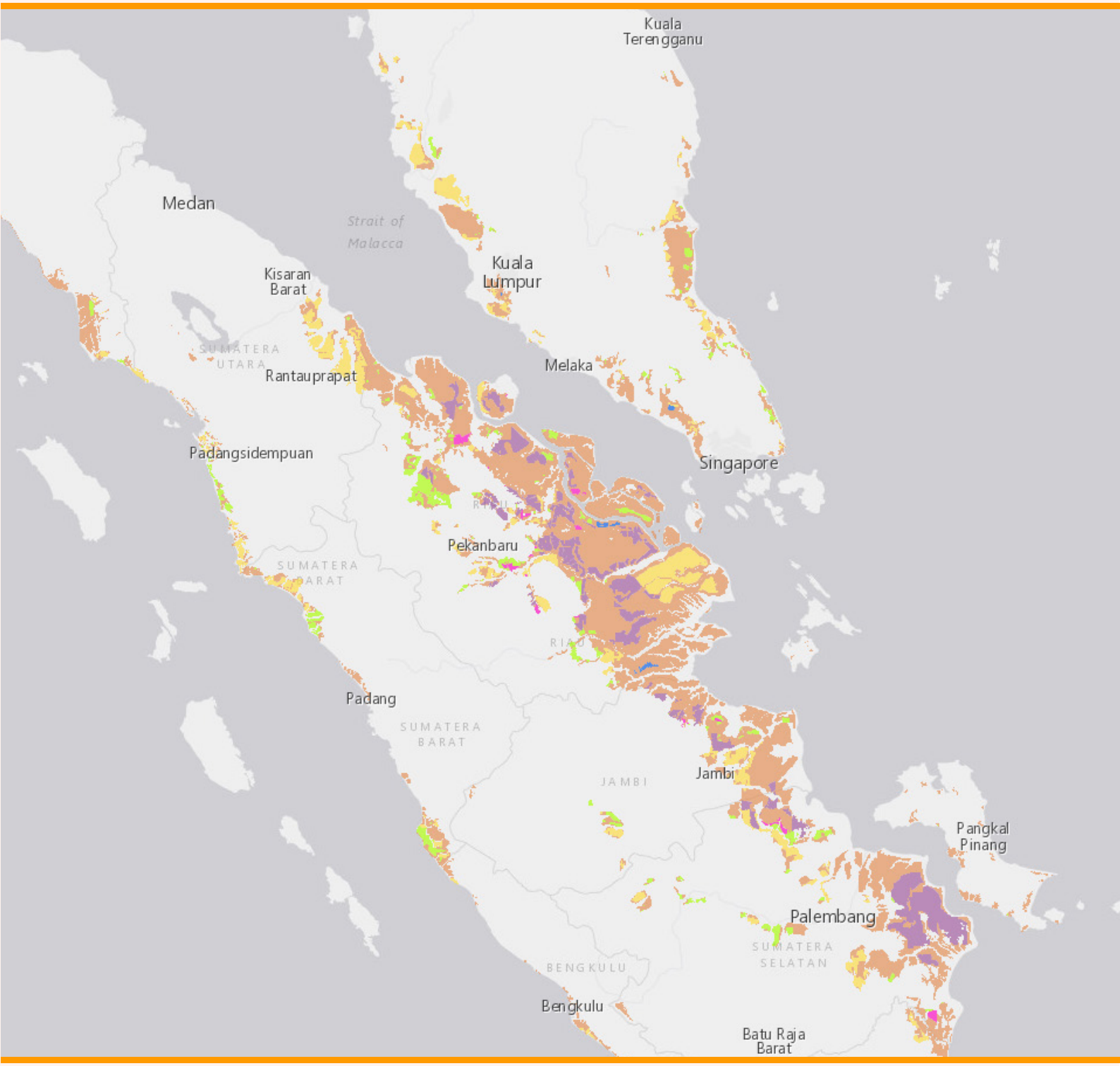
SINGAPORE INSTITUTE OF INTERNATIONAL AFFAIRS



SPECIAL REPORT

PEATLAND MANAGEMENT & REHABILITATION IN SOUTHEAST ASIA: MOVING FROM CONFLICT TO COLLABORATION

JUNE 2017

This report provides a holistic overview and analysis of the current opinions and approaches with regards to managing peatlands in Southeast Asia. Peatlands are a special type of ecosystem containing areas covered with peat, a type of soil largely formed from partially decayed organisms. These give peat a much higher organic content as compared to mineral soil. Southeast Asia contains large peatland areas, mostly in Indonesia and Malaysia, which naturally exist as waterlogged forests known as peat swamp forests.

The intention of this report is not to advocate for a particular approach to peatland management, but to highlight the areas of overlap, the opportunities for coordination and collaboration between stakeholders, and why such collaboration is essential.

INTRODUCTION

Peatlands have become the subject of increasing national and international attention as their links with major concerns such as forest fires, biodiversity loss, and climate change grow clearer. In particular, it is no longer possible to ignore the vital role that peatland management and rehabilitation plays in resolving the long-standing issue of annual haze pollution in Southeast Asia, which has caused huge financial losses[1] and is estimated to have contributed to the premature deaths of over a hundred thousand people across the region[2].

However, peatlands, particularly tropical peatlands, remain an under-researched and poorly-understood topic.[3] [4] Opinions differ on the best method for managing and rehabilitating peatlands, and the situation is further complicated by the presence of multiple stakeholders and competing interests.

As a result, differing approaches are currently being taken by various parties to manage peatlands in Southeast Asia, each striking a different balance between cultivation and rehabilitation. The resulting disagreements over how peatlands should be managed threaten to divert attention away from the urgency of the issue and the need to take immediate and concerted action.

Though these different approaches to peatland management appear to be incompatible on the surface, they nevertheless present several points of overlap and opportunities for collaboration when examined in greater detail. Such collaboration is essential as peatland management is a complex and multi-faceted issue, and maximal alignment between stakeholders will be required to successfully address the environmental, social, and governance problems associated with peatlands today.

This report will examine the current approaches to managing and rehabilitating peatlands in Southeast Asia on three levels. Firstly, it will describe the regional and national frameworks available to govern or provide direction on how peatlands are managed. Secondly, it will classify peatland management into three major approaches – "full cultivation", "full protection", and the "middle approach" – and outline the pros and cons of each, supported by examples. Finally, it will highlight the areas of overlap between the three approaches, and argue that focusing on these areas of overlap through the "landscape approach" enables beneficial outcomes to be achieved without becoming mired in polemical discourse. These beneficial outcomes include reduced conflict with local communities; improved fire-readiness; protection of peatlands from encroachment; increased agricultural yields and profits; and improved monitoring and evaluation of peatland projects.

FRAMEWORKS FOR PEATLAND MANAGEMENT IN SOUTHEAST ASIA

Three major frameworks are available to govern or provide direction on peatland management in Southeast Asia. On the regional level, ASEAN has created an ASEAN Peatland Management Strategy. On the country level, Malaysia and Indonesia both have national-level plans for peatland management. However, these plans differ radically in terms of aims, comprehensiveness, and rigour.

ASEAN

ASEAN's Peatland Management Strategy

The ASEAN Peatland Management Strategy (APMS) was first endorsed by the Environment Ministers of the ASEAN nations in 2006, and is slated to be operational until 2020.[5]

The stated aims of the APMS are to enhance awareness and capacity on peatlands, address transboundary haze pollution and environmental degradation, promote the sustainable management of peatlands, and promote regional cooperation.[6] It does so by overseeing the creation of National Action Plans for Peatlands for all ASEAN member states, identifying new peatland areas, and creating demonstration sites for peatland best management practices, among other initiatives.[7]

However, these ASEAN-led initiatives seem to have had little success in preventing the recurrence of the problems associated with peatland mismanagement. This may be attributable to the highly country-specific nature of these problems and the fact that these initiatives, many of which remain as pilot and demonstration sites,[8] are disproportionate in size to the vastness of Southeast Asia's peatland area.

MALAYSIA

Malaysia's Peatland Management Strategy

Malaysia has experienced peat fires since at least the mid-1990s, though not on the same magnitude as Indonesia.[9] In the past two decades, over 1 million hectares of peatland in Malaysia have been cleared for timber, oil palm, pulpwood, rice, and other crops, often without the use of peatland-appropriate agricultural methods.[10] As a result, peatland agriculture in Malaysia has become closely linked with the increased incidence of peat fires.[11]

In response to these issues, Malaysia introduced a National Action Plan for Peatlands in 2011.[12] However, the Plan is merely a set of guidelines for peatland management, rather than being legally binding.[13] In addition, the Plan does not provide detailed information on water management, and gives only general information on fire prevention[14], both of which are key to managing peatland.

The Malaysian government continues to pursue a policy of peatland conversion for agriculture, focusing in particular on oil palm expansion in Sarawak.[15] Government officials maintain that oil palm growers in Sarawak are employing best practices to minimise fire and environmental damage.[16] Many of these best practices have been developed by research institutions linked to the government, such as the Sarawak Tropical Peat Research Institute[17], which calls into question their level of objectivity.

Indonesia's Peatland Management Strategy

In response to the severity of the fires and haze of 2015, the Indonesian government has declared peatland conservation as its key strategy to prevent fires, and 2016 saw it take several concrete steps to protect peatland and regulate its use.

In January 2016, President Jokowi established the Peatland Restoration Agency (Badan Restorasi Gambut, or BRG), led by Nazir Foead, formerly a conservationist with the World Wildlife Fund. Reporting directly to the President, the agency is charged with coordinating and facilitating peatland restoration in seven provinces: Riau, Jambi, South Sumatra, West Kalimantan, Central Kalimantan, South Kalimantan, and Papua. BRG is targeting the restoration of approximately 2.1 million hectares of degraded peatland in these seven provinces by 2020[18] through three strategies: rewetting (through blocking canals and building deep bore wells), revegetation with native peat swamp forest species, and revitalising livelihoods for communities in peatland areas (through peat-appropriate agriculture, fisheries, cattle farming, and eco-tourism).[19]

To eliminate confusion resulting from contradictory and inconsistently-applied regulations,[20] the government released a new regulation, PP 57/2016, in December 2016. This regulation sets out clearer rules and standards governing cultivation activities in peat. Specifically, it is now illegal for both companies and local communities to burn peatland and peat forests for any reason.[21] Another stipulation is that 30 percent of each peat hydrological system must be zoned for protection, along with any areas with peat deeper than 3 metres.[22] Finally, the regulation establishes the legal lower limit for the peatland water table as 40 centimetres below the ground surface.[23] If the water table falls below this point, the peatland is deemed to be damaged, and the company or individuals who hold the rights to manage the land must restore the water table to 40 centimetres below the ground surface. They may also face sanctions from the Ministry of Environment and Forestry.

Finally, the regulation codifies into law a moratorium on issuing any new licences to develop plantations on peat until the Indonesian government finishes mapping all its peatlands and zoning protection areas.[24] It also bans all new land clearing and canal building on peatland, even in existing concessions.[25] This point in particular has been welcomed as a vital part of Indonesia's peatland regulatory framework by international observers, such as the United Nations Environment Programme and the government of Norway.[26]

Balancing Peatland Cultivation and Rehabilitation

Determining the ideal method for managing peatland is complicated, due to the multiple differing opinions and competing interests involved. In particular, there is an ongoing debate over the ideal balance between the amount of peatland to be used for cultivation and the amount to be set aside for rehabilitation. These approaches are commonly viewed as incompatible, leading to controversy and disagreement between proponents of each approach.

The approaches can be classified into three main categories: Full Cultivation, Middle Approach and Full Protection (see Figure 1). The following sections will examine each of these three approaches using examples, and summarise the advantages and drawbacks of each.

FULL CULTIVATION

"Full cultivation" aims to convert the maximum amount of peatland available to agricultural use, most commonly drainage-based agriculture.

COMMON TECHNIQUES

- Soil compaction
- Controlled drainage
- Planting on mounds
- Smallholder support (land leases, finance schemes)

NOTABLE EXAMPLES

- Sarawak state, Malaysia

FULL PROTECTION

"Full protection" aims to rehabilitate degraded peatland and prevent all drainage-based agriculture.

COMMON TECHNIQUES

- Blocking of all canals
- Revegetation using native plants
- Paludiculture and other alternative livelihood models
- Ecosystem Restoration Concessions

NOTABLE EXAMPLES

- Katingan Project, Central Kalimantan
- Berbak Green Prosperity Project, Jambi

MIDDLE APPROACH

The "middle" approach sets aside some areas within a single peat system for protection and uses the remaining area for agriculture.

COMMON TECHNIQUES

- Controlled drainage
- Re-zoning and land swaps
- Buffer zones
- Village fire preventionprogrammes
- Social forestry schemes

NOTABLE EXAMPLES

- Kampar Peninsula, Riau

Figure 1: A summary of the three current major approaches to peat management and rehabilitation.

Approach 1: Full Cultivation

Some companies and academics believe that by using specialised agricultural techniques, it is possible to cultivate almost all peat areas while mitigating the possible negative impacts. One of the chief proponents of this view is the Sarawak Tropical Peat Research Institute, a research arm of the Malaysian government based in Sarawak.

The Sarawak state government believes it is feasible to develop its peatlands on a large scale, particularly for oil palm plantations.[27] It targets the expansion of oil palm plantations in the state from 532,931 hectares in 2010[28] to 2 million hectares[29]. It is projected that the bulk of this expansion (up to 82 percent) will occur on peatlands.[30]

Techniques Used

The major technique that has been developed to manage peat by the Sarawak Tropical Peat Research Institute is artificial soil compaction. This refers to compressing peat into a smaller volume using mechanical equipment such as excavators,[31] thereby decreasing the size of the pore spaces within the peat soil.[32] This process is typically carried out three to four weeks after canals are dug, and is repeated in subsequent years as necessary.

In Sarawak, other techniques are used in conjunction with artificial soil compaction. These include a controlled drainage system to maintain the water table at a stable level,[33] supporting smallholders through state-owned land leases and finance schemes,[34] planting oil palm trees on raised mounds to prevent the trees from leaning,[35] and using excavators to push leaning trees into a regular angle.[36]

Advantages and Concerns

Artificial soil compaction has been observed to improve oil palm yield and reduce the need for regular fertilising, as compacted peat retains fertiliser better.[37] It also increases peat density and capillary rise, which reduces the rate of carbon emissions.[38] Finally, soil compaction reduces the amount of oxygen in the peat soil, and hence the flammability of peat and the risk of fire.[39] These advantages have drawn attention from parties outside Sarawak, including the Indonesian Palm Oil Association (GAPKI), the Indonesian national association for oil palm growers.[40]

The Sarawak government argues that given the scarcity of agricultural land on mineral soils in Sarawak, it is necessary to develop peatlands into plantations to improve the livelihoods of local communities.[41] It also points to the existence of plantations on peatlands that have matched the productivity of those on mineral soils to support its agricultural practices.[42]

On the other hand, some argue that artificial soil compaction is associated with various negative impacts, which may outweigh its possible benefits. For instance, compacted soil impedes root growth and penetration. As a result, uptake of water and nutrients is restricted, possibly leading to stunted, drought-stressed plants and lower crop yields.[43] Hence, some argue that the technique is only viable in specific areas which have flat terrain and little vegetation.[44]

In addition, artificial soil compaction reduces the ability of the peat soil to store water and regulate water flows. This may increase the severity of seasonal droughts and floods.[45]

Finally, artificial soil compaction does not address the issue of long-term peat subsidence.[46] With soil compaction techniques, the water table is usually maintained at about 70 centimetres below the surface,[47] meaning that peat above this level will continue to oxidise and decompose. This will create subsidence that will necessitate repeated compaction, causing the soil surface to gradually fall further. Subsidence is likely to persist until all the peat is oxidised or the area becomes flooded.[48]

Approach 2: Full Protection

Another group, consisting of academics and NGOs, holds the contrasting viewpoint that the only sustainable form of peatland management is conserving all the peatlands within a single peat hydrological system. This argument is based on the fact that all connected peat areas function as a single hydrological unit through which water can flow freely. Hence, draining any part of the peatland will negatively impact water availability, and correspondingly any rehabilitation efforts in surrounding peatland areas.[49]

Techniques Used

An integrated plan for full peatland rehabilitation generally involves hydrological rehabilitation, revegetation, and the implementation of an alternative livelihood scheme so that local communities can earn a living without the use of drainage-based agriculture.[50]

Hydrological rehabilitation is usually the first step of the process. This is carried out by building dams to block existing canals and prevent water from draining out of the peat hydrological system.[51] Other interventions, such as filling in canals and digging bore wells as an emergency water supply, may also be used.[52]

Repairing hydrological function has the effect of raising the water table and enabling the second phase, which is revegetation. Though this sometimes simply involves allowing the forest to regenerate naturally, evidence shows that it may be difficult for degraded peat swamp forest to restore itself to its original state without some human intervention, as essential ecosystem components may have already been lost.[53] Hence, natural revegetation is often supported by creating nurseries for native seedlings and teaching peat planting techniques to local communities through demonstration plots.[54]

The blocking of canals usually means that local communities will have to cease planting crops that require drainage, such as oil palm. To prevent the loss of livelihoods, alternative economic models have to be introduced. Schemes such as fisheries, cattle farming, and eco-tourism have been explored, but the model with the most potential and widespread applicability is paludiculture.[55] This refers to the cultivation of peat swamp forests using native plant species that do not require drainage.[56] To date, 222 such species have been discovered that can be harvested for timber, on top of 81 other species that have some "major economic use". These include agarwood (incense), bittergourd (fruit), candlenut (edible nuts), gemor (incense), illipe nut (oil), jelutong (latex), mangosteen (fruit), rambutan (fruit), ramin (incense), sago (starch), swamp taro (starch), water apple (fruit), and water chestnut (starch).[57]

Advantages and Concerns

Rehabilitating an entire peat hydrological system maximises the potential impact of rehabilitation efforts, as it eliminates the possibility of harm due to drainage from surrounding areas. In addition, full protection helps to minimise the risk of fire. If only one section of the peat hydrological system is protected, fires and haze may still enter from surrounding areas that are poorly-managed, damaging the protected area.[58]

In addition, intact peat hydrological systems provide many ecosystem services, which are not fully understood but may have valuable benefits. These services include removing sediments, removing toxic substances, and improving plant nutrient absorption.[59] It has been reported that rehabilitating peatland improves soil fertility in surrounding areas.[60] Finally, introducing measures to protect the entire ecosystem maximises the survival rates for the flora and fauna of the peat swamp forest by reducing opportunities for human encroachment.[61]

On the other hand, administering a rehabilitation project over an entire peat hydrological system is expensive and requires a great deal of manpower, expertise, and oversight, due to the large land area and wide array of stakeholders with competing interests involved.[62] As a result, full protection is not a viable option for many stakeholders.

Full protection usually necessitates the introduction of alternative livelihood models, which present an additional challenge. Though the potential returns for certain paludiculture crops (such as jelutong and illipe nut) are theoretically comparable to those of oil palm on peat (see Figure 2),[63] the market for these alternative crops remains underdeveloped in comparison to that for oil palm.[64,65] Blocking canals also removes the most common form of transportation in

peatland areas, posing an additional challenge for expanding paludiculture crops to a commercial scale.[66]
The generation and sale of carbon credits using ERCs is being tested as another model for making full protection profitable. However, ERCs face obstacles such as high start-up costs, estimated at US$14-16 million (S$20-23 million) in the first 6 years of operation.[67] In addition, despite growing annual demand,[68] the global market for carbon credits remains underdeveloped,[69] with Indonesian ERCs struggling to find buyers for the credits they generate[70]. To date, no ERC has managed to turn a profit without donor support.[71]

Without the ability to financially support themselves, many full protection programmes have to rely on funding from donors. Such donor partnerships are usually time-bound, requiring quantifiable results to be produced in a relatively short time for payment to be made. As a result, many projects neglect to consider the long-term viability of their interventions. Such projects may become poorly-maintained or unsustainable over time, and gains achieved may be reversed after a project has been completed and funding is removed.[72]

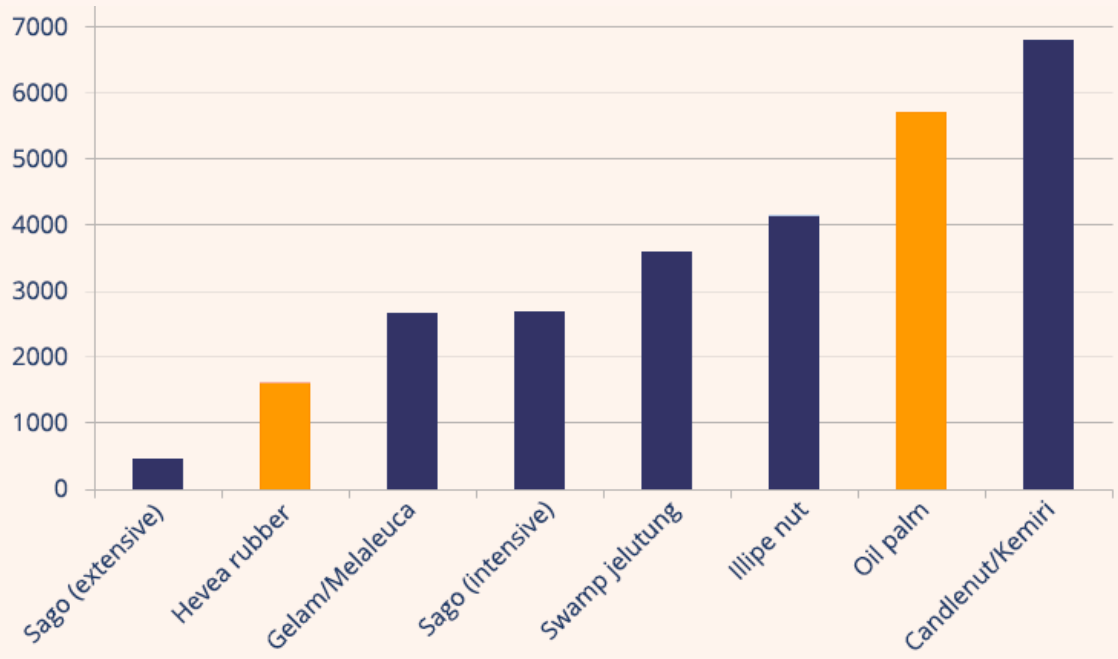


Figure 2: Financial returns for a range of agricultural commodities on peat. Blue bars indicate native peat swamp species that do not require drainage, while orange bars indicate non-native species that require drainage.
Source: Giesen, W. (2015) Utilising non-timber forest products to conserve Indonesia's peat swamp forests and reduce carbon emissions, Journal of Indonesian Natural History, 3(2), p. 13

CASE STUDY: ECOSYSTEM RESTORATION CONCESSIONS

In Indonesia, one model for peat rehabilitation that has garnered international interest is the Ecosystem Restoration Concession (ERC). An ERC is a degraded forest area that has been licensed to a private company for the purpose of protecting and restoring the forest, rather than converting it into a plantation.[73] Licence holders may generate income in ways that do not disturb rehabilitation activities, such as harvesting non-timber forest products, bee-keeping, animal farming, ecotourism, and selling carbon credits.[74] Often, ERCs also receive significant financial support from donors.[75]

Probably the most well-known example of an ERC is the Katingan Project, which began in 2010 on 149,800 hectares of logged peat forest in Central Kalimantan.[76] The Project, which is backed by international partners such as the investment firm Permian Global and NGO Wetlands International, is aiming to generate revenue by selling credits on the international carbon market.[77]

At least 12 ERCs now exist in Indonesia, covering a total of 480,093 ha.[78] This number is likely to increase in the future, as ERCs also form a cornerstone of BRG's strategy for rehabilitating degraded peatland within areas currently used for industrial plantations.[79]

Approach 2: The "Middle" Approach

The last approach to peatland management, advocated by private sector companies as well as some NGOs and academics, involves protecting and rehabilitating a certain proportion of peatland within a single peat hydrological system while allowing the rest to be drained and cultivated using best practices. In this paper, this will be referred to as the "middle" approach.

Often, the area conserved is the central part of the peat dome, the area where the peat is usually deepest. There is no consensus as to the ideal percentage of peatland to be conserved, but two commonly-used guidelines are 30 percent[80] and 70 percent.[81]

Of the three approaches discussed, this appears to be the one endorsed by the Indonesian government. The recently-passed Regulation PP 57/2016 mandates that at least 30 percent of a peat hydrological system must be conserved, in addition to any peat areas deeper than 3 metres.[82] BRG has also accepted a balance between cultivation and rehabilitation in the interim while it designs a long-term exit plan for plantations on peatlands.[83 84]

Techniques Used

The key principle of the "middle" approach is the minimisation of conflict between cultivation and rehabilitation activities. In order to achieve this, water management systems are vital. Technologies such as specialised dams are used to maintain the water table at a level that is low enough to permit existing agriculture, but high enough to avoid damaging rehabilitation areas.[85]

Another way to minimise conflicts is through the proper zoning of cultivation and rehabilitation areas. Land swaps have been used by some companies, such as the members of the Palm Oil Innovation Group, to move plantation areas away from rehabilitation areas and onto mineral soil[86] or shallow peat.[87] Land swaps have also been used to connect rehabilitation areas to each other to form "conservation corridors", thereby improving their effectiveness as wildlife habitats.[88]

To reduce illegal encroachment into the rehabilitation area, the peatland area is often surrounded by a buffer zone. Industrial plantations[89] or sustainable timber logging forests may sometimes be used to create this buffer zone.[90]

In Indonesia, the "middle" approach has been used in conjunction with social forestry schemes. Under such schemes, NGOs help a peatland village draft a plan to maintain a peat swamp forest, either within or near the village boundaries. Once this plan is approved by the Ministry of Environment and Forestry, the village receives the rights to the forested land, as well as the responsibility to protect it. The village may monetise the forest in any way that does not impact rehabilitation efforts, alongside the community's existing plantations.[91]

Social forestry schemes have proven successful in preventing deforestation and fires as they give communities a sense of ownership over the forest, on top of introducing them to alternative livelihood schemes that do not require burning or drainage.[92 93] As such, the Indonesian Ministry of Environment and Forestry has launched a high-profile programme that targets 12.7 million hectares of forest to be administered under social forestry schemes.[94] Social forestry is also a component of BRG's Peat-Aware Villages (Desa Peduli Gambut) programme, through which BRG hopes to introduce peatland best management practices to 1,000 villages by 2020.[95]

Another important scheme that is often used alongside the "middle" approach is the village fire prevention programme. Such village-level interventions are important, because without external support, villagers can usually only afford to clear land by using fire.[96 97]

Though known by many names (including Fire-Free Village, Desa Peduli Api, Masyarakat Peduli Api, and Desa Siaga Api), village fire prevention programmes generally feature the same core elements. These are providing villages with the necessary training and fire-fighting equipment to suppress fires; conducting regular fire patrols to spot fires quickly; regularly monitoring fire risk via satellite hotspot maps and ground verification; training villages in alternative ways to clear land without fire, and providing them with appropriate machinery to do so; and monitoring the fire-prevention performance of villages, sometimes rewarding performance with financial or other incentives.[98 99]

Though only introduced relatively recently, village fire prevention programmes have yielded significant success. For example, one such programme saw burnt areas in participating villages decline 90 percent between 2013 and 2015.[100]

Village fire prevention programmes have now been introduced by NGOs;[101] agroforestry companies such as Sinar Mas[102] and Royal Golden Eagle;[103] the provincial governments of Riau[104] and Jambi;[105] and the Ministry of Environment and Forestry.[106]

Advantages and Concerns

Despite the ecological benefits of rehabilitating the entire peat hydrological system, a balance between cultivation and rehabilitation may be more appropriate in certain areas for several reasons.

Firstly, many peatland areas already contain large-scale industrial plantations. It is often unfeasible to evict plantation companies from the area immediately.[107] Adopting the "middle" approach also gives the company time – at least until the end of the current planting cycle – to adopt an alternative business model that does not involve peat drainage.[108]

Secondly, many peatland areas are home to smallholders and indigenous peoples, whose agricultural activities and livelihoods would often be significantly affected by rehabilitation projects. Time is required to socialise these communities and introduce them to alternative economic models that do not involve peat drainage.

Thirdly, cancelling the rights of companies to manage concessions on peatlands would leave the land unsupervised. As the local government often lacks the capacity to monitor all such unmanaged areas, they risk falling victim to encroachment and illegal land clearing through slash and burn practices. Rather than have such a situation result, some companies argue that it is preferable to have them manage the land, using the best methods currently known for peatland management.[109]

Lastly, peat rehabilitation programmes are often costly, require significant knowledge and manpower, and need to be conducted over a period of several years to be effective.[110] Some plantation companies argue that these factors make them better placed to spearhead peat conservation programmes than donors (which often work only on short-term projects) and NGOs (which generally lack funding and manpower).[111]

On the other hand, some parties are opposed to the "middle" approach, as they argue that even under best management practices, draining any part of the peat hydrological system will create significant subsidence.[112] The flow of groundwater from rehabilitation areas to cultivation areas may also affect the health of the protected forest, jeopardising the success of rehabilitation efforts.[113]

Some have also expressed doubts concerning the intentions of agroforestry companies spearheading rehabilitation projects. There is a concern that these projects may be used as "greenwashing" to draw attention away from the companies' unsustainable practices in other areas.[114]

CASE STUDY: SIMULTANEOUS CULTIVATION AND CONSERVATION IN THE KAMPAR PENINSULA

The Kampar peninsula in Riau province, Indonesia, provides a good example of an approach combining peatland cultivation and conservation in practice.

The Kampar peninsula is an area of about 700,000 hectares in the east of Riau province, within the Pelalawan and Siak regencies.[115] It consists entirely of peatland, most of which is deep peat between 4 to 15 metres in depth.[116]

Until 2002, the Kampar peninsula was still covered by peat swamp forests. However, in subsequent years, the majority of the forest was degraded through timber harvesting and illegal logging. At the time, the peatland was managed as separate plots rather than as a single peat landscape, leading to unregulated drainage from the peat dome to the coast.[117] The creation of access roads and drainage canals also facilitated encroachment by illegal loggers, slash and burn farmers, and wildlife poachers, leading to uncontrolled deforestation, fires, and haze.[118]

Following this, most of the degraded area was licenced to create pulpwood plantations

supplying two major pulp and paper companies, APP and APRIL.[119] In 2013, the central part of Kampar peninsula's peat dome, along with another degraded peat forest area on nearby Padang Island, became protected under the Restorasi Ekosistem Riau (RER) project, an initiative by APRIL. RER is an Ecosystem Restoration Concession operating under a 60-year lease from the Ministry of Environment and Forestry, covering 150,000 hectares in total. APRIL has committed US$100 million (S$144 million) to support the project over the next 10 years.[120]

The central rehabilitation forest area is now surrounded by a ring of APRIL-affiliated plantations, making it harder for encroachers to access the forest. The water table in these plantations is maintained at a target of 60 centimetres below the surface, using a system of specialised dams to minimise negative impact on the rehabilitation area.[121] [122]

80 kilometres of drainage canals within the RER areas have also been mapped and blocked.[123] The remaining access routes are monitored against intrusion with the help of 150 local families that live within the protected area and support themselves through fishing.[124]

Fire prevention is a major focus of the RER project. APRIL employs rangers to patrol a 3-kilometre-wide buffer zone surrounding the protected area. 3 flux towers have been built to monitor greenhouse gas emissions. In addition to village fire prevention programme, a 50/50 cost share programme has been started to help nearby villages clear land using equipment instead of fire.[125]

RER is administered by APRIL in conjunction with NGO partners Fauna & Flora International, The Nature Conservancy, and BIDARA. Input is also obtained from two committees engaged by APRIL, the Stakeholder Advisory Committee[126] and the Independent Peat Expert Working Group, comprised of NGOs and academics.[127]

A LANDSCAPE APPROACH TO PEATLAND REHABILITATION: COMMONALITIES, CHALLENGES, AND OPPORTUNITIES FOR COLLABORATION

As outlined, the approaches taken by implementers differ in the extent to which they balance cultivation and rehabilitation. However, it may be observed that these approaches share some common elements. In particular, a growing number of implementers are beginning to adopt a "landscape approach" to manage the concerns of all their stakeholders.[128] Specifically, the "landscape approach" involves considering and addressing all the actors within the peat landscape and the ways in which they use peatlands, in order to maximise efficiency, minimise conflict, and improve the chances of achieving the implementer's objectives.[129] The "landscape approach" is particularly important for peatland ecosystems because of their complicated nature and the multiple stakeholders with competing interests that are often present in a single peatland area.

Elements of a Landscape Approach to Peatland Management

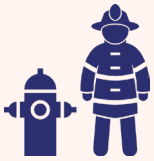
All three approaches to peatland management share common elements under the landscape approach. These are:

Engagement with Local Communities

Socialisation activities are carried out with local villages and indigenous peoples. Plantation companies engage with local communities to ensure that they are fully aware of and agreeable to the company's activities in the region, a process known as obtaining Free Prior and Informed Consent (FPIC). Through engagement, companies can also reach an agreement with these communities about important issues such as land management responsibilities, profit-sharing arrangements, and the boundaries of protected areas.

In more rehabilitation-oriented programmes, companies and NGOs engage local communities to educate them about the importance of peatlands and encourage them to protect remaining forested areas. These may be carried out in conjunction with social forestry schemes.

In both cases, such socialisation activities can help secure the support of the local communities, prevent protests and sabotage of projects by local communities, and reduce mismanagement of peatlands and illegal land encroachment by smallholders and other individuals.



Fire-Readiness

Emphasis is shifted from fire suppression to fire prevention. Local communities are given training and equipment to suppress fires, and are actively involved in the fire prevention efforts of plantation companies in the area. Regular fire patrols are conducted, and fire risk is regularly monitored using remote technology. Local communities are educated on the dangers of using fire on peatland and given financial and logistical support to clear land without using fire.

Protection, Monitoring & Evaluation

A baseline study is conducted before the project on peat begins so that the project's impacts can be measured. Data on carbon emissions, water table levels, subsidence, fire incidence, and encroachment is monitored and used to re-evaluate project plans on a regular basis so as to minimise environmental impact and ensure that the project is meeting its conservation objectives.

Such monitoring has become especially important in Indonesia, following the passage of Regulation PP 57/2016 that mandates a maximum water table level of 40 centimetres below the soil surface. As it is difficult in practice to maintain the water table at such a high level throughout the year in many cultivated areas, and because a water table level of 40cm is close to the upper limit at which many plantation crops experience crop damage and yield losses, regular and detailed monitoring of water table levels will be required to ensure that corrective actions can be quickly taken when the water table level varies too far above or below this level.[130]

To protect the peatland from unauthorised use and encroachment, buffer zones are created. Patrolling of peatland areas is increased, and enforcement of regulations concerning misuse of peatlands is strengthened. The improved data mentioned above can be used to support monitoring efforts and, if necessary, civil and criminal lawsuits against violators.

Additional Elements of the Landscape Approach When Targeting Peatland Rehabilitation

The "full protection" and "middle" approaches incorporate additional elements to maximise the success of peatland rehabilitation efforts. These include:

Rewetting

A study is first conducted to determine the hydrological characteristics of the area to be rehabilitated, including water flows, land elevation, peat depth, and the location of peat domes. Based on the findings of the study, rewetting activities are carried out to stop drainage, raise the water table, and create alternative sources of water for maintaining soil moisture during the dry season. Such activities include blocking and refilling canals, digging bore wells, and creating reservoirs.

Revegetation

Revegetation: Important native peat swamp plant species are selected. Seedlings are grown in a nursery to produce seedling stock, which is then replanted in the rehabilitation area. Replanted vegetation is regularly monitored to ensure healthy growth and assess resultant changes to the environment.

Alternative Livelihoods

Local communities are supported to switch to crops that require little or no drainage. Non-agricultural economic models are also introduced, for example fisheries, cattle farming, eco-tourism, and the harvesting of non-timber forest products such as honey and rattan. Companies, especially those running Ecosystem Restoration Concessions, may monetise the preservation of existing forest by selling carbon credits.

Challenges and Opportunities for Collaboration in Peatland Management

Implementers of peatland management projects, regardless of their approach, often report similar challenges. The need to overcome these challenges also presents opportunities for collaborative solutions. The following section outlines some of the collaborative solutions brought about by landscape approaches to challenges surrounding peatland management.

Coordination between Parties

Due to the scale of the effort and the different areas of expertise required, peatland projects are often implemented by a coalition of multiple actors with different areas of expertise. These may include NGOs, governments, academics, donors, and private sector companies. This is especially true of large-scale projects, such as those covering an entire national park or an entire sub-district or province, and projects involving peatland rehabilitation , which require expertise from multiple scientific disciplines and organisation types.

New tools and schemes are being developed to address issues of coordination and communication, especially for large-scale projects. For example, BRG has established a regional arm for each of the seven priority provinces where it works, known as the Regional Peat Restoration Teams (Tim Restorasi Gambut Daerah, or TRGD). TRGD will serve as a vehicle for BRG to monitor and coordinate the execution of peat rehabilitation projects on the ground.[131]

NGOs and non-state actors have also made important contributions to improve coordination. World Resources Institute Indonesia, an Indonesian NGO, is developing a public online platform to track peat rehabilitation commitments and the progress of projects across Indonesia, which is due to be released in 2017.[132] Other coordination platforms with a strong peatland management focus also exist, such as Lingkar Temu Kabupaten Lestari (LTKL), which aims to connect the heads (bupati) of various Indonesian sub-districts (kabupaten) to create a unified approach to environmental governance at the local government level.[133]

NGOs have also held various workshops focusing exclusively on peatland management to share lessons from the ground and secure greater collaboration between stakeholders. These include the "International Conference on Peatland Ecosystem, Haze, and Oil Palm Plantation", organised in November 2016 by Sawit Watch, and the "Regional Peat Restoration Workshop", organised in October 2016 by the Indonesian Conservation Communication Forum (FKKI) and the Singapore Institute of International Affairs. Such initiatives have proven valuable in informing and updating stakeholders, and should be continued in the coming years.

Effectively Engaging Local Communities

Both NGOs and private companies have contributed in significant ways to community engagement. BRG has called on NGOs to support its peat restoration targets by conducting socialisation activities on the ground, where the NGOs are familiar with the local community.[134] Many of the villages under BRG's Peat-Aware Villages scheme are slated to undergo socialisation activities to be conducted in collaboration with NGOs.[135]

Companies have also played an influential role by reaching out to communities in and around their concession areas. One example is the Fire-Free Alliance, formed in March 2016 to help plantation companies scale up and spread awareness of village fire prevention programmes. So far, APRIL, Asian Agri, IOI, Musim Mas, Sime Darby, and Wilmar have signed up as private sector members.[136] [137]

Also, some peatland communities have traditionally used specially adapted techniques to cultivate peatland that minimise their environmental impact. Examples include the use of tidal irrigation systems known as "handeel" in Central Kalimantan[138] and a peatland fishery method known as "beje" in East and Central Kalimantan.[139] Learning from these communities could lead to the creation of models for alternative livelihoods that could be applied and scaled up in other peatland communities.

When local communities are not adequately engaged, they may refuse to cooperate with or sabotage peatland projects. There are several cases of high-profile protests by local communities against plantation companies that failed to obtain their consent before commencing agricultural activities on or around community peatlands.[140] [141] On the other end of the spectrum, communities have also been known to sabotage peat rehabilitation projects by destroying dams used to repair peatland hydrology, as they block the canals that locals use for the transportation of people and goods.[142]

On the other hand, when traditional rights are respected and local viewpoints acknowledged, communities can become an important ally in monitoring and protecting forests. Cooperation will also encourage greater ownership from local communities and support smallholders in shifting to more profitable and sustainable livelihoods.[143]

Funding and Economic Support for Peatland Rehabilitation

Stakeholders have devised methods to provide financial support for peatland management, which can be an expensive undertaking. In October 2016, a new initiative known as the Tropical Landscapes Financing Facility was launched by BNP Paribas, ADM Capital, the United Nations Environment Programme, and other stakeholders.[144] The Facility will mobilise over US$1.1 billion (S$1.6 billion) of investments to provide long-term finance to projects that produce green growth and reverse land degradation.[145]

The creation of more such innovative financing schemes would help to drive interest in and provide support for large-scale peatland rehabilitation projects. The World Bank estimates the initial cost of restoring Indonesia's target of 2.1 million hectares of peatland at 27 trillion rupiah (S$2.9 billion), or 13.5 million rupiah (S$1,453) per hectare, excluding the long-term costs of maintaining rehabilitated areas.[146]

BRG has called for financial support from international governments and donors, notably at a "Peatland Investment Dialogue" held at the World Economic Forum in September 2016.[147] So far, it has received US$130 million (S$188 million) of pledges from Norway, the United States, the United Kingdom, Japan, and Germany.[148] More donors are needed to step up to fill the gaps that remain.

Some of these gaps can be filled by creating the right demand. For instance, Ecosystem Restoration Concessions that rehabilitate peat are dependent on the sale of carbon credits to finance their operations. The help of financiers and policymakers around the world is needed to translate the momentum behind recent climate change agreements to tangible market demand for these carbon credits.[149]

Also, the uptake of paludiculture, or the agriculture of peat-friendly crops that do not require drainage, has been slowed by the local market for these crops, which remains largely untapped and underdeveloped. NGOs have begun to address this issue by helping smallholders improve yields, crop quality, and access to international markets.[150] This work is valuable and should be continued. Peat-friendly crops would likely also experience increased uptake if they enjoyed the same access to governmental promotion, genetic research and development, and value chain development that is available to crops such as oil palm.

CONCLUSION

Improving peatland management practices is not simply about reducing negative impacts, but also improving the livelihoods of millions of small-scale farmers. Many such farmers generate barely enough income to survive, with the additional costs and difficulties of planting on peatland a major limiting factor.[151] Through peatland management programmes, these farmers can be educated in agricultural best practices and introduced to alternative economic models that have a better chance of improving their standard of living.

Other potential benefits are harder to quantify in monetary terms but are equally valuable. Rehabilitating degraded peatland will reduce the incidence and severity of fires and haze in the dry season, improving the health and life expectancy of people across the ASEAN region. Communities in and around peatland areas will benefit from reduced flooding and drought, as well as better yields for their crops. More broadly, switching away from crops requiring peatland drainage will help Indonesia and Malaysia diversify their economies and be an important step towards achieving their vision of becoming "green economies" aligned with the UN Sustainable Development Goals.[152] [153]

Currently, too much attention has been focused on the divide between cultivating and rehabilitating peatland. As a result, stakeholders, especially those adopting differing approaches, have overlooked the opportunities that exist to work together, such as devising closer engagement with local communities, being fire-ready, and creating mechanisms that allow for more effective protection, monitoring and evaluation.

Such types of collaboration are vital as improved peatland management should be understood as merely the first step in a long-term transition to more sustainable land management practices.[154] Even when the immediate risks have been addressed, further collaboration will be required to tackle the underlying drivers behind peatland clearing and burning. Only then will we be able to protect and preserve the peatlands of Southeast Asia in the long run.

REFERENCES

[1] World Bank (2016) *The cost of fire: An economic analysis of Indonesia's 2015 fire crisis*, [Online], Available: http://documents.worldbank.org/curated/en/776101467990969768/pdf/103668-BRI-Cost-of-Fires-Knowledge-Note-PUBLIC-ADD-NEW-SERIES-Indonesia-Sustainable-Landscapes-Knowledge-Note.pdf Retrieved: 3 May 2017
[2] Koplitz, S. et al. (2016) Public health impacts of the severe haze in Equatorial Asia in September–October 2015: Demonstration of a new framework for informing fire management strategies to reduce downwind smoke exposure, ***Environmental Research Letters***, 11, 094023
[3] Joosten, H., Tapio-Biström, M., and Tol, S. (eds.) (2012) *Peatlands – Guidance for climate change mitigation through conservation, rehabilitation and sustainable use* (2nd ed.), Food and Agriculture Organisation of the United Nations and Wetlands International, p. 48
[4] Page, S. et al. (2009) Restoration ecology of lowland tropical peatlands in Southeast Asia: Current knowledge and future research directions, *Ecosystems*, 12:888
[5] ASEAN Haze Action Online (n.d.) *ASEAN peatland management strategy*, [Online], Available: http://haze.asean.org/asean-peatland-management-strategy-apms-2/ Retrieved: 3 May 2017
[6] ASEAN Secretariat (2005) *Strategy and action plan for sustainable management of peatlands in ASEAN member countries*, p. 9
[7] ASEAN Secretariat and Global Environment Centre (2015) *APFP-SEAPEAT key achievements 2010-2015*, [Online], Available: http://www.gec.org.my/view_file.cfm?fileid=3093 Retrieved: 3 May 2017
[8] Ibid.
[9] Wan Ahmad, W.M.S. (2001) *Fire situation in Malaysia*, Forest Research Institute Malaysia, [Online], Available: http://www.fao.org/docrep/006/ad653e/ad653e46.htm Retrieved: 3 May 2017
[10] ASEAN Peatland Forests Project (n.d.) *Threats related to peatlands in Malaysia*, [Online], Available: http://www.aseanpeat.net/index.cfm?&menuid=83&parentid=67 Retrieved: 3 May 2017
[11] Ibid.
[12] Ministry of Natural Resources and Environment, Malaysia (2011) *National action plan for peatlands*, [Online], Available: http://www.nre.gov.my/ms-my/PustakaMedia/Penerbitan/National%20Action%20Plan%20for%20Peatlands.pdf Retrieved: 3 May 2017
[13] Evers, S. et al. (2017) Keep peatlands wet: The myth of sustainable development of tropical peatlands - implications for policies and management, *Global Change Biology*, 23, pp. 534-549
[14] Ibid.
[15] Ooi, T.C. (2014) Oil palm expansion plan continues, *My Palm Oil*, 17 March 2014, [Online], Available: http://mypalmoil.blogspot.sg/2014/03/oil-palm-expansion-plan-continues.html Retrieved: 3 May 2017
[16] Ibid.
[17] Mail, R. (2016) Research lab now called Sarawak Tropical Peat Research Institute, *The Borneo Post*, 8 November 2016, [Online], Available: http://www.theborneopost.com/2016/11/08/research-lab-now-called-sarawak-tropical-peat-research-institute/ Retrieved: 3 May 2017
[18] Wardhana, B. (2016) 'BRG's roadmap for peatland restoration,' Budi Wardhana, Deputy for Planning and Cooperation, Peatland Restoration Agency, presented at CBD & FAO Workshop "Forest Ecosystem Restoration", Bangkok, Thailand, 27 June
[19] Safitri, M. (2016) 'Mengenal restorasi gambut di tingkat tapak,' Myrna Safitri, Deputy for Education, Socialisation, Participation, and Partnership, Peatland Restoration Agency, presented at Sawit Watch Conference "Peatland Ecosystem Sustainability for People Welfare and Security", Bogor, Indonesia, 21 November
[20] Indradi, Y. (2016a) 'Mengharmoniskan perlindungan ekosistem gambut', Yuyun Indradi, Forest Campaigner, Greenpeace, presented at Sawit Watch Conference "Peatland Ecosystem Sustainability for People Welfare and Security", Bogor, Indonesia, 21 November
[21] Thoumi, G. (2016) Indonesia Strengthens Peatlands Moratorium, *Chain Reaction Research*, 7 December 2016, [Online], Available: https://chainreactionresearch.com/2016/12/07/the-chain-indonesia-strengthens-peatlands-moratorium-ing-places-e80-million-in-debt-for-socfins-palm-oil-and-rubber-expansion/ Retrieved: 3 May 2017
[22] Indradi, Y. (2016b) Comment: Indonesia's new plans to tackle forest fires fall short of Paris agreement targets, *Greenpeace Energy Desk*, 23 December 2016, [Online], Available: http://energydesk.greenpeace.org/2016/12/23/comment-indonesia-new-plans-to-tackle-forest-fires-palm-oil-jokowi/Retrieved: 3 May 2017
[23] (2016) Minister highlights key points of revised peat regulation, *Foresthints.news*, 4 December 2016, [Online], Available: http://www.foresthints.news/minister-highlights-key-points-of-revised-peat-regulation Retrieved: 3 May 2017
[24] (2016) Green groups raise red flags over Jokowi's widely acclaimed haze law, *Mongabay*, 9 December 2016, [Online], Available: https://news.mongabay.com/2016/12/green-groups-raise-red-flags-over-jokowis-widely-acclaimed-haze-law/ Retrieved: 3 May 2017
[25] Thoumi, G. (2016)
[26] (2016) Green groups raise red flags over Jokowi's widely acclaimed haze law
[27] (2016) Sarawak's efforts in managing peatland plantations proven successful, CM says, *The Malay Mail*, 16 August 2016, [Online], Available: http://www.themalaymailonline.com/malaysia/article/sarawaks-efforts-in-managing-peatland-plantations-proven-successful-cm-says Retrieved: 3 May 2017
[28] Miettinen, J. et al. (2012) *Historical analysis and projection of oil palm plantation expansion on peatland in Southeast Asia*, ICCT White Paper No. 17, p. 21
[29] Oxford Business Group (2011) *Sarawak: Palm oil industry earmarked for major expansion*, [Online], Available: http://www.oxfordbusinessgroup.com/sarawak-palm-oil-industry-earmarked-major-expansion Retrieved: 3 May 2017
[30] Miettinen, J. et al. (2012)
[31] Hasnol, O. et al. (2016) 'How to optimise oil palm production on marginal land in Malaysia', Hasnol, O. et al., Agronomy and Geospatial Technology Unit, Malaysian Palm Oil Board, presented at Field Clinic and Colloquium, International Society of Oil Palm Agronomists, Marihat, North Sumatra, Indonesia, 28-29 September
[32] McKenzie, R.H. (2010) *Agricultural soil compaction: Causes and management*, 29 October 2010, [Online], Available: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex13331 Retrieved: 3 May 2017
[33] (2016) Peat knowledge leads to agro-environ management, *The Borneo Post*, 19 August 2016, [Online], Available: https://www.pressreader.com/malaysia/the-borneo-post/20160819/281638189612317 Retrieved: 3 May 2017
[34] Cramb, R.A. and Sujang, P.S. (2012) *Pathways through the plantation: Oil palm smallholders and livelihood strategies in Sarawak, Malaysia*, Presentation paper, 56th AARES Annual Conference, Fremantle, Australia, 7-10 February, p. 4
[35] Hasnol, O. et al. (2016)
[36] Ibid.
[37] Hermansyah, A. (2016) Doubling CPO yields by compacting peatland, Sarawak style, *The Jakarta Post*, 26 February 2016, [Online], Available: http://www.thejakartapost.com/news/2016/02/26/doubling-cpo-yields-compacting-peatland-sarawak-style.html Retrieved: 3 May 2017
[38] Ooi, T.C. (2010)
[39] Wong, J. (2016) Yield of oil palm on peatland can be doubled, *The Star*, 16 August 2016, [Online], Available: http://www.thestar.com.my/business/business-news/2016/08/16/yield-of-oil-palm-on-peatland-can-be-doubled/ Retrieved: 3 May 2017
[40] Hermansyah, A. (2016)
[41] Cheng, L. (2016) Peatland – the last frontier of oil palm industry, *The Borneo Post*, 4 August 2016, [Online], Available: http://www.theborneopost.com/2016/08/04/peatland-the-last-frontier-of-oil-palm-industry/ Retrieved: 3 May 2017

[42] (2013) Oil palm most suitable crop for peat areas – Association, *The Borneo Post*, 23 March 2013, [Online], Available: http://www.theborneopost.com/2013/03/23/oil-palm-most-suitable-crop-for-peat-areas-association/ Retrieved: 3 May 2017
[43] McKenzie, R.H. (2010)
[44] Simorangkir, D., Moore, P., Haase, N., and Ng, G. (eds.) (2002) *Workshop report: Land clearing on degraded lands for plantation development*, Project FireFight South East Asia, p. 15
[45] Evers, S. et al. (2017)
[46] Wijedasa, L., personal communication, 3 October 2016.
[47] Hasnol, O. et al. (2016)
[48] Silvius, M. (2014) Chapter 11: Plantations in Southeast Asia, in Biancalani, R. and Avagyan, A. (eds.) *Towards climate-responsible peatlands management*, Food and Agriculture Organisation of the United Nations, p. 54
[49] Page, S.E., Rieley, J.O., Shotyk, Ø.W., and Weiss, D. (1999) Interdependence of peat and vegetation in a tropical peat swamp forest, *Philosophical Transactions of the Royal Society B*, 354, pp. 1885-1897
[50] Euroconsult Mott MacDonald and Deltares (2008) *Master plan for the rehabilitation and revitalisation of the ex-Mega Rice Project area in Central Kalimantan: Summary of main synthesis report*, p. 8
[51] Wösten, J.H.M., Rieley, J.O., and Page, SE. (eds.) (2008) *Restoration of tropical peatlands*, ALTERRA - Wageningen University and Research Centre, and the EU INCO – RESTORPEAT Partnership, pp. 17, 125
[52] Safitri, M. (2016)
[53] Blackham, G.V. (2013) *Ecological degradation and recovery in the former Mega Rice project tropical peatland ecosystem, Central Kalimantan, Indonesia* (Doctoral dissertation), p. 19
[54] Safitri, M. (2016)
[55] Ibid.
[56] Giesen, W. (2015) Utilising non-timber forest products to conserve Indonesia's peat swamp forests and reduce carbon emissions, *Journal of Indonesian Natural History,* 3(2), pp. 10-11
[57] Ibid., pp. 18-19
[58] Warta, Z. (2016) 'Restorasi lahan gambut Sebangau: Pelajaran peningkatan', Zulfira Warta, REDD+ Coordinator, World Wildlife Fund Indonesia, presented at the Regional Peat Restoration Workshop, Jakarta, Indonesia, 27 October
[59] United Nations Development Programme (2006) *Malaysia's peat swamp forests: Conservation and sustainable use*, p. 6
[60] Sanders, B. (2016) 'Sustainable Landscape Approach to Integrate Conservation, Restoration & Production', Brad Sanders, Deputy Head of Conservation, APRIL – Restorasi Ekosistem Indonesia, presented at the Regional Peat Restoration Workshop, Jakarta, Indonesia, 27 October
[61] Rainforest Action Network (2014) *The last place on Earth – Leuser ecosystem*, [Online], Available: http://www.ran.org/lastplaceonearth Retrieved: 3 May 2017
[62] Giesen, W., personal communication, 14 January 2017.
[63] Giesen, W. (2015) p. 13
[64] Janudianto, Sofiyuddin, M., Perdana, A., and Jasnari (2013) *Jelutong and rubber based-agroforest systems to improve local livelihood and reduce emission in peatland of Sumatra and Central Kalimantan*, World Agroforestry Centre, [Online], Available: http://www.worldagroforestry.org/downloads/Publications/PDFS/PO13298.pdf Retrieved: 3 May 2017
[65] Euroconsult Mott MacDonald (2013) *Paludiculture: sustainable alternatives on degraded peat land in Indonesia*, BAPPENAS & Ditjen Sumber Daya Air, PU and Partners for Water Programme, p. 32
[66] Fenton, T., personal communication, 20 January 2017.
[67] Walsh, T.A., Hidayanto, Y., Asmui, and Utomo, A.B. (2012) Ecosystem restoration in Indonesia's production forests: Towards financial feasibility, *ETFRN News*, December 2012, p. 37
[68] Forest Trends' Ecosystem Marketplace (2016) *View from the understory: State of forest carbon finance 2016*, [Online], Available: http://www.forest-trends.org/documents/files/doc_5388.pdf Retrieved: 3 May 2017
[69] Global Green Growth Institute (2015) *Costs and benefits of investing in ecosystem restoration and conservation: Green growth opportunities in Katingan peatlands*, p. 9
[70] Satriasanti, F.E. (2014) *Forest carbon investors impatient for state-backed global market*, Thomson Reuters Foundation, 11 July 2014, [Online], Available: http://news.trust.org//item/20140711095321-kwa0p Retrieved: 3 May 2017
[71] Sanders, B., personal communication, 25 August 2016.
[72] Wibisono, I.T.C. (2016) 'Restorasi gambut: Pengalaman, pelajaran dan rekomendasi', Iwan Tri Cahyo Wibisono, Forestry and Rehabilitation Specialist, Wetlands International Indonesia, presented at the Regional Peat Restoration Workshop, Jakarta, Indonesia, 27 October
[73] Buergin, R. (2016) Ecosystem restoration concessions in Indonesia: Conflicts and discourses, *Critical Asian Studies*, 48(2), p. 283
[74] Ibid.
[75] Ibid., p. 285
[76] PT Rimba Makmur Utama (2015) *Katingan peatland restoration and conservation project: Summary project description*, [Online], Available: http://www.v-c-s.org/wp-content/uploads/2016/10/CCB_PROJ_DESC_SUM_1477_1SEP15.pdf Retrieved: 3 May 2017
[77] Afiff, S. (2015) *Learning from green enclosure practice in Indonesia: Katingan REDD+ case study project in Central Kalimantan*, Conference Paper No. 67, Land Grabbing, Conflict and Agrarian-Environmental Transformations: Perspectives from East and Southeast Asia, Chiang Mai University, 5-6 June
[78] Buergin, R. (2016) p. 283
[79] Foead, N., personal communication, 24 November 2016
[80] Wetlands International (2014) *Policy Analysis of PP 71/2014*, [Online], Available: https://www.wetlands.org/download/11247/ Retrieved: 3 May 2017
[81] Khalid, Z., personal communication, 4 December 2016.
[82] Indradi (2016b)
[83] Wardhana, B. (2016)
[84] Foead, N., personal communication, 24 November 2016
[85] Bathgate, J., personal communication,, 25 August 2016
[86] Silvius, M. (2014) p. 56
[87] Euroconsult Mott MacDonald & partners (2013) *Quick assessment and nationwide screening (QANS) of peat and lowland resources and action planning for the implementation of a national lowland strategy: Final report*, BAPPENAS & Ditjen Sumber Daya Air, PU and Partners for Water Programme, p. 38
[88] Zoological Society of London (2011) *A practical handbook for conserving High Conservation Value species and habitats within oil palm landscapes*, pp. 13-14
[89] Jasmin, L. et al. (2016) Chapter 6.2.1: Landscape approach to conserving forested areas, in *Efficient agriculture, stronger economies in ASEAN*, Business Council for Sustainable Development Singapore, p. 50
[90] APFP-SEAPEAT (2014) 'Buffer zone management plan for North Selangor peat swamp forest', presentation.

[91] Syaf, R. and Akbar, N., personal communication, 30 November 2016
[92] Ibid.
[93] Hidayat, T., personal communication, 2 December 2016
[94] Setyowati, A.B. (2016) Social forestry: Where are we now?, *The Jakarta Post*, 19 September 2016, [Online], Available: http://www.thejakartapost.com/academia/2016/09/19/social-forestry-where-are-we-now.html, Retrieved: 3 May 2017
[95] Ramadhan, G. (2016) BRG targetkan 1000 Desa Peduli Gambut terbentuk dalam 4 tahun, *KBR*, 5 November 2016, [Online], Available: http://kbr.id/berita/11-2016/brg_targetkan_1000_desa_peduli_gambut_terbentuk_dalam_4_tahun/86500.html Retrieved: 3 May 2017
[96] Starling Resources, Marubeni Corporation, and Puter Indonesia (2015) *GHG reduction project through forest preservation in peat land in Central Kalimantan: METI REDD+ feasibility study FY2014 in Central Kalimantan, Indonesia*, p. 11
[97] Panjaitan, R. (2016) 'Pencegahan kebakaran hutan dan lahan', Raffles Panjaitan, Director of Forest Fire Prevention, Indonesia Ministry of Environment and Forestry, presented at Sawit Watch congress "Peatland Ecosystem, Haze, and Oil Palm Plantation: Peatland Ecosystem Sustainability for People Welfare and Security", Bogor, Indonesia, 21 November
[98] Carbon Conservation (2015) *Fire-free village program review 2015*, [Online], Available: http://www.aprilasia.com/images/pdf_files/ffvp-2015-review-report-audit.pdf Retrieved: 3 May 2017
[99] Lim, S.L. (2016) Desa siaga api: Merumuskan solusi jangka panjang dalam mengatasi kebakaran hutan di Indonesia, *PT SMART Tbk Blog*, 3 May 2016, [Online], Available: http://www.smart-tbk.com/desa-siaga-api-merumuskan-solusi-jangka-panjang-dalam-mengatasi-kebakaran-hutan-di-indonesia Retrieved: 3 May 2017
[100] Carbon Conservation (2015), p. 11
[101] Hidayat, T., personal communication, 2 December 2016
[102] Lim, S.L. (2016)
[103] Carbon Conservation (2015)
[104] Ibid., p. 7
[105] Zulkifli, Z.Z. (2016) 'Peranan pemerintah daerah dalam pengelolaan dan upaya restorasi gambut di provinsi Jambi', Zumi Zola Zulkifli, Governor of Jambi, presented at Sawit Watch congress "Peatland Ecosystem, Haze, and Oil Palm Plantation: Peatland Ecosystem Sustainability for People Welfare and Security", Bogor, Indonesia, 21 November
[106] Panjaitan, R. (2016)
[107] Satriastanti, F. (2016) Protecting peatland and business interests a fine balance, *Eco-Business*, 22 August 2016, [Online], Available: http://www.eco-business.com/news/protecting-peatland-and-business-interests-a-fine-balance/ Retrieved: 3 May 2017
[108] Shah, V. (2016) Healthy forests, zero burning, prosperous economy: Can Indonesia have it all?, *Eco-Business*, 18 November 2016, [Online], Available: http://www.eco-business.com/news/healthy-forests-zero-burning-prosperous-economy-can-indonesia-have-it-all/ Retrieved: 3 May 2017
[109] Sanders, B., personal communication, 24 August 2016
[110] Blackham, G.V. (2013) pp. 145-146
[111] Sanders, B. (2016)
[112] Wetlands International & Tropenbos International (2016)
[113] Ibid., p. 11
[114] (2016) Indonesian authorities reject APP landscape conservation, *Foresthints.news*, 10 November 2016, [Online], Available: http://www.foresthints.news/indonesian-authorities-reject-app-landscape-conservation Retrieved: 3 May 2017
[115] World Wildlife Fund (n.d.) *Kampar Peninsula*, [Online], Available: http://www.wwf.or.id/en/about_wwf/whatwedo/forest_species/where_we_work/kampar.cfm Retrieved: 3 May 2017
[116] Miettinen, O. (2009) K*ampar peninsula as a peat swamp forest conservation priority*, Friends of the Earth Finland, [Online], Available: http://www.greenpeace.org/finland/Global/finland/p2/metsa/report/2009/kampar-peninsula-as-a-peat-swa.pdf Retrieved: 3 May 2017
[117] Sanders, B. (2016)
[118] Ibid.
[119] Ibid.
[120] Ibid.
[121] Ibid.
[122] Bathgate, J., personal communication,, 25 August 2016
[123] Sanders, B. (2016)
[124] Sanders, B., personal communication, 24 August 2016
[125] Ibid.
[126] Stakeholder Advisory Committee (2016) *Stakeholder advisory committee (SAC) on APRIL's sustainable forest management policy (SFMP 2.0): Summary of the first three years and priorities moving forward*, [Online], Available: http://www.aprildialog.com/wp-content/uploads/2016/12/SAC-Meeting-Report-7-9-Dec-2016_FINAL15Dec2016.pdf Retrieved: 3 May 2017
[127] APRIL Independent Peat Expert Working Group (2016) *IPEWG meeting #3 summary report*, [Online], Available: http://www.aprildialog.com/wp-content/uploads/2016/09/IPEWG-Summary-Report-Meeting3.pdf Retrieved: 3 May 2017
[128] Safitri, M. (2016)
[129] Sayer, J. et al. (2013) Ten principles for a landscape approach to reconciling agriculture, conservation, and other competing land uses, *Proceedings of the National Academy of Sciences*, 110(21), pp. 8349-8356
[130] Uda, S.K., Hein, L., and Sumarga, E. (2017) Towards sustainable management of Indonesian tropical peatlands, *Wetlands Ecology and Management*, doi:10.1007/s11273-017-9544-0
[131] Syaf, R. and Akbar, N., personal communication, 30 November 2016
[132] Wicaksono, S., personal communication, 25 November 2016
[133] World Resources Institute (2017) *Lingkar temu kabupaten lestari: Connecting the dots*
[134] Setyorini, V.P. (2017) Langkah awal perjalanan panjang restorasi gambut Indonesia, *AntaraNews.com*, 3 January 2017, [Online], Available: http://www.antaranews.com/berita/604700/langkah-awal-perjalanan-panjang-restorasi-gambut-indonesia Retrieved: 3 May 2017
[135] Foead, N., personal communication, 24 November 2016
[136] APRIL Group (2016) *Fire-Free Alliance to extend fire prevention to broader landscape*, [Online], Available: http://www.aprilasia.com/images/pdf_files/ffa-media-release.pdf Retrieved: 3 May 2017
[137] Al Azhari, M. (2017) Fire Free Alliance welcomes Malaysian palm oil giants, *Jakarta Globe*, 16 March 2017, [Online], Available: http://eyewitness.thejakartaglobe.com/business/fire-free-alliance-welcomes-malaysian-palm-oil-giants/ Retrieved: 3 May 2017
[138] Subahani, E. (2016) 'Praktek pengelolaan lahan gambut oleh masyarakat di kabupaten Pulang Pisau', Edy Subahani, Executive Director, POKKER SHK, presented at Sawit Watch congress "Peatland Ecosystem, Haze, and Oil Palm Plantation: Peatland Ecosystem Sustainability for People Welfare and Security", Bogor, Indonesia, 21 November
[139] (2016) *Beje aquaculture and inland fishery in tropical peatland of Indonesia*, Food and Agriculture Organisation of the United Nations, [Online], Available: http://teca.fao.org/read/8619 Retrieved: 3 May 2017
[140] Eyes on the Forest (2010) *Peat swamp forest and community livelihoods threatened by planned natural forest clearing by PT Lestari Unggul Makmur,*

a pulpwood plantation company, associated to Asian Pacific Resources International Holdings Limited (APRIL) and Raja Garuda Mas (RMG), in Pulau Tebing Tinggi, Riau of central Sumatra, [Online], Available: http://www.eyesontheforest.or.id/attach/EoF_Investigative%20Report%20PT%20LUM_APRIL_Sep-Oct_2009_Feb2010.pdf Retrieved: 3 May 2017

[141] Arshad, A. (2016) Indonesian pulp firm halts work in Riau over building of 'illegal canals', *The Straits Times*, 10 September 2016, [Online], Available: http://www.straitstimes.com/asia/se-asia/pulp-firm-halts-work-in-riau-over-building-of-illegal-canals Retrieved: 3 May 2017

[142] Warta, Z. (2016)

[143] Panjaitan, R. (2016)

[144] Simons, T. (2016) A better deal – Incentivising wise land use with the Tropical Landscape Finance Facility, *World Agroforestry Centre Blog*, 31 October 2016, [Online], Available: http://blog.worldagroforestry.org/index.php/2016/10/31/better-deal-incentivising-wise-land-use-tropical-landscape-finance-facility/ Retrieved: 3 May 2017

[145] Ibid.

[146] (2016) Indonesia seeks foreign funds to aid peat restoration drive, *Mongabay*, 26 September 2016, [Online], Available: https://news.mongabay.com/2016/09/indonesia-seeks-foreign-funds-to-aid-peat-restoration-drive/ Retrieved: 3 May 2017

[147] Hatta, A. (2016) BRG temui investor gambut di AS, *Warta Ekonomi*, 22 September 2016, [Online], Available: http://wartaekonomi.co.id/read/2016/09/22/114135/brg-temui-investor-gambut-di-as.html Retrieved: 3 May 2017

[148] (2016) 5 donor countries give Indonesia funds for peatland restoration, *Tempo.co*, 1 June 2016, [Online], Available: http://en.tempo.co/read/news/2016/06/01/206775776/5-Donor-Countries-Give-Indonesia-Funds-for-Peatland-Restoration Retrieved: 3 May 2017

[149] Forest Trends' Ecosystem Marketplace (2016)

[150] Syaf, R. (2016) 'Inisiatif dan pembelajaran menuju pengelolaan gambut berkelanjutan melalui skema BHPM dan praktek CSA (studi kasus di prop. Jambi)', Rudi Syaf, Executive Director, KKI Warsi, presented at the Regional Peat Restoration Workshop, Jakarta, Indonesia, 27 October

[151] Sitorus, M. (2016) 'Tantangan pembangunan kebun kelapa sawit di lahan gambut oleh petani', Maruli Sitorus, Indonesian Palm Oil Smallholders Union, presented at Sawit Watch Congress "Peatland Ecosystem, Haze, and Oil Palm Plantation: Peatland Ecosystem Sustainability for People Welfare and Security", Bogor, Indonesia, 21 November

[152] (2016) GGGI to help foster 'green economy' in Indonesia for next 3 years, *The Jakarta Post*, 21 September 2016, [Online], Available: http://www.thejakartapost.com/news/2016/09/21/gggi-to-help-foster-green-economy-in-indonesia-for-next-3-years.html Retrieved: 3 May 2017

[153] Wan Junaidi bin Tuanku Jaafar (2017) 'Keynote address by Malaysia', delivered at the 4th Singapore Dialogue on Sustainable World Resources 2017, Singapore, 6 April

[154-] (2016) Japanese academics express cautious optimism on peat restoration efforts, *Foresthints.news*, 7 June 2016, [Online], Available: http://www.foresthints.news/japanese-academics-express-cautious-optimism-on-peat-restoration-efforts Retrieved: 3 May 2017

About the SIIA's Sustainability Programme

The SIIA's sustainability programme focuses on haze caused by fires in Indonesia and on the sustainability of the plantation sector, both key issues for Singapore. The SIIA also works on climate change issues facing ASEAN and Asia.

The SIIA's sustainability work goes back to 1997, when it organised Singapore's first haze dialogue with the Singapore Environment Council. Over the years, the SIIA has increasingly broadened its sustainability work from haze to related issues, such as forest governance and sustainable livelihoods. In 2014, the SIIA launched the annual **Singapore Dialogue on Sustainable World Resources**, now in its 4th year, to highlight best practices within the plantation industry. In 2016, the SIIA co-organised the **Regional Peat Restoration Workshop**, the first NGO-led regional workshop to focus on peat restoration, in Jakarta with the NGO consortium Indonesian Conservation Communication Forum (FKKI).

The SIIA also recognises the importance of public outreach and education in creating sustainable environmental solutions. It curated Singapore's first public exhibition on haze, **"Haze: Know it. Stop it"**, and supports the local NGO **People's Movement to Stop Haze** in its efforts to promote responsible consumerism among Singaporeans. The SIIA has also launched **HazeTracker** (www.hazetracker.org), a one-stop portal for haze-related maps and general information.

About This Report

"Peatland Management & Rehabilitation in Southeast Asia: Moving from Conflict to Collaboration" is a Special Report by SIIA. The information and opinions in this report were sourced through interviews with academics, NGO representatives, and other experts; a review of the current literature; and site visits to communities living in peatland areas.

About the SIIA

The Singapore Institute of International Affairs (SIIA) is a non-profit, non-governmental organisation dedicated to the research, analysis, and discussion of politics, economics, and sustainability. Founded in 1962, it is Singapore's oldest think tank and ranks as one of the top think tanks in Southeast Asia and the Pacific.

The SIIA regularly convenes dialogues and roundtables to inform policy makers, business professionals, and the public on issues facing the international community. Recent examples include a Minister's Dialogue on the investment outlook for Myanmar in December 2016, held in conjunction with the Myanmar Investment Commission, and a closed-door corporate briefing in Jakarta in April 2016, which focused on Indonesian politics and their business implications. Many leading Singapore-based corporates and financial institutions are SIIA members.

Cover image: Satellite map of peatlands in Sumatra and Peninsular Malaysia. Orange areas indicate peatland. Yellow and green areas indicate likely oil palm plantations. Purple and pink areas indicate likely pulp and paper plantations.

Cover image source: Centre for Remote Imaging, Sensing and Processing (CRISP), National University of Singapore

Other images: Noun Project (abeldb, Aneeque Ahmed, art shop, BomSymbols, Co-Effect Creative, Edward Boatman, Gan Khoon Lay, Hamish, JeraOcean, KEN MURRAY, OCHA Visual Information Unit, Rflor, Scott Lewis)