indonesia stepped forward to improve forest governance, especially peat ecosystems. There has been a radical change from a policy perspective and strong political leadership and transparency from everyone involved in peatland management [20]. Table 3 presents various sustainable peat protection policies for the period 2011-2020.

3.2. Areas and hotspots of three decades of forest and land fires
It is not easy to know the exact figure of the total area affected by forest and land fires because various official government sources and institutions report different figures [21]. In 2016, the government, through the Ministry of Environment and Forestry, who acted as the data guardian, released data on burned areas and hotspots that could be accessed from SiPongi or the information system for warning
early detection of forest and land fire control. The forest fire data information management system and fire alerts from Sipongi are considered to have worked well technically and in the concept of using technology [22]. Table 4 presents data on burned areas and hotspots in Indonesia for three decades.

Table 1. Government policy to protect peatlands in efforts to control forest and land fires in Indonesia for the period 1990-2000

| Year | Policy | Explanation |
|------|--------|-------------|
| 1990 | Law Number 5 of 1990 concerning Conservation of Biological Natural Resources and Their Ecosystems Presidential Decree (Keppres) No. 32 of 1990 concerning protected areas. | It regulates peat management, especially in conservation areas such as National Parks, Nature Reserves, and others. This policy contains aspects of peatland legality. For the first time, a separate definition appears between peat with protected status (> 3 meters), and peat with cultivated status (<3 meters). Including provisions regarding the depth of peat that needs to be protected which is the basis for peat protection [18]. However, the issuance of this policy became the basis for clearing a million hectares of peatland through Presidential Decree number 82 of 1995 which later turned out to have a negative impact on the environment. |
| 1992 | Law number 24 of 1992 | This is the first law that regulates spatial planning, including the use of peat areas. However, from a legal standpoint, this policy is still not in sync with the substance of peat protection to support the completion of the RTRWP modification, which continues to come from all over Indonesia [23]. |
| 1997 | Government Regulation (PP) 47 of 1997 | Although it does not specifically mention peat, the policy on the National Spatial Plan, aims to regulate utilization patterns, criteria, and management patterns for protected areas, cultivated areas, and certain areas. In part 2 of article 10, it is stated that one of the protected areas is an area that provides protection for its subordinate areas. Then it is explained in Article 10 paragraph (2) that what is meant is protected forest areas, peat areas, and water catchment areas. |
| 1999 | Law 23 of 1997 | This policy is about environmental management. The principle adopted in criminal liability against corporations that commit environmental crimes is liability based on errors (criminal liability based on errors). This makes it difficult for environmental law enforcement in the case of forest and land fires because there must be evidence that the corporation is indeed involved as the mastermind or perpetrator of the arson. So that the existence of this law is considered ineffective in providing a deterrent effect because it considers it a mistake or culpability [24]. |
| 2000 | Government Regulation (PP) 150 of 2000 | This policy regulates forestry. Although it does not specifically mention peat, this policy is closely related to peat management in forest areas. However, the policy direction of this law is still considered centralized and only oriented towards economic growth [11]. This law was later amended by Law Number 11 of 2020 concerning Job Creation. Policy on soil damage control for biomass production. However, this only regulates the damage to land for biomass production (agriculture, plantations, and forest plantations) due to human actions within the production area, controls outside the production area are regulated by other regulations. This restriction affects the status of soil damage because the high intensity of land use and cultivation is a determining factor in the occurrence of soil damage [25]. In general, the parameters of biomass production are higher than forestry biomass production, therefore efforts need to be made to prevent damage to production agricultural land to reduce land clearing by burning [26]. |
Table 2. Government policy to protect peatlands in efforts to control forest and land fires in Indonesia for the period 2001-2010

| Year  | Policy | Explanation |
|-------|--------|-------------|
| 2001  | Government Regulation (PP) 4 of 2001 | The scope of this government regulation includes efforts to prevent, overcome, and recover and monitor the control of damage and or environmental pollution related to forest and land fires [27]. However, this policy is considered to have triggered conflict and overlaps with other policies. There is no clarity regarding the institutions that must be responsible and the context that regulates cross-agency collaboration in coordinating forest and land fire-control [28]. |
| 2004  | Government Regulation (PP) 44 of 2004 | This policy regulates forestry planning. Although this policy clearly states the functions, roles, and criteria of protected forests and the utilization that can be carried out on them, this policy is considered not to lead to sustainable protected forest management because there are still changes in the use of forest areas for use outside the forest area, including closure mining [29]. |
|       | Government Regulation (PP) 45 of 2004 | This policy regulates forest protection. In general, this policy is to prevent and limit forest damage, one of which is caused by intentional human actions, fires, and other forest management-related activities. However, when referring to PP 4 of 2001, the interpretation of the use of article 10 in PP number 45 of 2004 regarding law enforcement actions is minimized because it will only apply to those who do not have a permit or legal letter according to regulations [30]. |
|       | Law 18 of 2004 | This policy is a reference for plantation commodities on peatlands, especially for oil palm commodities. However, it does not contain administrative sanctions for corporations or parties carrying out land clearing by burning, including peatlands [30]. This law was later revoked by Law Number 39 of 2014 concerning Plantations after going through a judicial review at the Constitutional Court [31]. |
| 2007  | Law 26 of 2007 | This policy is about spatial planning. This policy has implications for the hydrological unity of peat and its suitability with spatial planning [32]. This policy still requires harmonizing laws and regulations both vertically and horizontally with related regulations [33]. |
|       | Presidential Instruction 2 of 2007 | This policy regulates the acceleration of the rehabilitation and revitalization of the PLG area in Central Kalimantan. It covers an area of 1.4 million ha, which is used as a settlement for transmigrants, and the majority is peat. After several years have passed, the programs in the Presidential Instruction have not been implemented [34]. |
| 2008  | Government Regulation (PP) 26 of 2008 | Policy on National Spatial Planning. Through this policy, green open space (RTH) for coastal areas is regulated as a form of concern in dealing with the negative impacts of global warming [35]. |
| 2009  | Law 32 of 2009 | This policy regulates the protection and management of peat ecosystems. This is the first law covering peat ecosystems [18], including containing legal substance as the basis for enforcing environmental law for forest and land burning [36]. The application of sanctions for perpetrators of environmental crimes, both individuals and corporations, can be carried out through administrative law, civil law, and criminal law [37]. |
### Table 3. Government policy to protect peatlands in efforts to control forest and land fires in Indonesia for the period 2011-2020

| Year     | Policy                                                                 | Explanation                                                                                                                                                                                                                                                                                                                                 |
|----------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2011     | Presidential Instruction 10 of 2011                                     | In general, this Presidential Instruction regulates the delay in granting new permits and improving the governance of primary natural forests and peatlands to reduce GHG emissions from forests and peatlands. However, in fact, on the ground, forest conversion permits for oil palm plantation companies, industrial forest plantations, mining, and other national strategic projects, are still being issued, thus putting pressure on forest and peatland destruction, including expanding tenure conflicts [38]. |
| 2011     | Presidential Decree Number 61 of 2011                                  | This policy regulates the National Action Plan for Reducing GHG Emissions in the forestry and peatland sector through core activities and supporting activities. It is the responsibility of the company to report information related to environmental performance, and the public has the right to obtain adequate information. However, the results of the study show that company managers do not consider the return on assets in making decisions to disclose greenhouse gas emissions or not [39]. |
| 2012     | Government Regulation (PP) 27 of 2012                                   | This policy regulates environmental permits. However, its implementation is hampered by law enforcement infrastructure, especially in Regional Regulations [40].                                                                                                                     |
| 2012     | Government Regulation (PP) 37 of 2012                                   | This policy regulates the management of watersheds. The derivative of the policy is Regulation of the Minister of Forestry P.12/Menhut-II/2012, which regulates the procedures for the preparation of technical plans for the rehabilitation of forest and watershed land in peatland areas with the function of protection and cultivation, as a complement to the Permenhut P.32/Menhut-II/2009 on procedures for preparing technical plans for forest and land rehabilitation in watersheds[41]. |
| 2013     | Government Regulation (PP) 73 of 2013                                   | This policy regulates swamps and becomes one of the policy bases in formulating the 2016-2020 Peatland Restoration Agency's strategic plan [42].                                                                                                                                     |
| 2013     | Presidential Instruction 6 of 2013                                     | Although the previous moratorium policy has not shown significant results, the extension of the moratorium policy for the next two years is very important to maintain Indonesia's commitment to reducing greenhouse gas emissions [43]. Inpres 10/2011 and Inpres 6/2013 provide total protection for peat regardless of thickness. |
| 2014     | Government Regulation (PP) 71 of 2014                                   | This policy regulates the protection and management of peat ecosystems, which is a derivative of the mandate of Law 32 of 2009. This PP is the first regulation that specifically regulates peat, including planning, utilization, control, maintenance, supervision, and administrative sanctions. This PP has also led to sustainability by containing the obligation of 30% of the entire area of the Peat Hydrological Unit (KHG). Peat peaks and their surroundings are designated as protection functions [11]. However, this policy does not have a significant correlation with the ongoing release of forest areas. In 2011, the release of 159,300 hectares of forest area increased in 2012 to 1.8 million hectares. 2.4 million hectares were released in 2013, and 2014 was the peak year for releasing forest areas of 3.2 million hectares [44]. |
| 2015     | Presidential Instruction 11 of 2015                                    | This policy regulates the improvement of forest and land fire control and marks a general policy that changes the working paradigm from extinguishing to prevention. Among them are through the efforts of an early warning system and early detection by utilizing satellite imagery, field monitoring with routine patrols, support for air operations, socialization, monitoring of peat soil water levels, weather modification technology, law enforcement, coordination, and synergy between institutions, and playing an active role in international relations [2]. |
2016 Government Regulation (PP) 57 of 2016
This policy regulates changes to government regulation number 71 of 2014 concerning the protection and management of peat ecosystems. This is a correction of government policy, which will also be the basis for correcting actions to protect peat ecosystems, especially on corporate obligations or compliance, including strengthening law enforcement [45].

Presidential Decree 1 Number 1 of 2016
This policy is related to the establishment of the Peat Restoration Agency (BRG). This institution was formed with the main task of accelerating the restoration of the hydrological function of peat damaged by fire and drainage, with a target of around 2 million ha by 2020 [46]. There are seven peat restoration targets, including West Kalimantan, South Kalimantan, Central Kalimantan, South Sumatra, Jambi, Riau and Papua. Restoration activities in these provinces are expected to reduce the number of forest and land fires in the future [47].

Ministerial Regulation 32 of 2016
This policy contains norms, standards, criteria, and guidelines for planning, organizing, implementing operations, monitoring, and evaluating the implementation of forest and land forest fire-prone businesses/activities/actions for related parties to ensure the effectiveness and efficiency of the range of forest and land fire control, especially in areas prone to fires such as peat.

2017 Ministerial Regulation number 14 of 2017
This policy regulates the procedure for inventorying and determining the function of the peat ecosystem.

Ministerial Regulation number 15 of 2017
This policy regulates how to measure the groundwater level at the point of arrangement of the peat ecosystem.

Ministerial Regulation number 16 of 2017
This policy regulates technical guidelines for restoring the function of peat ecosystems.

Ministerial Regulation number 17 of 2017
This policy concerns changes to the regulation of the Minister of Environment and Forestry Number P.12 of 2015 concerning the development of Industrial Plantation Forests/HTI. However, this policy was later canceled through the decision of the Supreme Court (MA) number 49 P/Hum/2017SK.129 of 2017
This policy regulates changes to the National Peat Hydrological Unit Map.

SK.130 of 2017
This policy is about establishing a national peat ecosystem function map.

Presidential Instruction 6 of 2017
This policy is a Presidential Instruction to continue the postponement and improvement of new permits for primary natural forests and peatlands. This policy is valid for two years [48]

2019 Presidential Instruction 5 Year 2019
With the issuance of this instruction, there will no longer be the issuance of new concession permits for the crop industry, agriculture, oil palm plantations, and mining. It is stated that the termination of this permit is to increase the protection of natural forests and peat [49]. From the periodic policies initiated since 2011 through Presidential Instruction 10, there has been a significant reduction in deforestation in the moratorium area of around 38%, with an area of about 66 million ha [50].

Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 11 of 2019
This policy regulates changes from P.30/2014 concerning the Business Plan for utilizing Timber Forest Products in Industrial Plantation Forests or RKUPHHK-HTI.

Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 37 of 2019
This policy regulates social forestry, peat ecosystem map.

Regulation of the Minister of Environment and Policies on procedures for the preparation, amendment and stipulation of the Peat Ecosystem Protection and Management Plan or RPPEG.
Forestry of the Republic of Indonesia Number 60 of 2019

2020 Decree of the Minister of Environment and Forestry of the Republic of Indonesia number 246 of 2020

Policy on national RPPEG

This policy is regarding establishing an Indicative Map for the Cessation of New Permits (PIPIB) Primary Natural Forest and Peatland 2020 Period I. In this revision, the indicative area is increased by 314.3 thousand ha from the previous version so that the area of primary natural forest and peatland that is protected and cannot be converted is 66.3 million ha [51].

2020 Decree of the Minister of Environment and Forestry of the Republic of Indonesia number 851 of 2020

This policy is a reinforcement of the previous policy through Presidential Instruction Number 3 of 2020, which places more emphasis on prevention, suppression, and post-karhutla management [45].

2020 Presidential Instruction Number 3 of 2020

This policy replaces Presidential Decree 1 Number 1 of 2016 so that the Peatland Restoration Agency (BRG) is changed to the Peat and Mangrove Restoration Agency or BRGM (2020).

There are four crucial points in the UUCK, namely the ease of the business licensing process, where environmental permits are not abolished but are integrated into business permits; prioritizing administrative sanctions or ultimum remedium but still containing criminal sanctions; directly affected community involvement is carried out in the business license service test team, and restorative justice for illegal activities in forest areas by imposing fines [53].

Table 4. Data on the area of fires and hotspots in Indonesia for three decades (1990-2020)

| Year | Burned Area | Number of Hotspots | Description |
|------|-------------|--------------------|-------------|
| 1990 | 500,000 ha with the impact of a local scale disaster [2] | Hotspot data is not available during this period. The impact of the disaster in the form of smoke was felt by Malaysia and Singapore, which then underlies international cooperation in handling forest and land fires [2] | Forest and land fire data from 1982-1998 are sourced from research references (Cifor, IPB) |
| 1992 | 1994: 5,900,000 ha [54]. | Hotspot data is not available during this period. The impact of the disaster in the form of smoke was felt by Malaysia and Singapore, which then underlies international cooperation in handling forest and land fires [2] | Forest and land fire data from 1982-1998 are sourced from research references (Cifor, IPB) |
| 1997 | In the period 1997/1998 Karhutla burned more than 10,000,000 ha [11]. | Hotspot data is not available during this period. The transboundary haze pollution has even disrupted political stability with neighboring countries (Ditjen PPI KLHK, 2021 hal 10) | Data for 2000-2014 comes from analysis of interpretation of Landsat imagery and has not been further validated. The area can change after validation and verification (Dit PKHL KLHK). |
| 1999 | Bappenas-ADB through the revised calculation of the area affected by forest and land fires in 1997/1998 reached 11,698,379 ha. [54]. | Hotspot data is not available during this period. The impact of the disaster in the form of smoke was felt by Malaysia and Singapore, which then underlies international cooperation in handling forest and land fires [2] | Forest and land fire data from 1982-1998 are sourced from research references (Cifor, IPB) |
| 2000 | 401,499 ha | Hotspot data is not available during this period. Thick smog because the burned area comes from a type of peat that is difficult to control. Forest and land fires occur | Data for 2000-2014 comes from analysis of interpretation of Landsat imagery and has not been further validated. The area can change after validation and verification (Dit PKHL KLHK). |
2003: 1,206,919 ha on land owned by plantation companies, forest concessions, and community land (Ditjen PPI KLHK, 2021)

2004: 1,382,102 ha
2005: 980,627 ha
2006: 3,888,044 ha
2007: 593,622 ha
2008: 399,579 ha
2009: 1,118,405 ha
2010: 231,054 ha
2011: 614,183 ha
2012: 1,078,368 ha
2013: 429,810 ha
2014: 1,779,152 ha
2015: 2,611,411 ha

The first time hotspot data was presented publicly by the government, referring to Terra Aqua (NASA) satellite data, it was recorded that hotspots reached 70.971

The area of forest and land fires decreased by 92.5% in the 2015-2018 period (Dit PKHL KLHK).

2016: 438,363 ha

2017: 165,484 ha

Tahun 2017: 2.440
Tahun 2018: 9.245

2018: 529,266 ha

2019: 1,649,258 ha

2020: 296,942 ha

(1 January-17 Desember 2020 Period)

Even though it is a large hotspot, there is no transboundary smoke, because hotspots are intervened more quickly. Not a national disaster.

After that, a thorough evaluation was carried out for the field work team, especially strengthening the prevention aspect (Dit PKHL KLHK)

2019: 29.341

Comparison of total hotspots in 2019, the decline in hotspots in 2020 reached 91.32%. This data uses the Terra/Aqua satellite (Dit PKHL KLHK)
4. Conclusion
Over the last three decades, the government has adopted a slew of regulations and policies to prevent forest and land fires. There are about 8 policies in the form of laws, 11 government regulations, 1 presidential decree, 7 presidential directions, and up to sectoral implementation policies through seven ministerial regulations and three ministerial decrees.

In the first decade (1990-2000), the protection and management of peatlands in Indonesia were more focused on the use of peat by prioritizing development goals over environmental values. Peat conservation and management policies remained lax in the second decade (2001-2010). Law 32, which governs the protection of peat habitats, was only passed in 2009. As the third decade (2011-2020) began, the Indonesian government’s policy direction began to move to the sustainable use of peatlands, specifically through Presidential Instruction 10 of 2011. However, between regulations, there is still a dichotomy between economic and environmental interests. There is still a massive release of forest areas that correlates with the increase in hotspots in 2013. In the middle of the third decade or after the 2015 forest fires, policy corrections and actions were carried out as a whole that further strengthened the utilization and peat protection, including environmental law enforcement. At this time, the Indonesian government’s policies consistently lead to sustainable peat management, which stops at the regulatory aspects and implementation down to the site level.

A policy that regards peat as an entity to be exploited will increase the amount of burned land and the number of hotspots that persist even after several years of regulation. In the two decades of 1990-2010, forest and land fires were approximately 28,972,209 ha. However, when the policy prioritizes the utilization and protection aspects of peat, while at the same time seeing it as a unified ecosystem, the result can intervene total burned area to 9,153,874 in the 2011-2020 periods. Even with policy corrections and corrective actions that change the paradigm of blackouts to prevention following the 2015 incident, the number of hotspots in Indonesia can be decreased by more than 90% in 2020.

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