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SDG-sensitive international cooperation for tropical peatland restoration: the pursuit of institutional synergies

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Abstract

Tropical peatlands provide diverse ecosystem functions and services. The peatlands, however, have been degraded rapidly by forest fires, anthropogenic drainages, and exploitations. The degradation not only causes environmental costs but also social and economic losses, and their impacts are not limited to domestic. Thus, national efforts and international cooperation for the restoration and sustainable use of the peatlands are in progress. Meanwhile, the UN 2030 Agenda for Sustainable Development is another important challenge, which requires national and international efforts. This study analyzes potential institutional synergies between tropical peatland restoration and Sustainable Development Goals (SDGs) to provide implication for international cooperation. This study focused on the peatland restoration institution of the government of Indonesia, which possesses 47% of global tropical peatland, to draw out potential synergies with SDGs. Institutional interaction framework was applied to the Indonesian peatland restoration institution and SDGs. Depending on relationship of each institution's core objectives and co-benefits, the potential institutional synergies were classified into core, complementary and supplementary synergy. Core synergies (SDG 1, 2, 15) and complementary synergies (SDG 7, 8, 13) were identified. Supplementary synergies, which are expected when unforeseen co-benefits interact, were also suggested by reviewing research articles on tropical peatland restoration (SDG 3, 6). SDG-sensitive international cooperation, considering the potential synergies, is required for restoration and sustainable use of the tropical peatland.

Keywords: sustainable development goals, institutional interaction, interplay management, ecosystem services

Introduction, scope and main objectives

Tropical peatlands, which has been formed with organic matter such as submerged plant stems and roots decomposed very slowly in an oxygen-poor environment, contain exotic ecosystems including wetlands and forests. The world's tropical peatlands cover an area of 33.4-57.8 million hectares and hold 50-105 GtC of carbon, performing an important global carbon storage function (Warren et al., 2017). In addition, peat wetlands and peat swamp forests provide habitats for a variety of flora and fauna, and provisioning services, such as wood and non-timber forest products, to local people (Kimmel & Mander, 2010).

Peatlands provide a variety of ecosystem functions and services. The ecosystem, however, has been rapidly damaged by fire, drainage, and excessive use (Limin & Ermiasi, 2007; Page et al., 2011). Destruction of tropical peatlands, which increases the vulnerability of the peat ecosystem and causes environmental damage accompanying socioeconomic loss, has been reported in Indonesia, which possesses the largest area of tropical peatlands in the world (Osaki & Tsuji, 2016). In particular, 1,750 mtCO_2-e was emitted from the Indonesian peat forest fire in 2015, causing transnational ecological, environmental and social damage (Glauber et al., 2016; Randerson et al., 2015).

Indonesia established the Peatland Restoration Agency (BRG), and prepared a strategic plan for the restoration of peatlands. The Indonesian government's peatlands management policy has a dual purpose of restoring and conserving damaged peatlands, and sustainably using ecosystem services provided by the peatlands (BRG, 2015). The Indonesian government's national efforts for the restoration and sustainable use of damaged tropical peatlands were welcomed internationally, and $92 million of international supports for the efforts were delivered between 2016 and 2020 (BRG, 2016). The Peatland Restoration Agency was scheduled to be restore and manage the peatland until 2020, however, the peatland restoration will be continued by the Peatland Mangrove Restoration Agency, which was established in 2020 to restore 12 million ha of peatland habitat and 600,000 ha of mangroves by 2024 (GoI, 2020).

Meanwhile, after the 2030 Agenda for Sustainable Development was adopted in 2015, international cooperation has been focused on achieving economic and environmental goals to meet the Sustainable Development Goals (SDGs). Rudolph (2017) proposed the need for SDG-sensitive cooperation in all areas to achieve sustainable development in developing countries. Through SDG-sensitive actions, the global public goods such as strengthening of global economy, climate change, biodiversity, and peace and security promotion can be promoted (Rudolph, 2017). Considering the potential that precise and prudent use and restoration of peatlands may contribute to the country's environmental and socioeconomic sustainable development, international cooperation for the restoration of peatland needs to SDG-Sensitive to enhance cooperation outcomes.

In order to realize international cooperation considering the achievement of the SDGs, understanding of the interaction between the SDGs and related institutions is required. Studies on the interaction between various international environmental institutions have been steadily done (reference). Although each institution was formed to respond to problems in different issue areas, interaction in partially overlapping issue areas occurs, and it is important to realize and seek synergy between the institutions (Lima et al., 2015). In this context, in order to promote international cooperation in tropical peatlands considering the achievement of SDGs, it is necessary to analyze institutional synergies between SDGs and peatland restoration. This study was conducted to enhance the SDG Sensitivity of international cooperation for the restoration of tropical peatlands. The institutional synergy between Indonesia's peatland restoration and Sustainable Development Goals were analyzed to provide implications for SDG-sensitive international cooperation.

Methodology

1. Data collection

In order to analyze the Indonesian peatland restoration institution, relevant laws, a strategic plan, and a performance report were reviewed. Presidential Decree on the Protection and Management of Peatland Ecosystem in Indonesia (GoI, 2014; GoI, 2016a) and Presidential Decree on the Indonesian Peatland Restoration Agency and Peatland Mangrove Restoration Agency (GoI, 2015; GoI, 2020), Peatland Restoration Agency's 2016-2020 Strategic Plan (BRG, 2015) and Peatland Restoration Performance Report (BRG, 2019) was collected. The SDGs roadmap established by the Indonesian government was collected to analyze the national direction for achieving Indonesia's SDGs.

2. Classification of institutional synergies

We applied the classification of institutional synergies proposed by Lima et al. (2015), to classify the core synergy, complementary synergy and supplementary synergy between Indonesian peatland restoration and SDGs. The common core objective of Indonesia's peatland restoration institution and the Roadmap of SDGs Indonesia was classified as the core synergy; the core objective of one institution, but a secondary objective or co-benefit of the other institution was classified as the complementary synergy; the unexpected co-benefit in the both institutions was classified as the supplementary synergy. The core synergy and the complementary synergy were

identified by analyzing the relevant documents, however, the supplementary synergy, which theoretically exists between the institutions, was unable to be identified from the analysis because they are not explicitly targeted in both institutions. To identify the supplementary synergy, based on the science policy interface perspective, systematic literature review was conducted on research studies on tropical peatland restoration relevant to each SDGs goal, which were not categorized into core synergy nor complementary synergy. For the systematic literature review to explore supplementary synergy, we collected research articles and reviews with SCOPUS, by searching titles, abstracts and keywords containing tropical peatlands (tropical peat, tropical peatland, tropical peatlands) combined with search queries on SDGs developed by Elsevier data science teams. The collected documents were reviewed and the irrelevant items were discarded.

Table 1: Classification of synergies (Lima et al., 2015)

	Core objective of institution A	Expected co-benefit of institution A	Unexpected co-benefit of institution A
Core objective of institution B	Core synergy		
Expected co-benefit of institution B		Complementary synergy	
Unexpected co-benefit of institution B			Supplementary synergy

Results

1. Core synergy

Three key synergies were identified between Indonesia's peatland restoration and the SDG (Table 2). The Indonesian government recognizes peatlands as an ecosystem to be protected and utilized, designating peat ecosystem for both protection function and cultivation function (GoI, 2014). This dual-purpose approach toward the peatland can also be found from the function of BRG and BRGM, which contains improvement of community livelihoods in peatlands (GoI, 2016b; GoI, 2020). Among the peatland restoration approaches (3Rs) of the Peatland Restoration Agency, the revitalization of peat villages is to develop alternative means of livelihood and products for sustainable use of peatlands (BRG, 2017). The peat care village program is being operated to increase the income of local residents and to direct and indirectly participate in the restoration of peatland. If the local communities utilize peatland for cultivation in sustainable manner, based on a sufficient understanding of the peat ecosystem, hydrology, and indigenous traditional knowledge, it is expected to have core synergy with SDG 1 (End poverty in all forms everywhere) and SDG 2 (End hunger, achieve food security and improved nutrition and promote sustainable agriculture).

The other core synergy was found between peatland restoration and SDG 15, which contains the conservation of terrestrial ecosystems, was in line with the peatland ecosystem protection and management, which is the main purpose of the peatland restoration. Indonesian peatland restoration includes planning, utilization, control, maintenance, supervision and administrative sanctions (GoI, 2014; GoI, 2016b; GoI, 2020). It prohibits land clearing in peat ecosystem with protection function, construction of drainage canals to the peat, and burning of peat (GoI, 2014). According to the strategic plan, BRG planned to establish a community-based patrol system to eradicate illegal logging, and enhance restoration of peat ecosystems which enable to provide habitats of diverse species by preventing floods in rainy season and fires in dry season (BRG, 2016).

Table 2: Core synergies between SDGs and peatland restoration

SDGs	Main Targets	Peatland Restoration

1. End poverty in all forms everywhere	1.2.1 Percentage of population living below the national poverty line	- The Peat Ecosystem Protection and Management includes utilization of peatland ecosystem for cultivation (GoI, 2014) - Establishment of protection zone and cultivation zone (GoI, 2016a) - Plan for sustainable use of peatland was included in the Strategic Restoration plan (BRG, 2016) - Improving community livelihoods on peatlands is one of the tasks of the Peat and Mangrove Restoration Agency (GoI, 2020)
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture	2.1.1 Prevalence of insufficient food consumption 2.1.2 Prevalence of population with moderate/severe food insecurity by food insecurity experiences scale	
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	15.1.1.(a) Proportion of forest cover to total land area 15.3.1.(a) Proportion of degraded forest to total land area	- Indonesian peatland restoration includes planning, utilization, control, maintenance, supervision and administrative sanctions (GoI, 2014; GoI, 2016b; GoI, 2020) - Land clearing in peat ecosystem with protection function, making drainage canals to the peat, and burning of peat are prohibited (GoI, 2014) - Recovery of peat shall be carried out by natural succession, rehabilitation, and restoration (GoI, 2016b) - BRG will utilize a community-based patrol system to eradicate illegal logging, and restoration of peat ecosystems provide habitats of diverse organisms, preventing floods and fires (BRG, 2016).

2. Complementary synergy

A complementary synergy between Indonesia's peatland restoration institution and three SDGs was identified. Indonesian government targets renewable energy mix at 26.1% by 2030 in its SDG road map. To meet the target, the government set ambitious policies to utilize new renewable energy to generate electricity, and develop new technologies on biofuels. The Peatland Restoration Agency stated in its strategic plan to monitor the bioenergy conversion potential of Nyamplung seeds as a raw material for bioenergy production that does not compete with food and the characteristics of tree growth in each peatland (BRG, 2016). This is in line with the Indonesian government's energy mix policy, and is expected to contribute to the achievement of environmentally friendly production and consumption of SDG 7 (Ensure access to affordable, reliable, sustainable and modern energy for all).

Tropical peatlands have exotic ecosystem with high biodiversity. Thus, Peatland Restoration Agency, while restoring degraded peatlands, expected at least 2 million foreign tourists to visit the peatland forest within five years, by developing peatland tourism (BRG, 2016). Such co-benefit can contribute to achieving SDG 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all), by attracting international tourists.

SDG 13, which can be accomplished by reducing greenhouse gas emission intensity and increasing percentage of greenhouse gas emissions reduction, is another goal which has complementary synergy with peatland restoration. Peatland is one of the global carbon sinks with high carbon density. According to the decrees on the Protection and Management of Peatland Ecosystem in Indonesia (GoI, 2014; GoI, 2016b), the relevant plans shall at least contain adaptation and mitigation to climate change. In addition, efforts to restore peatland to prevent peatland fires and greenhouse gas emissions are required in the BRG's strategic plan (BRG, 2016).

Table 3: Complementary synergies between SDGs and peatland restoration

SDGs	Main Targets	Peatland Restoration
7. Ensure access to affordable, reliable, sustainable and modern energy for all	7.2.1 Renewable Energy Mix	- For energy maintenance, especially for the successful development of renewable energy, the Peatland Restoration Agency monitors the bioenergy conversion potential of Nyamplung seeds and the growth characteristics of each peatland (BRG, 2016)
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	8.9.1.(a) Number of International Tourists	- Compared to ASEAN countries, Indonesia's tourism business is not developed. Therefore, the Peatland Restoration Agency is aiming for at least 2 million foreign tourists to visit the peatland forest within five years, and is making efforts to create a new breakthrough in peatland tourism (BRG, 2016)
13. Take urgent action to combat climate change and its impacts	13.2.1.(b) Greenhouse Gas Emission Intensity 13.2.1.(c) Percentage of Greenhouse Gas Emission Reduction	- The Peat Ecosystem Protection and Management Plans shall at least contain adaptation and mitigation to climate change (GoI, 2014; GoI, 2016b) - Efforts to restore peatland to prevent peatland fires and greenhouse gas emissions are required (BRG, 2016)

3. Supplementary synergy

By reviewing research articles on tropical peatland restoration, potential synergies with two SDG goals, which were not categorized into the core synergy nor complementary synergy, were identified.

Tropical peatlands provide habitats for various fauna and flora, but they are rapidly being damaged due to the development of agriculture and plantations. It has been reported that the conservation management of peatlands can have a positive effect on the control of the outbreak of potential communicable diseases as this process results in contact between humans and organisms living in peatlands, and may increase the potential of new infectious diseases (Harrison et al., 2020). On the other hand, air pollution caused by peatland fires was also reported to have a negative effect on the health of local residents in many studies, so the necessity of establishing a system for managing peatland fires was discussed (Uda et al., 2019; Roulston et al., 2018). Therefore, it is expected that peatland restoration may have supplementary synergy with SDG 3 (Ensure healthy lives and promote well-being for all ages), by preventing outbreak of potential diseases and peatland fires.

Peatlands perform hydrological functions including water system control and water source cultivation, and it has been confirmed that water quality deterioration of the local environment occurs when peatlands are converted for agriculture and plantation. If management is carried out in consideration of the negative ecological impact of using peatland that performs production functions, especially the impact of aquatic ecosystem services provided by peatland, it can contribute to achieving SDG 6 (Ensure availability and sustainable management of water and sanitation for all).

Table 4: Supplementary synergies between SDGs and peatland restoration

SDGs	Main Targets	Peatland Restoration
3. Ensure healthy lives and promote well-being for all ages	3.1.1 Maternal Mortality Rate per 100,000 live births 3.2.1 Toddler Mortality Rate per 1000 live births 3.2.2 Child Mortality Rate per 1,000 live births 3.2.2.(a) Infant Mortality Rate per 1000 live births 3.3.3.(a) Number of districts/cities achieving malaria elimination status	- Tropical peatlands conservation is important in the context of COVID-19 and potential future (zoonotic) disease pandemics (Harrison et al., 2020) - Peatland fires negatively affect the health of the community (Uda et al., 2019; Roulston et al., 2018)
6. Ensure availability and sustainable management of water and sanitation for all	6.1.1.(a) Percentage of households that have access to safe drinking water sources 6.2.1.(b) Percentage of Households with Access to Adequate Sanitation	- To utilize peat water, water treatment is required to remove humic substances (Rahman et al., 2021; Qadafi et al., 2020) - palm oil plantations and agricultural activities in peatlands deteriorate the water quality by causing low oxygen saturation and high acidity (Gandaseca et al., 2015; Gandaseca et al., 2014)

Discussion

This content analysis was conducted to identify synergies between restoration of peatlands and achievement of SDGs, to seek SDG-sensitive international cooperation for tropical peatlands restoration.

Among the two core synergies identified, the synergy between SDG 15 to protect terrestrial ecosystem and the restoration of peatland were intuitively expected. Maintaining a higher proportion of forests in the entire country and lowering the proportion of damaged forests can be achieved by restoring damaged peat swamp forests through peatland restoration activities, and by lowering fire vulnerability of the peat ecosystem. On the other hand, the core synergy between peatland restoration and SDG 1 to end poverty and SDG 2 to end hunger might be seemed to be awkward because those SDGs may counter the restoration of peatland. In fact, the Indonesian government had implemented a Mega-rice project on peatlands for large scale of food production. The project failed to achieve its target and caused critical damages to the peatlands. However, considering that peatlands can be converted due to the livelihood activities of local residents, protecting peatlands within ecologically more important area, and use other peatlands within a relatively low importance area activities in a sustainable manner can be a reasonable approach to reduce peatland conversion pressure. Indonesian government has been preparing indicative maps and monitoring peatlands for sustainable management. In addition, efforts to identify alternative peatland products is another on-going task. International cooperation is required to support those efforts, to enhance the existing monitoring system and local livelihoods.

Peatlands restoration is found to have complementary synergies with SDG 7 by contributing to renewable energy mix, SDG 8 by attracting international peatland tourists, and SDG 15 by reducing greenhouse gas emission from peatlands. In addition, each synergy is relevant to achieve national target to increase use of biofuel for transportation and power generation, to become a competitive and sustainable tourism destination (OECD, 2020), and to reduce national emissions. To achieve those goals more effectively, it would be important to link

existing domestic and international efforts in each sector to make contributions to realize those co-benefits of peatland restoration.

Conclusions/ wider implications of findings

The institutional synergy between the Indonesian government's peatland restoration system and the SDGs was analyzed for SDG-sensitive international cooperation to promote cooperation on the restoration of tropical peatlands in consideration of the achievement of the SDGs in developing countries. Three core synergies and three complementary synergies were identified through content analysis, and three additional synergies were identified by analyzing previous studies on the restoration of tropical peatlands.

However, in order to realize the identified synergies, intentional efforts are required in the design and implementation of the domestic system for peatland restoration. In addition, to support these national efforts, international cooperation in connection with existing peatland restoration systems and efforts should be provided.

Indonesia's peatland restoration is recognized as an important transnational issue, and various countries are promoting international cooperation. Technical and financial support has been provided for the restoration of tropical peatlands, mainly management of peat sluices for the restoration of peatlands in central Kalimantan and Sumatra, fire prevention and control, improvement of livelihoods of local residents, and greenhouse gas emission through peatland conservation Cooperation in various fields such as carbon projects is taking place.

For the alignment and aid harmonization of the international community's support, countries and international organizations that have cooperated for peatland restoration need to communicate with partners to update the status of cooperation and major results, and to share experiences and lessons.

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