Report on Capacity Development Need and Gap Analysis (CDNGA)

Version June 2021

With support of the
Measurable Action for Haze-Free Sustainable Land Management in Southeast Asia (MAHFSA) Programme

Funded by
International Fund for Agricultural Development (IFAD)

Report on Capacity Development Need and Gap Analysis (CDNGA)

Version June 2021

Prepared by
Global Environment Centre

Table of Contents

Annexes

1. Working paper, questionnaire and preliminary assessment
2. Strategies and Indicators to measure the progress of ASEAN Haze-Free Roadmap
3. List of members of COM to AATHP
4. List of members of ATFP
5. List of NMC (together with contacts)
6. Country profiles (10 AMS)
7. Trends of hotspot detected in the region
8. Additional capacity development topics suggested in regional workshop by stakeholders

List of Figures

Figure 1: Peatlands in Southeast Asia
Figure 2: Regional institutional arrangement in ASEAN in relation to land and forest fire, peatlands and transboundary haze pollution
Figure 3: Diagram to show the institutional framework to guide the implementation of the APMS as established at the adoption of the APMS in 2006
Figure 4: Diagram to show the institutional framework to guide the implementation of the APMS as per the 2013 revision of the APMS
Figure 5: Hotspot information on map published on the ASMC website
Figure 6: Example of Regional Haze Map produced by AMSC with alert level indicated above the map
Figure 7: Structure of FDRS for ASEAN region
Figure 8: Hotspot identification by ASMC
Figure 9: Proportion of FDRS monitoring activity by AMS
Figure 10: Extent of peatland data availability and its utilisation by AMS
Figure 11: Availability of information and utilization level in AMS for extent of peatlands affected by fire
Figure 12: 2017 Chiang Rai Plan of Action
Figure 13: General circulation of information from sources to ground level for verification
Figure 14: Reporting process from ground level to regional level
Figure 15: ASEAN Fire Alert PhoneApp Tool is available in Android and iOS versions
Figure 16: Suggested enhanced result management system using centralised website platform
Figure 17: Google Earth in Bahasa Indonesia shows FDRS and hotspot (vector file in Google Earth format (i.e., KML) for Northern ASEAN region on 18 June 2021
Figure 18: Google Earth enables user to edit and add information to the data. The information added in this example is according to ASEAN SOP

List of Tables

List of Abbreviations

AATHP	ASEAN Agreement on Transboundary Haze Pollution
ACC	ASEAN Coordinating Centre for Transboundary Haze Pollution Control
AMME	ASEAN Ministerial Meeting on Environment
AMS	ASEAN Member State
APFP	ASEAN Peatland Forests Project
APMI	ASEAN Peatland Management Initiative
APMS	ASEAN Peatland Management Strategy
APSMPE	ASEAN Programme on Sustainable Management of Peatland Ecosystems
ASCC	ASEAN Socio-Cultural Community
ASEAN	Association of Southeast Asian Nations
ASEANCOF	ASEAN Climate Outlook Forum
ASEC	ASEAN Secretariat
ASMC	ASEAN Specialised Meteorological Centre
ATFP	ASEAN Task Force on Peatlands
BMB	Biodiversity Management Bureau, the Philippines
BMKG	Meteorology, Climatology and Geophysical Agency (Badan Meteorologi, Klimatologi dan Geofisika), Indonesia
BMPs	Best Management Practices
BRG	Peatland Restoration Agency (Badan Restorasi Gambut), Indonesia
BUI	Build Up Index
CBFiM	Community Based Fire Management
CFS	Canadian Forest Service
CIFOR	Center for International Forestry Research
COM	Committee under COP to AATHP
COP	Conference of the Parties to the AATHP
CO_2	Carbon dioxide
CSOs	Civil Society Organisations
CSR	Corporate Social Responsibility
DC	Drought Code
DENR	Department of Environment and Natural Resources, the Philippines
DMC	Duff Moisture Code
DNP	Department of National Parks, Wildlife and Plant Conservation, Thailand
EU	European Union
FDRS	Fire Danger Rating System
FFMC	Fine Fuel Moisture Code
FGD	Focus Group Discussion
FIRMS	Fire Information Resource Management System
FORFIS	Forest Fire Information System
FWI	Fire Weather Index
GEC	Global Environment Centre
GEF	Global Environment Facility
GHG	Greenhouse Gas
GISTDA	Geo-Informatics Science and Technology Development Agency, Thailand
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GPC	Global Producing Centre
GPI	Global Peatlands Initiative
GPS	Global Positioning System
Gt	Giga tons
Ha	Hectare
HTTF	Haze Technical Task Force

IFAD	International Fund for Agricultural Development
IFM	Integrated Fire Management
IMPLI	Integrated Management of Peatland Landscapes in Indonesia
ISI	Initial Spread Index
ITPC	International Tropical Peatland Center
IUCN	International Union for Conservation of Nature
KASA	Ministry of Environment and Water (*Kementerian Alam Sekitar dan Air*), Malaysia
KeTSA	Ministry of Energy and Natural Resources (*Kementerian Tenaga dan Sumber Asli*), Malaysia
LAPAN	National Institute of Aeronautics and Space (Lembaga Penerbangan dan Antariksa Nasional), Indonesia
LULUCF	Land Use, Land Use Change and Forestry
MACRES	Malaysia Centre of Remote Sensing
MAHFSA	Measurable Action for Haze Free Sustainable Land Management in Southeast Asia
MARD	Ministry of Agriculture and Rural Development, Viet Nam
MET Malaysia	Malaysia Meteorological Department
MHa	Million Hectares
MNRE	Ministry of Natural Resources and Environment of Thailand
MOA	Ministry of Agriculture
MOD	Ministry of Development, Brunei Darussalam
MODIS	Moderate Resolution Imaging Spectroradiometer
MOE	Ministry of Environment
MOEF	Ministry of Environment and Forestry (*Kementerian Lingkungan Hidup dan Kehutanan/KLHK*), Indonesia
MONRE	Ministry of Natural Resources and Environment
MONREC	Ministry of Natural Resources and Environmental Conservation, Myanmar
MSC	Sub-Regional Ministerial Steering Committee on Transboundary Haze Pollution
MSS	Meteorological Service Singapore
NAPPs	National Action Plans on Peatlands
NDC	Nationally Determined Contribution
NEA	National Environment Agency, Singapore
NFP	National Focal Point
NGO	Non-Governmental Organisation
NMC	National Monitoring Centre
NTFP	Non-Timber Forest Product
OLI	Operational Land Imager
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PSF	Peat Swamp Forest
RCC	Regional Climate Center
SEApeat	Sustainable Management of Peatland Forests in Southeast Asia Project
SMPEI	Sustainable Management of Peatland Ecosystems in Indonesia
SMPEM	Sustainable Management of Peatland Ecosystems in Malaysia
SOP	Standard Operating Procedure
SPM	Sustainable Peatland Management
SSTC	South-South Triangular Cooperation
SUPA	Sustainable Use of Peatland and Haze Mitigation in ASEAN
TAKE-SMPEM	Technical Assistance and Knowledge Exchange for Sustainable Management of Peatland Ecosystems in Malaysia
TWG	Technical Working Group

UAV	Unmanned Aerial Vehicle
USAID	United States Agency for International Development
UNEP	United Nations Environment Programme
VIIRS	Visible Infrared Imaging Radiometer Suite
WRI	World Resources Institute

1. Introduction

1.   The regional programme "Measurable Action for Haze-Free Sustainable Land Management in Southeast Asia (MAHFSA)" was initiated in 2019. The Programme is being funded by International Fund for Agricultural Development (IFAD) to support the ASEAN Secretariat (ASEC), with its co-implementing partners i.e. Center for International Forestry Research (CIFOR) and Global Environment Centre (GEC). The Programme aims to strengthen existing ASEAN regional coordination mechanisms to facilitate a more harmonised response to tackling the transboundary haze pollution and for promoting sustainable forest management and peatland conservation. The Capacity Development Need and Gap Analysis (CDNGA) is to help assess the regional and national capacity in implementing the ASEAN Peatland Management Strategy (APMS) and the Roadmap on ASEAN Cooperation towards Transboundary Haze Pollution Control with Means of Implementation (also known as ASEAN Haze-Free Roadmap), as well as the use of available information and results management system for monitoring and reducing transboundary haze pollution in the region, then to build capacity and enhance data, information and results management systems for sustainable peatland management and haze control.

2.   As part of the CDNGA process, a working paper with a questionnaire (**Annex 1**) was circulated to the National Focal Points (NFPs) of Committee under the Conference of the Parties to the ASEAN Agreement on Transboundary Haze Pollution (COM AATHP) and ASEAN Task Force on Peatlands (ATFP) on 30 June 2020, followed by a virtual briefing on 7 July 2020. The questionnaire had been further circulated by the NFPs to key stakeholders within the country for inputs, including the National Monitoring Centres (NMCs). This CDNGA is not intended to capture inputs from individual or organisations at local and sub-national levels due to limited timeframe and challenges during this pandemic period where travel has been suspended.

3.   Through this process, the input and information received has been used to prepare this report and later will assist in the following: i) development of a regional data, information and results management system; ii) support improvement of the national data, information and results management systems; and iii) support development of a capacity building package tailored to meet country and regional data and results management needs.

4.   The findings from the questionnaire and inputs from the ASEAN Member States (AMS) will support implementation of the MAHFSA programme, in particular the Component 1:

Output 1.1 – Capacity building package for data and information collection/ sharing and regional results management developed
- Activity 1.1.1 – Regional level data, information and capacity gap analysis;
- Activity 1.1.2 – Development of guidelines for information and data collection and results management; and
- Activity 1.1.3 – Development of capacity building package.

Output 1.2 – Capacity building undertaken at country and regional levels for improved data and information gathering and results management
- Activity 1.2.1 – Implementation of capacity building package; and
- Activity 1.2.2 – Establishment of regional information and results management system.

5.   The intended outcome of the Component 1 is to strengthen capacity of ASEAN to use information and results management systems for sustainable land and haze management. It is expected that capacity building packages are tailored to meet country and regional data and results management needs, and that the number of people capable of performing data and information gathering, and results management is increased.

2. Background

6.   A key element of the support under the MAHFSA programme is to assist AMS and ASEAN in results management. Results management encompasses the management of key information related to the achievement of targeted results related to peatland fire and haze management. This entails the setting of clear indicators of success and the collation and analysis of related information to track progress in achieving results. Given the ASEAN framework, it is important that each AMS has clear targets and systems for tracking progress against the targets and identifying areas needed additional support or resources. It is also important for the progress at the national level to be clearly documented and articulated to the regional level in a consistent manner – such that it will be possible for regional syntheses of progress to be made to inform key stakeholders and enable adjustments of course corrections to ensure the overall targets are met.

7.   In order to undertake this CDNGA, it is important that AMS and ASEC have a common and clear results management and reporting system to collate and synthesise information on progress and constraints in enhancing peatland management, fire and haze prevention. With regards to the haze, in line with the ASEAN Standard Operating Procedure (SOP) for Monitoring, Assessment and Joint Emergency Response, AMS should designate one or more bodies to function as NMCs[1], to undertake the monitoring of (i) all fire prone areas, (ii) all land and/or forest fires, (iii) environmental conditions conducive to such land and/or forest fires, and (iv) haze pollution arising from such land and/or forest fires, in accordance with their respective national procedures.

8.   This CDNGA therefore has gathered information from the AMS and regional entities on the nature of results management systems used and a range of indicators that are currently tracked and analysed at the country level in relation to peatland and fire management. This can help to identify gaps to be filled through enhanced information collection as well as opportunities for enhancing of national or regional result management systems.

9.   This CDNGA is also supporting the implementation of the APMS. This gap analysis cross-references the conclusions and country priorities from the Final Review of the APMS adopted in January 2021 and associated recommendations for the next phase of the strategy. The country-based capacity development packages will be prepared according to the country needs as much as possible to support each AMS in implementing the national priorities.

10.   As stated in the ASEAN SOP for Monitoring, Assessment and Joint Emergency Response[2], under the framework of the AATHP, each AMS through its NMC should undertake monitoring measures and the ASEAN Coordinating Centre on Transboundary Haze Pollution Control (ACC THPC) should establish linkages with the NMCs to communicate the data at agreed regular interval. The procedures are listed as:
   i.   The ACC THPC[3] will issue weather forecasts and haze outlook on a monthly basis throughout the year and publish the updates on its intranet. During the dry season, the ACC THPC will provide more frequent updates.
   ii. At the start of the dry season, the ACC THPC[4] will alert the NMCs to submit weekly situation report to the ACC THPC on every Monday. The ACC THPC will consolidate, analyse, and process the information into a user-friendly format.

---

[1] Function of National Monitoring Centres (NMCs) as listed in AATHP Article 7 Monitoring
[2] This paragraph is derived from the Section III of the SOP for Monitoring, Assessment and Joint Emergency Response
[3] During the interim period, this function is performed by the ASEAN Secretariat. The ASMC will alert the ASEAN Secretariat when the dry season starts.
[4] *Ibid.*

iii. The ACC THPC will consolidate and analyse the situation reports received from NMCs and circulate the consolidated report to the NFPs at the end of the day through email or other means of communication.

iv. When the air quality reaches unhealthy level in many areas of the region or when there is significant increase of hotspots activities, the ACC THPC will alert the NMCs to provide the situation report on a daily basis.

v. The ACC THPC will also provide the above situation reports in the password-required section of its website.

2.1 Peatlands, Fire and Haze in ASEAN

Peatlands

11. The total area of peatlands in Southeast Asia is estimated to be about 23 million hectares (Mha) (**Table 1**), which is approximately 38% of the world's known tropical peatlands and roughly 6% of the entire extent of global peatland resource. The majority of the peatlands of Southeast Asia occurs in Indonesia, which has over 85% of total peatland area in the region. Other major peatland areas are found in Malaysia, Brunei Darussalam and Thailand, while Viet Nam, Philippines, Cambodia, Lao PDR and Myanmar have smaller areas of peatlands (Figure 1). Singapore has no reported peatlands in the country. However, increased development, land conversion and degradation caused by land and forest fires have reduced the extent and quality of peatland resources in ASEAN significantly over the last 30 years.

Table 1: Distribution of peatlands in Southeast Asia (updated as per the APMS Final Review Report)

No.	AMS	Peatland area (ha)	Reference
1.	Indonesia	20,200,000	CIFOR (2017 and 2018)[5]
2.	Malaysia	2,560,341	Department of Environment (DOE), 2019[6]
3.	Brunei Darussalam	90,900	National Action Plan on Peatlands (NAPP), 2014
4.	Thailand	64,555	Input provided to Joint Regional Training of SUPA and MAHFSA, September 2020
5.	Viet Nam	24,000	Input provided to Joint Regional Training of SUPA and MAHFSA, September 2020; National Action Plan on Peatlands (NAPP)
6.	Philippines	20,188	Input provided to Joint Regional Training of SUPA and MAHFSA, September 2020; National Action Plan on Peatlands (NAPP), Assessment reports, 2011-2015, APFP-SEApeat Project
7.	Myanmar	11,233	Input provided to Joint Regional Training of SUPA and MAHFSA, September 2020; Assessment reports, 2014-2015, SEApeat Project
8.	Cambodia	9,850	Assessment reports, 2014-2015, SEApeat Project
9.	Lao PDR	1,000	Assessment reports, 2014-2015, SEApeat Project

---

[5] Gumbricht et al. (2017) An expert system model for mapping tropical wetlands and peatlands reveals South America as the largest contributor. Wiley Global Change Biology, DOI: 10.1111/gcb.13689, Accepted 20 January 2017; Murdiyarso et al. (2017) New map reveals more peat in the tropics. Brief Info No. 189, October 2017, DOI: 10.17528/cifor/006452. Center of International Forestry Research (CIFOR); Hergoualc'h et al. (2018) Managing peatlands in Indonesia: Challenges and opportunities for local and global communities. Brief Info No. 205, February 2018, DOI: 10.17528/cifor/006449. CIFOR.

[6] Department of Environment, Malaysia. 2019. National Programme on Peatland Prevention to Tackle Haze in Malaysia.

No.	AMS	Peatland area (ha)	Reference
	TOTAL	**22,982,067**	Estimated figures from multiple sources as listed above

12.   Peat is formed by the accummulation of undecomposed plant materials on the land where water or low temperatures restrict decomposition rates. Peat formation occurs over a long period of time with the formation rate about 1-2 millimetres (mm) per year, which means 1 metre (m) depth of peat layer needs 500-1,000 years to form. Peat in Sumatra and Borneo is sometimes more than 10 m deep. Based on the decomposition level, peat is classified as *fibrist* (1/3 decomposed), *saprist* (2/3 decomposed), and *hemist* (between *fibrist* and *saprist*). Tropical peat is different to temperate peat which originates mainly from homogenous materials such as spaghnum, sedge and other smaller plant species, tropical peat originated primarily from the roots of tropical forest tree species. Tropical peatlands have generally formed faster than temperate peats due to higher rates of and year-round plant productivity. When tropical peatlands are drained, they degrade at much faster rates than temperate peatlands, due to year-round high temperatures and more rapid rates of bacterial decomposition and high fire risks. Tropical peatlands are very sensitive to changes, hence they need careful and wise management in particular to minimise any disruption of their water table.

13.   Peatlands in ASEAN are mainly found at low altitude, sub-coastal areas extending inland for distances up to 300 kilometres (km) and fed mostly by rainfall and sometimes by groundwater or excess water from rivers or lakes. The depth of peat varies from 0.5 m to more than 20 m. However, peatland can also be found in high altitude, which is formed by biomass accumulation and decomposition in topographic depressions fed by high rainfall. There has been lots of interest focused on lowland peats, but highland peatlands have not been well described and documented. In Indonesia, for example, highland peat is found in North Sumatera, Sulawesi and Papua. It has also been documented in Malaysia and Thailand.
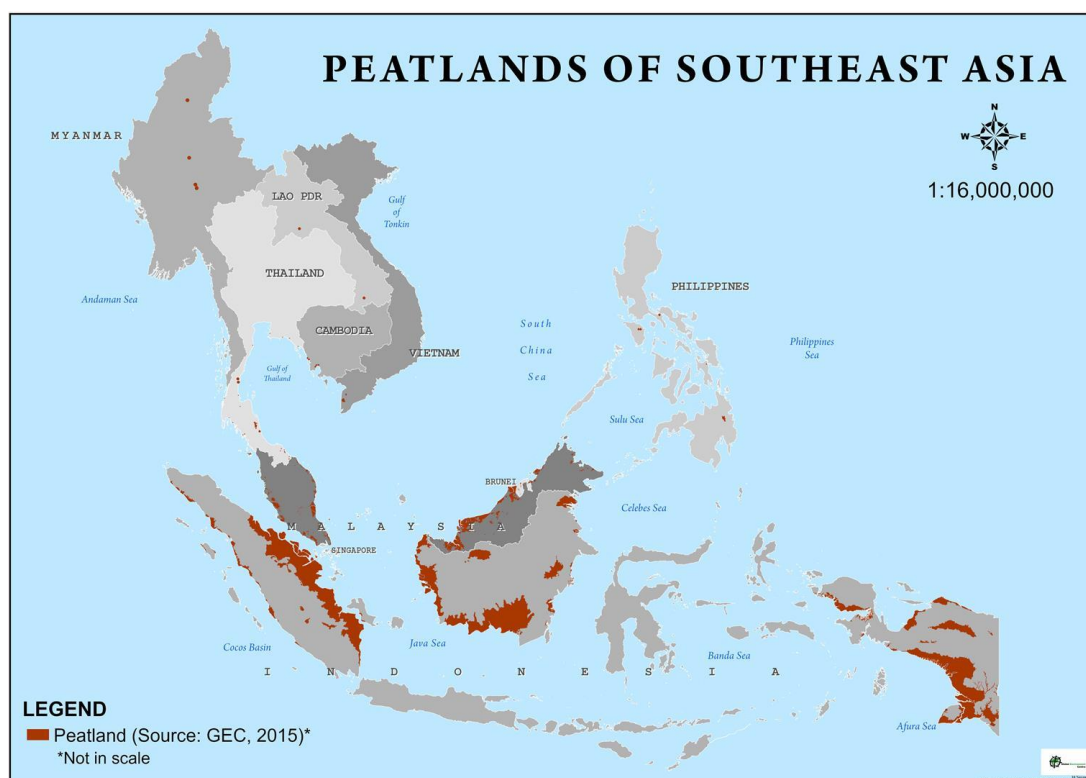

Figure 1: Peatlands in Southeast Asia (Source: ASEAN Peatland Forests Project and SEApeat Project, 2015)

Land use status and haze issue

14.   Every year, land clearance using fire by smallholder farmers, and medium and large scale plantations in Southeast Asia creates a thick blanket of haze covering up to 3-5 million km^2 of the region[7]. This phenomenon has been increasing in intensity over the last 20 years resulting in dramatic socio-economic and environmental costs in the region. The El Niño drought years have been the most severe: the 1997-1998 and 2015-2016 haze events affected up to 50 million people. In 2015-2016, more than 100,000 premature deaths have been attributed to haze in Southeast Asia[8]. The economic costs of the 2015-2016 fire and haze emissions was estimated at over US$16.2 billion for Indonesia alone[9]. This estimate did not include the costs to neighbouring countries where schools, businesses, airports, and ports have been brought to a standstill during intense haze events – the costs of which have yet to be fully determined.

15.   Southeast Asia holds 5% of the world's forests i.e., 236 Mha[10], which constitutes one of the most important global terrestrial ecosystems for carbon storage and biodiversity. It also contributes significantly to the livelihoods of a substantial number of poor people that live in and around these forests. The region lost about 80 Mha of forest between 2005 and 2015, which translates to a forest loss rate of around 8 Mha per year[11], making Southeast Asia the region with the highest deforestation rate globally[12]. Since 1995, more than 6 Mha of peatlands have been severely degraded or lost due to land clearing forest harvesting and fires.

16.   For example, in Indonesia alone 2.6 Mha of forest and peatland burned in 2015, producing an estimated 1,750 million metric tons of carbon dioxide (CO_2) equivalent[13,14]. Consequently, Indonesia went from sixth to fourth on the list of largest global greenhouse gas (GHG) emitters[15], with peatlands accounting for one third of the area burned and responsible for the vast majority of the haze and CO_2 emissions[16]. Moreover, the massive GHG loading is

---

[7] http://www.fire.uni-freiburg.de/iffn/country/id/id_32.html

[8] Koplitz, S.N., Mickley, L.J., Marlier, M.E., Buonocore, J., Kim, P.S, Liu, T., Sulprizio, M.P., DeFries, R.S., Jacob, D.J., and Schwartz, J. 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(9). Available at: http://iopscience.iop.org/article/10.1088/1748-9326/11/9/094023/pdf

[9] Glauber, A.J. and Gunawan, I. 2016. The Cost of Fire: An Economic Analysis of Indonesia's 2015 Fire Crisis. The World Bank. Available at:
https://openknowledge.worldbank.org/bitstream/handle/10986/23840/Forest%20Fire%20Notes%20FINAL%20APRIL%2018.pdf?sequence=5&isAllowed=y

[10] Estimated in 2010 – Stibig, H.J., Achard, F., Carboni, S., Rasi, R., and Miettinen, J. 2014. Change in tropical forest cover of Southeast Asia from 1990 to 2010. Biogeosciences 11:247-258. Available at:
http://www.biogeosciences.net/11/247/2014/bg-11-247-2014.pdf

[11] Estoque, R.C., Ooba, M., Avitabile, V. et al. 2009. The future of Southeast Asia's forests. Nat Commun 10, 1829. https://doi.org/10.1038/s41467-019-09646-4

[12] ADB and WWF. 2012. Ecological footprint and investment in natural capital in Asia and the Pacific Inner Workings (INWK), UK ISBN 978-2-940443-38-3. Available at:
http://www.footprintnetwork.org/images/article_uploads/ecological-footprint-asia-pacific-2012-final.pdf

[13] Glauber, A.J. and Gunawan, I. 2016. The Cost of Fire: An Economic Analysis of Indonesia's 2015 Fire Crisis. The World Bank. Available at:
https://openknowledge.worldbank.org/bitstream/handle/10986/23840/Forest%20Fire%20Notes%20FINAL%20APRIL%2018.pdf?sequence=5&isAllowed=y

[14] http://www.globalfiredata.org/updates.html

[15] http://www.wri.org/blog/2015/10/latest-fires-crisis-indonesia-surpasses-russia-world%E2%80%99s-fourth-largest-emitter

[16] Glauber, A.J. and Gunawan, I. 2016. The Cost of Fire: An Economic Analysis of Indonesia's 2015 Fire Crisis. The World Bank. Available at:
https://openknowledge.worldbank.org/bitstream/handle/10986/23840/Forest%20Fire%20Notes%20FINAL%20APRIL%2018.pdf?sequence=5&isAllowed=y

causing a positive feedback loop where intensified El Niño events are converging with a drying out of peatlands to increase fire risk, and this is likely to continue[17].

17.   Land clearance using fire and wildfires spreading into adjacent peatlands and forests are the direct cause of the haze problem propelled by the following underlying key drivers: i) increasing global demand for palm oil (for food, industrial and biofuel sectors), pulp and paper, and timber, facilitated by perverse incentives for land clearance, acquisition and expulsion of local communities for establishment of large-scale plantations[18]; ii) population increase, poverty pockets and marginalisation contributing to land conversion for smallholder farming notably oil palm production[19]; iii) insufficient law enforcement, inter-agency coordination, relatively weak governance, and poor institutional capacity for forest and peatland management[20]; iv) climate change[21]; and v) insufficient valuation of ecosystem services provided by peatland and other forest ecosystems[22].

18.   The challenge on the ground is intensifying with more forest lands being converted for plantations – global production of palm oil has more than doubled since 2000 and is growing by 8% per year. The global land area of mature oil palm increased from 3.5 Mha in 1990 to 13.1 Mha in 2010; more than 90% of this expansion occurred in Malaysia and Indonesia[23]. Given the lack of income generation and agriculture production alternatives, smallholder farmers are increasingly engaging in oil palm cultivation due to its lucrative nature. Smallholders make up respectively 41% and 38% of production in Indonesia and Malaysia. The remaining approximately 60% of oil palm cultivation is done by large private sector plantation companies. In the case of pulp and paper production, however, it is mainly done by large private sector plantations. Given that the cheapest and easiest form of land clearance is by using fire, both plantation companies and smallholders have historically adopted this method largely unchallenged. However, the benefits of fire are enjoyed by a minuscule few, while the direct costs are borne by millions of people regionally, and the climate change costs are shouldered globally[24]. Therefore, moving towards fire-free farming requires a behavioural change by both the large-scale private sector plantations as well as by the smallholder farmers.

---

[17] Tosca, M.G., Randerson, J.T., Zender, C.S., Flanner, M.G., and Rasch, P.J. 2010. Do biomass burning aerosols intensify drought in equatorial Asia during El Nino? Atmos. Chem. Phys., 10, 3515–3528, 2010. Available at: www.atmos-chem-phys.net/10/3515/2010

[18] Varkkey, H. 2011. Plantation Land Management, Fires and Haze in Southeast Asia. Available at: https://www.researchgate.net/publication/257029059_Plantation_Land_Management_Fires_and_Haze_in_Southeast_Asia

[19] Page, S.E. and Hooijer, A. 2016. In the line of fire: the peatlands of Southeast Asia. Available at: https://royalsocietypublishing.org/doi/pdf/10.1098/rstb.2015.0176

[20] A review and analysis of legal and regulatory aspects of forest fire in SEA. Report by y Project FireFight South East Asia. Available at: https://portals.iucn.org/library/efiles/documents/2002-074.pdf

[21] Flannigan, M.D., Amiro, B.D., Logan, K.A., Stocks, B.J. and Wotton, B.M. 2005. Wotton Forest fire and climate change in the 21st century. Available at: https://www.researchgate.net/publication/227105085_Forest_Fires_and_Climate_Change_in_the_21ST_Century/link/0fcfd50b3e57f56bdb000000/download

[22] Report from Secretariat of the Convention on Biological Diversity. 2001. Impacts of human-caused fires on biodiversity and ecosystem functioning, and their causes in tropical, temperate and boreal forest biomes. Available at: https://www.cbd.int/doc/publications/cbd-ts-05.pdf

[23] Wike, B., Sikkema, R., Dornburg, V., and Faaij, A. 2011. Exploring land use changes and the role of palm oil production in Indonesia and Malaysia. Land Use Policy, 28 (1): 193-206. Available at: http://www.sciencedirect.com/science/article/pii/S0264837710000633

[24] Purnomo, H., Shantiko, B., Sitorus, S., Gunawan, Achdiawan, R., Kartodihardjo, H., Dewayani, A.A. 2017. Fire economy and actor network of forest and land fires in Indonesia. Forest Policy and Economics (78):21–31. Available at: http://www.sciencedirect.com/science/article/pii/S1389934117300023

2.2 ASEAN Framework for Peatlands and Fire

2.2.1 ASEAN Agreement on Transboundary Haze Pollution (AATHP)

19.   The Governments of the ten AMS signed the AATHP on 10 June 2002 in Kuala Lumpur, Malaysia. The AATHP is the first regional arrangement in the world that binds a group of contiguous states to tackle transboundary haze pollution resulting from land and forest fires. It has also been considered as a global role model for the tackling of transboundary issues.

20.   The AATHP requires the Parties to the Agreement to[25]:
1. *Co-operate in developing and implementing measures to prevent and monitor transboundary haze pollution as a result of land and/or forest fires which should be mitigated, and to control sources of fires, including by the identification of fires, development of monitoring, assessment and early warning systems, exchange of information and technology, and the provision of mutual assistance.*
2. *When the transboundary haze pollution originates from within their territories, respond promptly to a request for relevant information or consultations sought by a State or States that are or may be affected by such transboundary haze pollution, with a view to minimising the consequences of the transboundary haze pollution.*
3. *Take legislative, administrative and/or other measures to implement their obligations under this Agreement.*

21.   The AATHP entered into force on 25 November 2003. All AMS have ratified and become Parties to the AATHP (see **Table 2**).

Table 2: Details of instruments of ratification or approval from AMS on AATHP[26]

Member Country	Date of Ratification/Approval	Date of Deposit of Instrument of Ratification/Approval to ASEC
Brunei Darussalam	27 February 2003	23 April 2003
Cambodia	24 April 2006	9 November 2006
Indonesia	14 October 2014	20 January 2015
Lao PDR	19 December 2004	13 July 2005
Malaysia	3 December 2002	18 February 2003
Myanmar	5 March 2003	17 March 2003
Philippines	1 February 2010	4 March 2010
Singapore	13 January 2003	14 January 2003
Thailand	10 September 2003	26 September 2003
Viet Nam	24 March 2003	29 May 2003

22.   The AATHP contains measures on: i) monitoring and assessment; ii) prevention; iii) preparedness; iv) national and joint emergency response; v) procedures for deployment of people, materials and equipment across borders; and vi) technical cooperation and scientific research.

23.   The AATHP gives a mandate and provides a framework to establish the ACC THPC to facilitate cooperation and coordination among parties in managing the impact of land and/or forest fires in particular haze pollution arising from such fires.

---

[25] Source: Article 4 of AATHP
[26] ASEAN Secretariat. ASEAN Haze Action Online. https://haze.asean.org/asean-agreement-on-transboundary-haze-pollution-2/.

24. The regional SOP for Monitoring, Assessment and Joint Emergency Response was developed to outline the procedure for regular communication of data between the ACC THPC and NMCs/NFPs, and for coordination of requests and offers of assistance and reporting of joint mobilisation of resources.

25. Under the said SOP, during the interim period, the functions of the ACC THPC are shared by (i) the ASEAN Specialised Meteorological Centre (ASMC) for monitoring and assessment; and (ii) the ASEC for coordination of joint emergency response, donor funding and assistance, development of the SOP, and development and maintenance of database.

2.2.2 ASEAN Peatland Management Strategy 2006-2020 (APMS)

26. The Strategy and Action Plan for Sustainable Management of Peatlands in ASEAN Member Countries (or APMS) was developed by AMS to guide actions to support management of peatlands in the region. The APMS was prepared due to pressing need recognised by both local and international communities for wise use and sustainable management of peatlands as well as emerging threat of peatland fire and its associated haze to the economy and health of the region, and its possibility of contributing to global climate change. The APMS was developed within the framework of the ASEAN Peatland Management Initiative (APMI) and the AATHP. The APMS was developed with 13 Focal Areas, 25 Operational Objectives (See **Table 3**) and 98 Actions.

Table 3: APMS' 13 Focal Areas and 25 Operational Objectives

Focal Areas	Operational Objectives
1. Inventory and Assessment	1.1 Determine the extent and status of peatlands in the ASEAN region
	1.2 Assess problems and constraints faced in peatland management
	1.3 Monitor and evaluate peatland status and management
2. Research	2.1 Undertake priority research activities
3. Awareness and Capacity Building	3.1 Enhance public awareness on importance of peatlands, their vulnerability to fire and the threat of haze through implementation of a comprehensive plan
	3.2 Build institutional capacity on management of peatlands
4. Information Sharing	4.1 Enhance information management and promote sharing
5. Policies and Legislation	5.1 Develop or strengthen policies and legislation to protect peatlands and reduce peat fire
6. Fire Prevention, Control and Monitoring	6.1 Reduce and minimise occurrence of fire and associated haze
7. Conservation of Peatland Biodiversity	7.1 Promote conservation of peatland biodiversity
8. Integrated Management of Peatlands	8.1 Promote multi-agency involvement in peatland management
	8.2 Promote integrated water resources and peatland management using a basin-wide approach and avoiding fragmentation
	8.3 Promote integrated forest and peatland management
	8.4 Manage agriculture in peatland areas in integrated manner
	8.5 Promote integrated community livelihood and peatland management
9. Promotion of Best Management Practices of Peatlands	9.1 Promote best management practices through documentation and demonstration sites

Focal Areas	Operational Objectives
10. Restoration and Rehabilitation	10.1 Develop appropriate techniques for the restoration or rehabilitation of degraded peatlands
	10.2 Rehabilitation of burnt, drained and degraded peatlands
11. Peatland and Climate Change	11.1 Protect and improve function of peatlands for carbon sequestration and storage
	11.2 Support incorporation of peatlands into climate change adaptation processes
12. Regional Cooperation	12.1 Promote exchange of expertise in addressing peatland management issues
	12.2 Establishment if 'networks or centres of excellence' in the region for peatland assessment and management
	12.3 Contribute to the implementation of other related agreements and regional cooperation mechanisms
	12.4 Enhance multi-stakeholder partnerships to support peatland management
13. Financing of the Implementation of Strategy	13.1 Generate financial resources and incentives required for the programmes and activities to achieve targets of the strategy

2.2.3 Roadmap on ASEAN Cooperation towards Transboundary Haze Pollution Control with Means of Implementation

27.   The 12th Meeting of the Conference of the Parties (COP-12) to the AATHP held in Kuala Lumpur, Malaysia on 11 August 2016 adopted the Roadmap on ASEAN Cooperation towards Transboundary Haze Pollution Control with Means of Implementation (hereinafter Roadmap or ASEAN Haze-Free Roadmap), resulting from the Task Force Meeting to draft the Roadmap held on 7-9 March 2016 in Chiang Mai, Thailand and the discussion on 10 August 2016, in parallel with COM-12. Subsequently, the ASEAN Leaders at the 28th and 29th ASEAN Summits held in Vientiane, Lao PDR on 6-7 September 2016, noted the adoption of the Roadmap at the COP-12.

28.   The Roadmap serves as a strategic, action-oriented and time-bound framework for the implementation of the collaborative actions to control transboundary haze pollution in the ASEAN region to achieve a vision of Transboundary Haze-Free ASEAN by 2020.

29.   "Transboundary Haze-Free" is defined as "Measurable improvement of the situation of regional transboundary haze pollution from forest and/or land fires through quantitative indicators and targets". These indicators are:
   (i) An increase of numbers of days having good or moderate air quality in terms of Pollutant Standard Index (PSI) or Air Quality Index (AQI) based on particulate matter (PM) 10 and/or PM2.5;
   (ii) Reduction of hotspot numbers below alert level 2 under the ASEAN SOP on haze; and
   (iii) Decrease of transboundary haze pollution area.

30.   There are eight strategies under the Roadmap as listed:
   i.   Implementation of the AATHP;
   ii. Sustainable Management of Peatlands for Peatland Fires Prevention;
   iii. Sustainable Management of Agricultural Land and Forest for Large Scale Forest and/or Land Fires Prevention;

iv. Strengthening Policies, Laws, Regulations and their Implementations, including to facilitate exchange of experience and relevant information among enforcement authorities of the Parties in accordance with the AATHP Article 16 (f);

v. Enhancing Cooperation, Exchange of Information and Technology, and Strengthening of Capacity of Institutions at All Levels;

vi. Enhancing Public Awareness and Cross-Sectoral and Stakeholders Participation;

vii. Securing Adequate Resources from Multi-Stakeholders for Transboundary Haze Prevention; and

viii. Reducing Health and Environmental Risks and Protection of Global Environment.

31. Each of the Strategy has specific indicators to measure the progress (see **Annex 2**).

2.3 Objectives of CDNGA

32. As specified in the MAHFSA Design Document, the Programme will help close data gaps between and within AMS and propose a comprehensive results management system for effective programme implementation and to harmonise data between several data gathering activities. In this regard, an analysis of needs and gaps in data management at the national and regional level is needed.

33. To close the data gaps, the Programme will assess the capacity of key regional and national institutions, ministries and departments of the 10 AMS in data collection, analysis and sharing and strengthen regional and country capacities in management and analysis of result and trends as tool to support achieving and tracking progress in generating key results as specified in the APMS and the Roadmap.

34. The results of this CDNGA will inform the development of guidelines for information and data collection and results management, support establishment and enhancement of regional information and results management systems, and the development of capacity building package tailored with AMS' needs as key activities of the Component 1 of the Programme.

35. In addition, it is envisaged that this CDNGA will then support other elements of the MAHFSA Programme including: i) development and promotion of knowledge products under Component 2; ii) the engagement of relevant specialised/technical agencies to contribute to the multi-stakeholder platform to share information expertise and knowledge, as well as contribute to enhancement of national and regional results and information systems in the region; iii) support for the development of the proposed investment framework, to be developed under Component 3.

2.4 Scope

36. The scope of this CDNGA is guided by the framework of AATHP, APMS, ASEAN Haze-Free Roadmap, the SOP for Monitoring, Assessment and Joint Emergency Response, as well as ASEAN Programme on Sustainable Management of Peatland Ecosystems 2014-2020 (APSMPE).

37. As approved by First Programme Steering Committee Meeting of the MAHFSA on 27 November 2019 in Bangkok, Thailand, the five potential areas of focus for Component 1 were identified, presented and listed as below:

i. Peatland inventory, mapping, assessment of degradation status, monitoring (APSMPE Key Target 1 All peatland areas in ASEAN are identified and inventorised);

ii. Peatland fire prevention measures (APSMPE Key Target 2 Zero-burning is uniformly practiced and controlled-burning only used in exceptional cases to prevent any uncontrolled wildfires on peatlands and eliminate any widespread smoke haze/ ASEAN Haze-Free Roadmap Strategy 2 Sustainable management of peatlands for peatland fires prevention) in particular on rewetting and patrolling, and Fire Danger Rating System (FDRS) operation and promotion;

iii. Peatland fire and haze occurrence (APMSPE Key Target 2/ASEAN Haze-Free Roadmap Strategy 2), in particular extent of fire prone areas and monitoring fire occurrence (hotspots/burn-scars) using satellite;

iv. Resources allocated and generated for peatland management and fire prevention (APSMPE Focal Area 12 Regional cooperation/ASEAN Haze-Free Roadmap Strategy 7 Securing adequate resources from multi-stakeholders for preventing transboundary haze); and

v. Implementation of National Action Plan on Peatlands (NAPP), APMS and the ASEAN Haze-Free Roadmap.

2.5 Methodology for CDNGA

38.   An assessment on the capacity of key Ministries and/or departments of the 10 AMS responsible for monitoring (data and information collection, management and analysis), reporting and results management was done to understand what are the constraints in compiling, standardising and disseminating data as outlined by the ASEAN SOP for Monitoring, Assessment and Joint Emergency Response as well as relating the APMS and ASEAN Haze-Free Roadmap. NFPs of the AATHP and ATFP reviewed the information compiled by the preliminary assessment undertaken in 2019 and provided feedback on national level practices using the questionnaire attached to a working paper circulated to AMS by ASEC on 3 July 2020 (**Annex 1**).

39.   The methodology of this CDNGA comprises four elements as follows:
   i) Desk study review of key documents related to regional monitoring, reporting and results management was done to understand constraints in compiling, standardising and disseminating data as outlined by the ASEAN SOP for Monitoring, Assessment and Joint Emergency Response.
   ii) Information collection through questionnaire, includes the following sections:
      A. Institutional Analysis of AMS institutions responsible for peatland and fire information and data management
      B. Assessment of availability of key information for tracking results against ASEAN Haze-Free Roadmap Strategy 2
      C. Information from AMS on current source and use of hotspot data and FDRS
      D. Review of overall priorities of AMS for information and data management for peatland and fire management
   iii) Verification interview or virtual meeting with key resource persons from the interim ACC THPC (i.e. ASEC), ministries and/or departments or specialised agencies on the findings of the desk study and questionnaire
   iv) Linkage with other processes

2.5.1 Desk Study

40.   A desk study review was undertaken on relevant documents such as the AATHP, the SOP for Monitoring, Assessment and Joint Emergency Response, ASEAN Guidelines on Peatland Fire Management, APMS, ASEAN Haze-Free Roadmap, the alert levels and trigger points specified in the SOP and other relevant analyses/studies (including the First and the Final Review of Implementation of the APMS), in order to provide sound and valid recommendations and to close gaps of the national's and regional's results management systems.

41.   The preliminary assessment on the following issues was undertaken by MAHFSA (and annexed to the working paper on the CDNGA provided to the AMS):
  i.   Availability of regional level data and information on remote sensing options commonly used in fire management;
  ii. Analysis based on categories of information i.e. air quality, hotspot, wind direction, history/vintage data, fire scar, haze, rainfall and Fire Danger Rating System (FDRS);
  iii. Hotspot information;
  iv. Air quality information; and
  v.   Information layers for improvement of existing applications used for ASEAN Fire Alert Tool.

The preliminary assessment is in **Annex 1**.

2.5.2 Inputs from AMS through Questionnaire

42.   In order to compile relevant information to support the analysis, an official Working Paper with inclusion of a questionnaire (as in **Annex 1**) was developed and shared to the NFPs of the AATHP, the ATFP, and later further circulation by the NFPs to key stakeholders within the country for inputs, including the NMCs. As of June 2021, there have been sixteen (16) responses received from nine (9) AMS.

2.5.3 Verification Interview/Focus Group Discussions with AMS

43.   Informal verification interview or virtual meetings were organised on request with key resource persons from the regional institutions, ministries and/or departments or specialised agencies from Indonesia, Malaysia, Philippines, Singapore and Thailand for information validation. It is critical to have close communication with the official of key ministries, departments or specialised agencies, after submission of inputs to questionnaire, to discuss the feedback on the questionnaire and other information requested as well as to identify other key stakeholders/resource persons at national level on managing peatland and fire, according to existing mechanisms. In view that there are many available information and datasets publicly accessible through internet, it is important that clarification is made with key resource persons on which dataset is officially utilised to support decision-making at policy level.

2.5.4 Linkage with Other Processes

44.   The process of undertaking this CDNGA was linked as appropriate with other related processes such as the Final Review of implementation of the APMS, the Review of the ASEAN Haze-Free Roadmap, and activities undertaken and planned under European Union (EU) – Government of Germany supported Sustainable Use of Peatlands and Haze Mitigation in ASEAN (SUPA) programme and Global Environment Facility (GEF) – International Union on Conservation of Nature (IUCN) supported Sustainable Management of Peatland Ecosystems in Mekong Countries (Mekong Peatlands) project. Therefore, close communication has been

maintained with related ASEAN Peatland Partners to ensure optimal synergy and synchronisation for the peatland conservation and protection effort in the region. This collaboration has been ongoing through the existing regional coordination mechanism being facilitated by ASEC. Since GEC had also undertaken the Final Review of the Implementation of the APMS, feedback provided by AMS on the APMS Review was also utilised as appropriate in preparing this CDNGA report. Efforts were taken and discussions were undertaken with ASEC for guidance and clarification to minimise overlap between questions for this CDNGA and the APMS Review.

2.6 Limitation in Information Collation

45.   The main limitation for the CDNGA was that it was almost all undertaken during the unprecedented COVID-19 pandemic. During the period of mid-March 2020 to June 2021, government and stakeholder offices in many of the AMS were closed and many staff were put on leave or were working from home with limited or no access to files and reference materials in their offices. Travel bans were put in place between AMS since March 2020 and are still in operation in mid-2021. As a result, no travel or face-to-face meetings were possible. This has meant that almost all of the analysis were undertaken through emails, virtual meetings and communication by phone calls or instant messaging.

46.   The original plan for the CDNGA included a series of regional physical meetings for representatives of all AMS and face-to-face focus group discussions (FGDs) in many countries. It was expected that there would be interactive workshops with breakout discussions on various elements of the analysis with active participation of AMS. None of these planned actions were possible to implement.

47.   The CDNGA was therefore almost fully based on the feedback on the questionnaire by the AMS, and open sources of data and information available on internet, as per the preliminary assessment shared with AMS together with the Working Paper and questionnaire (**Annex 1**) as well as drawing on the extensive literature and knowledge held by GEC.

48.   However, an interactive regional workshop was conducted online on 16 March 2021 with a session to briefly present findings of this CDNGA and recommended possible capacity building packages to the workshop participants from AMS and ASEAN Peatland Partners. This workshop via interactive tool managed to gathered additional inputs from the participants in prioritising focal areas for capacity building packages and suggesting potential partners to conduct training sessions at national level due to the travel restriction in the region.

3. Information Collation
3.1   Questionnaire Feedback from AMS

49.   A set of questions was included as an annex to the working paper circulated by ASEC to AMS on 30 June 2020. The questionnaire was sent to NFPs of AATHP, ATFP, and later further circulation by the NFPs to key stakeholders within the country. Follow-up with each AMS through email was taken place since August 2020 and through social platform using smartphone communication applications e.g. Whatsapp, Viber and Line.

50.   A total of sixteen (16) responses (as of June 2021) have been received from nine (9) AMS. Breakdown of the responses from AMS as in **Table 4**.

Table 4: Breakdown of questionnaires responses from AMS

Country	Response Received	Agencies Responded
Brunei Darussalam	Pending	Pending
Cambodia	1	Department of Freshwater Wetlands Conservation, Ministry of Environment (NFP of COM AATHP and ATFP)
Indonesia	2	• Directorate of Forest and Land Fire Management, Ministry of Environment and Forestry (MOEF) (NFP of COM AATHP) • Preservation of Peatland Ecosystem, Directorate of Peat Degradation Control, Ministry of Environment and Forestry (MOEF) (NFP of ATFP)
Lao PDR	1	• Department of Water Resources, Ministry of Natural Resources and Environment (NFP of ATFP)
Malaysia	2	• Department of Environment, Ministry of Environment and Water (NFP of COM AATHP) • Forestry Department Peninsular Malaysia, Ministry of Energy and Natural Resources (alternate NFP of ATFP)
Myanmar	1	• Environmental Conservation Department (ECD), Ministry of Natural Resources and Environmental Conservation (MONREC) (NFP of COM AATHP and ATFP)
Philippines	6	• Ecosystems Research and Development Bureau (ERDB) • DOST-PAGASA (National meteorological/hydrological services) • DENR – Provincial Environment and Natural Resources Office of Agusan del Sur (Technical Agency) • Bureau of Fire Protection (alternate NFP of ATFP) • Biodiversity Management Bureau – Department Of Environment and Natural Resources (BMB-DENR) (NFP of ATFP) • Forest Management Bureau (NFP of COM AATHP)
Singapore	1	• National Environment Agency (NFP of COM AATHP and ATFP)
Thailand	1	• Department of National Parks, Wildlife and Plant Conservation (NFP of ATFP)
Viet Nam	1	• Forest Protection Department (NFP of ATFP)

3.2 Literature Papers and Reports on Peatlands in ASEAN

51.   A large number of papers, reports and publications related to peatlands have been identified and classified according to different key topics by the MAHFSA Programme in association with the Final Review of the Implementation of APMS 2006-2020. The key topics include peatland management, peatland fire management, developments on peatland, climate change, peatland/wetland inventory, peatland assessment and others. This information has given key insights into the area of knowledge and expertise related to peatlands in the 10 AMS.

52.   These publications will be used as key references during consultation sessions/workshops to be undertaken with respective AMS to tailor-make the capacity building packages in 2021. In addition, there has also been a publication list prepared by the MAHFSA Programme (in the MAHFSA Knowledge Stock Take Analysis Report) of knowledge products available at local, national, and regional levels in relation to the peatland, land and forest fire, and smoke haze matters.

53.   In addition, reports and publications produced by previous peatland related projects such as APFP and SEApeat Project were used as reference in developing the CDNGA.

3.3   Information from Other Sources

54.   The CDNGA has also drawn on activities of other ongoing peatland-related programmes and projects in the region, including, the SUPA Programme being implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and World Resources Institutes (WRI), the Mekong Peatlands Project being implemented by IUCN, and other national peatland projects such as GEF-IFAD Sustainable Management of Peatland Ecosystems in Indonesia (SMPEI), Sustainable Management of Peatland Ecosystems in Malaysia (SMPEM) and Integrated Management of Peatland Landscapes in Indonesia (IMPLI).

55.   Within the implementation of the programmes and/or projects, there have been some similarity on identifying gaps of knowledge and capacity of the relevant stakeholders that have been working on peatland and haze related matters.

3.3.1 APMS Review

56.   The Final Review of Implementation of the APMS (2006-2020) was prepared at the request of the AMS. It was implemented under the Task Force of APMS Review supported by the SUPA Programme Component 1 and was facilitated by GEC which was appointed by GIZ. The Final Review was undertaken in close consultation with the AMS, ASEC, GIZ and relevant stakeholders.

57.   The review process started in March 2020 guided by ASEC and GIZ, which involved literature review, focus group discussions, interviews, questionnaires, review of reports submitted by AMS, discussions; as well as regional Task Force meetings organised virtually. It also drew upon relevant AMS reports to relevant ASEAN meetings; experts' inputs and harnessed experiences from previous ASEAN peatland programmes and related ASEAN processes.

58.   The Final Report of the Review was endorsed by the Task Force on Final Review of Implementation of the APMS on 25 November 2020 and adopted by the 5th Meeting of the ATFP on 1 December 2020. Subsequently the Report was presented to the COM AATHP through a special briefing on 28 December 2020. The inputs from the AMS were incorporated into the final version of the report which was subsequently endorsed by COM on 11 January 2021 via ad-referendum.

59.   Within the consultation and information gathering from the AMS through the APMS Review process, there have been challenges and national priorities identified and proposed by the AMS (see **Section 4.3**). This information was used to develop priorities for the CDNGA and will be used further to develop country-tailored capacity building packages.

3.3.2 MAHFSA-SUPA Training

60.   A series of workshops were organised jointly by the SUPA and MAHFSA Programmes in September 2020 for representatives from six AMS in Northern ASEAN (i.e. Cambodia, Lao PDR, Myanmar, Philippines, Thailand and Viet Nam). These sessions focussed on needs assessment and training sessions on peatland assessment and mapping, and land and forest fire monitoring and detection. The training sessions were held on 2, 9 and 23 September and participated by 52 representatives from the six AMS. There were inputs from the AMS on the challenges and countries' priorities identified and presented during the training sessions. In general, there have been lack of knowledge on peatland assessment and management, insufficient hardware and software including resources to map and monitor development of the peatland areas within the country, as well as technical support on better agricultural practices to move away from shifting cultivation and land preparation by burning. These inputs were referred in developing the CDNGA recommendations and will be taken into consideration when developing the capacity building packages.

3.3.3 AMS Reports to COM/COP/TWG Meetings

61.   Selected Country Reports by AMS to ASEAN meetings such as COM AATHP, ATFP, Technical Working Group (TWG) and Ministerial Sub-regional Committee (MSC) to AATHP were referred to, to better understand on current situation and efforts of respective AMS on tackling transboundary haze pollution and peatland management.

4. CDNGA Findings

62.   This section discusses the findings of the CDNGA based on analysis of the information collated as described in Section 3. Particularly this section covers three important elements in order to understand the information gathering and result management practices by AMS and regional entities.

63.   The elements are:
*   Regional and national institutional arrangements for peatland and fire management;
*   Data monitoring practices in AMS; and
*   Overall review of national priorities of AMS on peatland and fire management.

4.1 Regional and National Institutional Arrangements for Peatland and Fire Management

64.   A critical element of the CDNGA was identifying institutional arrangement at national and regional levels that were responsible for data collection, analysis and dissemination of results in relation to peatland management, and fire and haze prevention.

65.   In view that there has been different level of concern by AMS on matters of land and forest fire including peatland fire, utilisation of data/information/results from different meteorological specialised institutions at national and regional levels, there is a need to understand those available information and results that being used by the AMS, and how the information and results being distributed to relevant agencies to support decision making.

4.1.1 Regional Institutional Arrangements and Capacity for Peatland and Fire Management

a) Institutional arrangements for land and forest fire and transboundary haze

66.   Since the establishment of the APMS, the overall organisational mechanism for land and forest fire and transboundary haze, has been modified. In 2006, fire and haze were overseen by the ASEAN Senior Officials on Environment (ASOEN), Haze Technical Task Force (HTTF) reporting to the ASEAN Ministerial Meeting on Haze (AMMH). It was supported by the Sub-regional Fire Fighting Arrangement (SRFA). With the entry into force of the AATHP, this was replaced by the ministerial-level COP of the AATHP supported by the Committee of the COP to AATHP (COM).

67.   The current regional level implementation mechanism[27], under the framework of AATHP, related to land and forest fire and transboundary haze pollution is as in **Figure 2** below.

---

[27] Source from ASEAN Agreement on Transboundary Haze Pollution (AATHP)
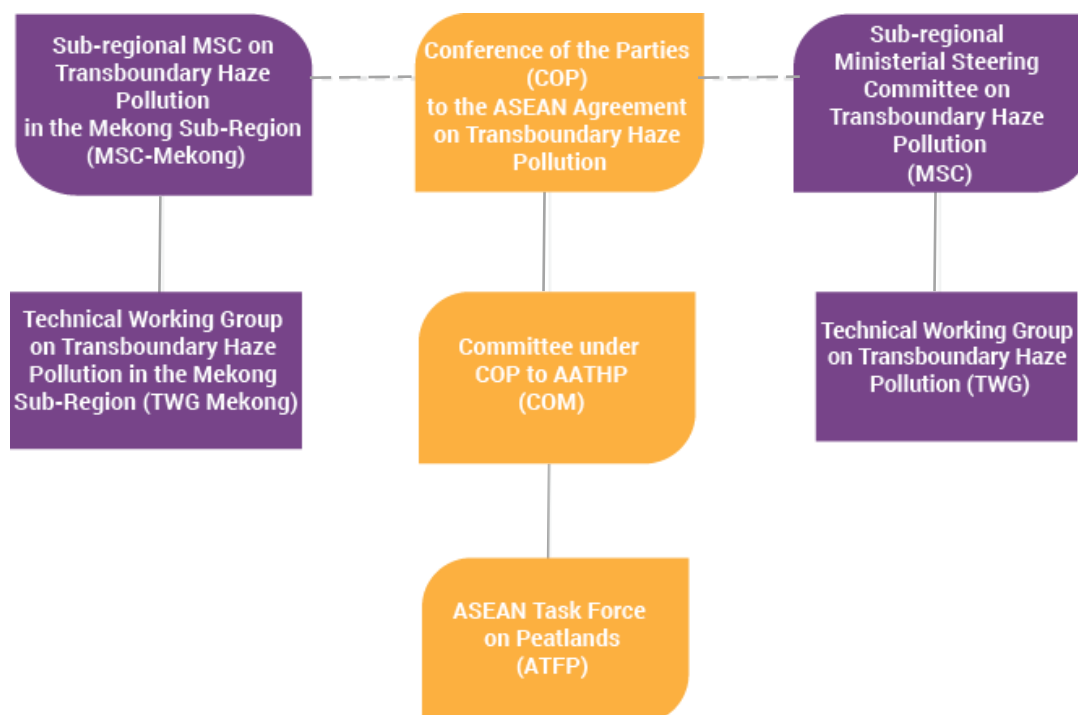
Figure 2: Regional institutional arrangement in ASEAN in relation to land and forest fire, peatlands and transboundary haze pollution

68.   Two sub-regional structures were established, the first being the Sub-regional Ministerial Steering Committee on Transboundary Haze Pollution (MSC) which groups AMS in the southern ASEAN sub-region (Brunei Darussalam, Indonesia, Malaysia, Singapore and Thailand). This has targeted on addressing the large-scale transboundary haze in the southern portion of ASEAN which is particularly linked to peatland fires. The second sub-regional mechanism established was the Sub-regional Ministerial Steering Committee on Transboundary Haze in the Mekong Sub-Region (MSC-Mekong) which groups Cambodia, Lao PDR, Myanmar, Thailand and Viet Nam. The MSC-Mekong was established to handle the emergent problem of transboundary haze in the Mekong region which is particularly linked to land clearing by fire and burning of agricultural residues. Both the MSC and MSC-Mekong meet at least once a year together with their associated TWGs to update progress and inform challenges in addressing the transboundary haze problems. Progress with work undertaken to address peatland management have been reported to the TWG and TWG-Mekong on a regular basis in addition to the direct reporting to the COM of the AATHP. The list of National Focal Points of the COM is in **Annex 3**.

69.   In order to facilitate the frameworks and activities under the AATHP, the AATHP specifies that the ACC THPC should be established. The ACC THPC is still in the process of establishment at the moment; therefore, the function of the ACC THPC has been provided by the ASEC as an interim ACC, with support on some issues by the ASMC. The delay in establishing the ACC THPC has necessarily affected the implementation progress of the AATHP, but AMS and specified partners have been providing necessary support to ASEC. In mid-2021, two specialists have been engaged by ASEC with support of SUPA Programme – i.e., Knowledge Management Specialist and Database Specialist to assist the work of the intern ACC.

70.   From the feedback and information collated, there has been a challenge faced by the interim ACC due to lack of dedicated manpower in the ASEC to handle the complete AATHP, ATFP and APMS implementation. The limited existing staffing in the Environment Division have many different obligations and are simultaneously handling a very large portfolio of activities, including work areas on land and biodiversity, transboundary haze, oceans, freshwater, cities, climate, chemicals and waste, and environmental education. This necessarily limits the amount of time and effort that the Division can place on any one task such as the AATHP or APMS implementation. In this regard support has been provided by other AMS and the ASMC as well as ASEAN Partners through various regional projects to support the AATHP implementation, in particular SUPA Programme, MAHFSA programme and other fire and haze related programmes and projects. ASEC has also been working closely with GEC as the Technical and Operational Support Partner of the APMS (particularly in relation to Strategy 2 of the ASEAN Roadmap, related to peatland fire prevention).

b) Institutional mechanism for the peatlands

71.   The institutional structure of overseeing and guiding the implementation of peatland management is based on the framework established for the APMS, specified in the original APMS adopted in 2006 is shown in **Figure 3**. Under this structure, the APMS implementation was overseen by the ASOEN Haze Technical Task Force, reporting to the ASEAN Ministerial Meeting on Haze. Regional coordination was facilitated by the ASEC supported by the GEC. The lead at the country level was taken by the AMS coordinated by a NFP and supported by country partners or supporters such as donors or academic organisations. A Technical Advisory Group of international experts on peatlands was also envisaged in the APMS but was not formally established.
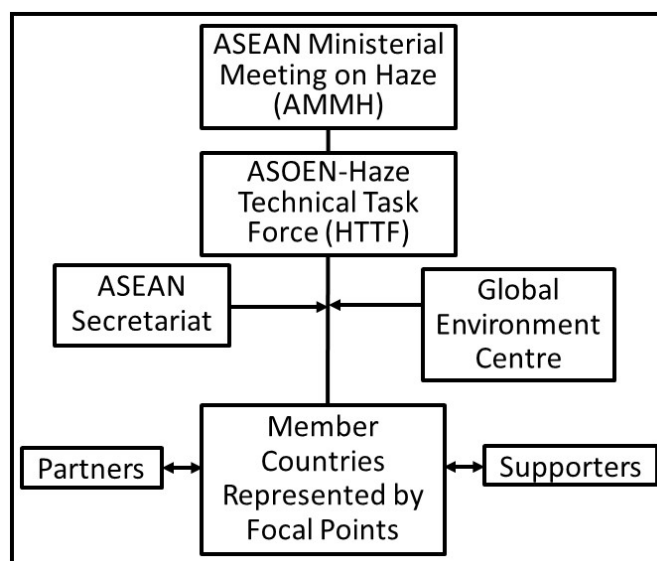
Figure 3: Diagram to show the institutional framework to guide the implementation of the APMS as established at the adoption of the APMS in 2006

72.   Following the First Review of the APMS in 2013, the institutional structure was adjusted and adopted by the COP AATHP, as specified in **Figure 4**. The main changes made in the structure were the formation of the ATFP that comprises representatives from APMS Focal Points and peatland experts. In the adjustment of the structure approved by the COP, the role of GEC was also adjusted to provide technical and operational support not only at the regional level through ASEC but also directly to support the AMS in their actions at the country level.

73. This ATFP structure was recommended to replace the original concept of the APMS that envisaged inclusion of a Technical Advisory Group of international peatland experts. The establishment of the ATFP was enabled by the significant increase in the capacity and level of activity on peatlands at the national level in AMS in the period 2006 to 2012. The ATFP also built on the successful operation of the Project Steering Committee of the APFP which was established in 2006 initially as the Project Planning and Preparation Working Group for the project design and then morphed into the Project Steering Committee (PSC) in 2010. Even though the APFP focussed on four AMS (i.e. Indonesia, Malaysia, Philippines and Viet Nam), the PSC included representatives of all AMS as there was additional component focussed on regional activities and cooperation. Subsequently, the scope of the PSC was expanded in 2011 to oversee the related SEApeat project managed by GEC which complemented the APFP and channelled funds to additional AMS in the Mekong region.
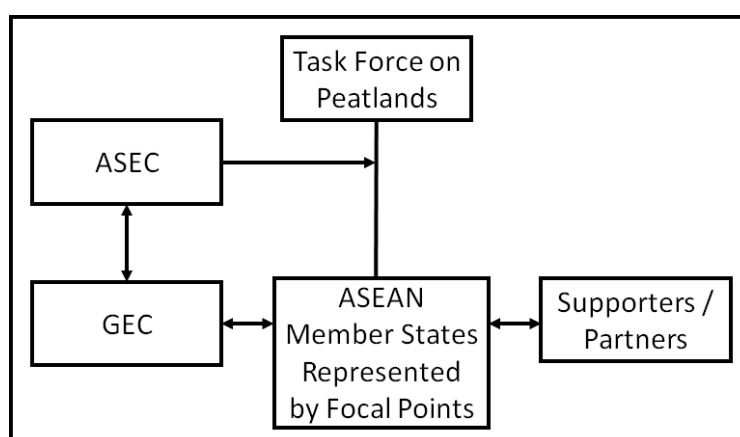
Figure 4: Diagram to show the institutional framework to guide the implementation of the APMS as per the 2013 revision of the APMS

74. The function of the ATFP is to monitor and guide the implementation of the APMS as well as prepare annual report to the COM of the AATHP. The ATFP has scheduled six (6) meetings since the approval for its establishment in 2013, as described in **Table 5**. The Fifth meeting planned for April 2020 was postponed to 1 December 2020 for an online meeting due to the COVID-19 pandemic. The list of current ATFP representatives is in **Annex 4**.

Table 5: Meetings of the ATFP

Meeting	Host/Venue	Date
1st ATFP meeting	Philippines	June 2015
2nd ATFP meeting	Malaysia	February 2017
3rd ATFP meeting	Brunei Darussalam	April 2018
4th ATFP meeting	Myanmar	February 2019
5th ATFP Meeting	Cambodia (online)	April 2020 (postponed to 1 December 2020)
6th ATFP Meeting	Philippines (online)	30 June 2021

75. The ATFP has functioned as an important forum for the AMPS to report annually on the progress in implementing the APMS as well as coordinating the development of regional initiatives with partners to support the APMS implementation. ATFP is relatively unique compared to other ASEAN meetings in that the meetings have generally been mainly open to observers from GEC and development cooperation partners supporting the implementation of the APMS. This has been very useful in that the development cooperation partners can listen to the annual reports from AMS on progress in implementation of the APMS as well as discussions on priorities and challenges. This has helped the partners in the formulation of programmes and activities to support the APMS implementation.

c) ASEAN Transboundary Haze Pollution Control Fund

76.   The 2nd Meeting of the COP AATHP (COP-2) held in March 2007 in Brunei Darussalam agreed to establish the ASEAN Transboundary Haze Pollution Control Fund (ASEAN Haze Fund) by providing an initial target amount of USD 500,000 from the Parties. The COP-2 also adopted the Financial Rules for the ASEAN Haze Fund and the Implementation Plan for the Operationalisation of the ASEAN Haze Fund. The Financial Rules stipulated that the Fund shall be used to provide financial resources for the implementation of the ASEAN Haze Agreement and shall only be used for the following purposes:

   i.   Operational costs for emergency uses, i.e. when there is an imminent threat and a significant degree of transboundary haze pollution that requires fire suppression or other emergency response to be activated.
  ii.   Purchase of equipment or other assets for fire suppression or other emergency operation.
 iii.   Operational costs of approved projects under the ASEAN Haze Agreement.
  iv.   Operational costs for managing the ASEAN Coordinating Centre for Transboundary Haze Pollution.

d) Haze and hotspot information sharing by ASEAN Specialised Meteorological Centre (ASMC)

77.   The AMSC was given the mandate to serve as the designated regional centre for weather, climate, and haze monitoring, assessments, and weather outlooks. The ASMC also provides early warning on the occurrence of transboundary haze in the ASEAN region[28]. The early warning is issued in the form of an advisory according to a three-tier system (**Table 6**). The ASMC is the only agency in the region has been providing haze information. When assessing the risk of transboundary haze occurrence, ASMC takes into consideration factors including forecast of meteorological conditions (rainfall and prevailing winds, etc.), smoke haze density, and hotspot counts and location.

Table 6: Early warning three-tier system used by ASMC

Level 0 (Green)	No transboundary smoke haze/Stand down.
Level 1 (Yellow)	Dry season.
Level 2 (Orange)	Increasing risk of transboundary haze in the region: - Escalating hotspot activities with moderate to dense smoke haze observed over 2 or more consecutive days; - Dry weather persisting; - Prevailing winds blowing smoke haze from the hotspots towards neighbouring ASEAN countries.
Level 3 (Red)	High risk of severe transboundary haze in the region. - Significant and persistent hotspot activities with widespread moderate to dense smoke haze observed over 2 or more days; - Dry weather persisting; Prevailing winds blowing smoke haze from the hotspots towards neighbouring ASEAN countries.

78.   The hotspots depicted in the ASMC maps are derived from various National Oceanic and Atmospheric Administration (NOAA) satellites and they represent locations with possible active fires (**Figure 5**). NOAA's products and services support daily weather forecasts, severe storm warnings, climate monitoring to fisheries management, coastal restoration and supports marine commerce, as well as economic vitality[29]. Hotspots may go undetected due to cloudy

---

[28] Referred to ASMC website http://asmc.asean.org/asmc-alerts/
[29] NOAA website https://www.noaa.gov/about-our-agency

conditions or partial satellite pass. The hotspot information derived from satellite data reprocessed may differ slightly from that received near real-time but reprocessing is necessary for better quality data. In addition to NOAA, the ASMC is also providing hotspot information based on Moderate Resolution Imaging Spectroradiometer (MODIS) sensors i.e. Aqua and Terra and Suomi-NPP with satellite images available for download on the same website[30].
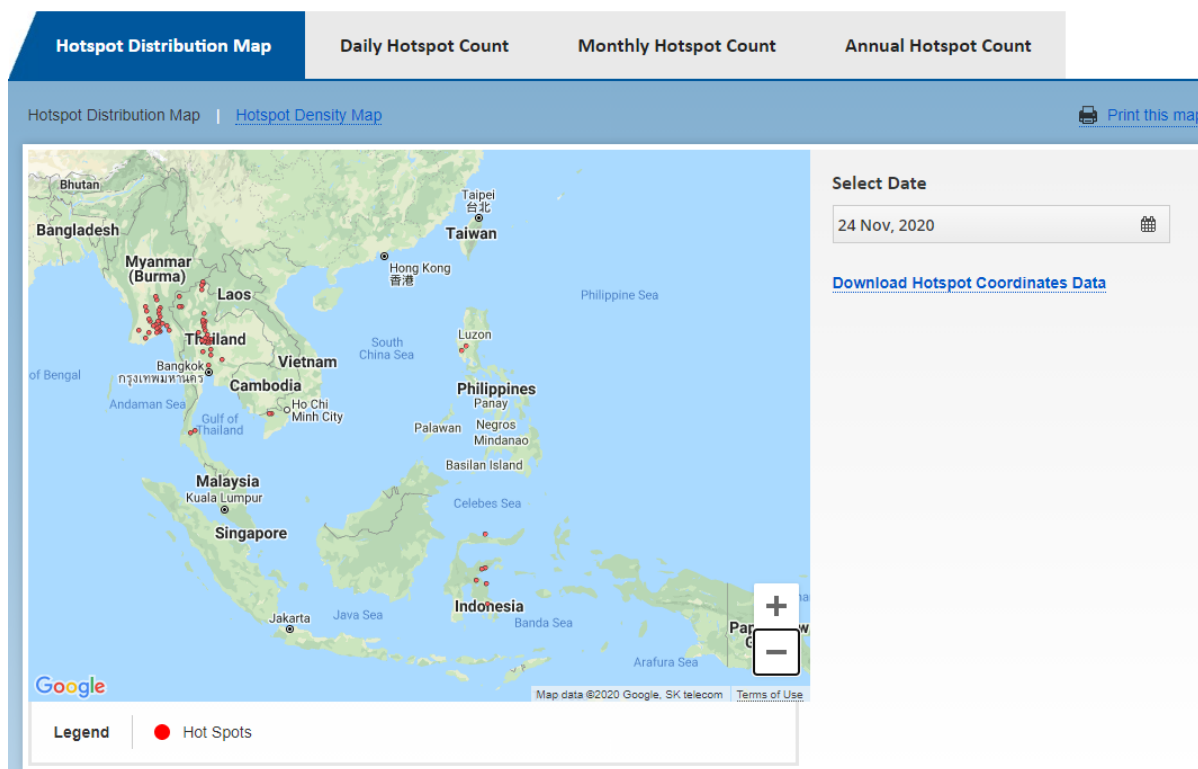
Figure 5: Hotspot information on map published on the ASMC website

79.   Besides the hotspot information, ASMC also provides regional haze map to support tracking of haze activities in the region (**Figure 6**). The regional haze map with wind blow direction and hotspot assist the readers/viewers to understand better the possible haze movement within the local and/or transboundary situation.

---

[30] https://wis.asmc.asean.org/wis/openwis-user-portal/srv/en/main.home

Alert Level 0 | End of Dry Season for the Northern ASEAN Region

Regional Haze Situation
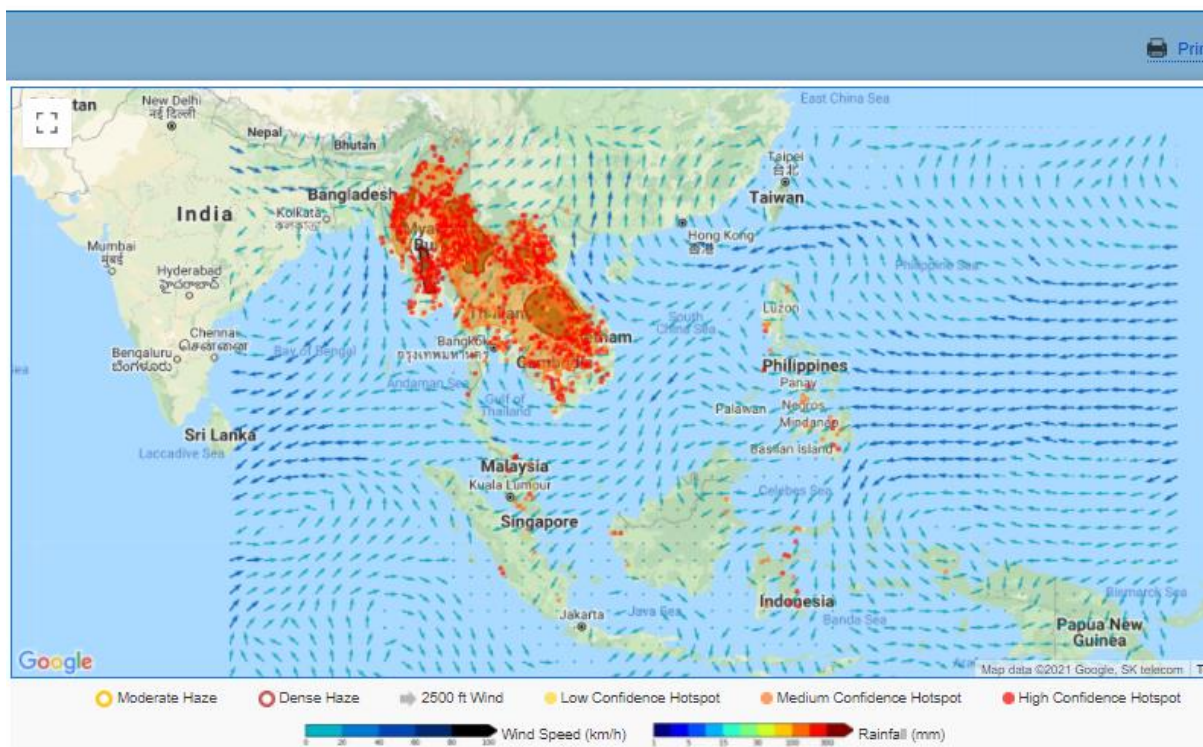
Figure 6: Example of Regional Haze Map produced by AMSC with alert level indicated above the map

e) Fire Danger Rating System in ASEAN

80.   Following the extensive fires and transboundary smoke haze in 1997, associated with a severe El Nino episode, ASEAN initiated the development of a Fire Danger Rating System (FDRS). In 1998, ASEAN approved the need for an early warning system in the Regional Haze Action Plan (RHAP) to prevent forest fires and its resulting haze through improved management policies and enforcement. In 1999, collaboration between Canadian International Development Agency (CIDA) and AMS with Canadian Forest Service (CFS) as an Executing Agency to develop the regional early warning system, first started in Indonesia then Malaysia[31,32]. Under the collaboration, CFS was running the FDRS for ASEAN region from Canada. In September 2003, CFS has asked Malaysian Meteorological Department (MET Malaysia) to take over the responsibility to run the regional FDRS from Malaysia[33]. The FDRS comprises two concepts, namely Fuel Moisture Concept and Fire Behaviour Concept, using weather data (**Figure 7**). The Fuel Moisture Concept allows the system tracks moisture content of three types of forest floor materials or fuels that have different drying rates: surface litter, loosely compacted duff and deep compact organic layers. These fuels are thought to be most

---

[31] Tanpipat, V. Thailand and Upper ASEAN Early Warning or Fire Danger Rating System. Presentation file for SUPA and MAHFSA Joint Regional Training to Strengthen Capacities of Northern ASEAN Member State on Peatland Assessment and Mapping, Fire Detection and Monitoring, 9 September 2020

[32] Mohamad Saad, A.Z. 2020. Malaysian Meteorological Department. Operational FDR in Malaysia and Association of Southeast Asia Nations. http://www.wamis.org/agm/meetings/wofire08/S2-Zaki_Malaysia.pdf

[33] Malaysian Meteorological Department website https://www.met.gov.my/iklim/fdrs/afdrs

critical to fire behaviour (**Table 7**)[34]. The FDRS also reflects current fire potential in relation with fire environment that consists of the surrounding condition, influences and modifying forces of topography, fuels and weather that determine the fire behaviour (**Table 8**)[35].
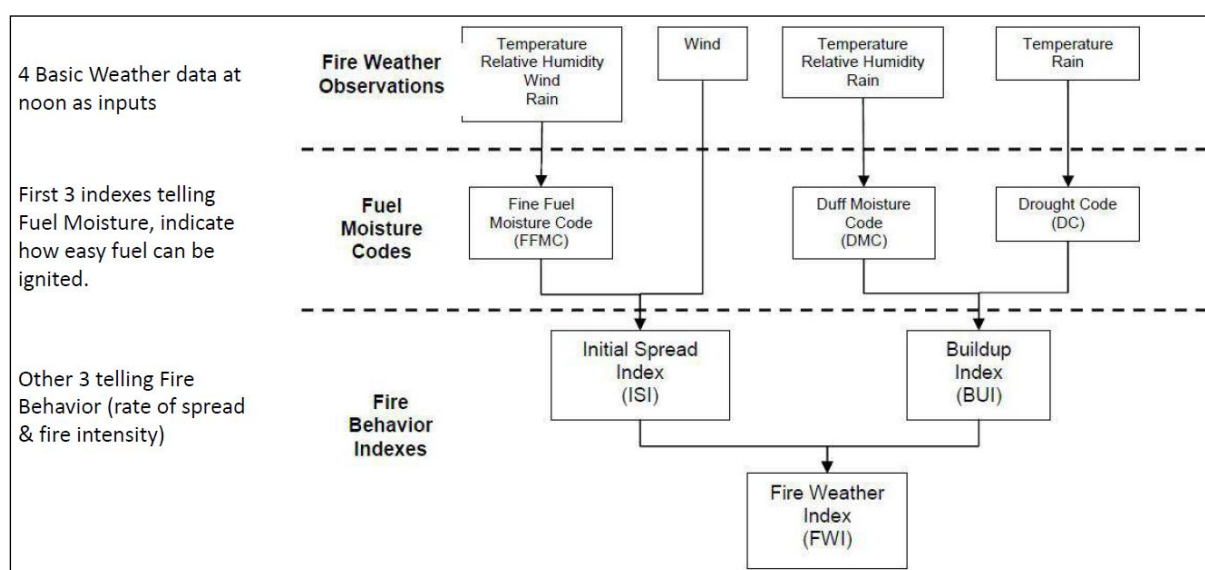
Figure 7: Structure of FDRS for ASEAN region[36]

Table 7: Three codes from the FDRS that represent Fuel Moisture Concept

Code	Description
Fine Fuel Moisture Code (FFMC)	Represents relationship of moisture content and ease of ignition (often used as an indicator of bush or grassland fires)
Duff Moisture Code (DMC)	Represents relationship of moisture content and the flammability of the duff layer (used as an indicator of fire risk in drained peatlands)
Drought Code (DC)	Represents relationship of moisture content and how it is an indicator of seasonal drought (often used as an indicator of risk for peat fires)

Table 8: Three indices produced by FDRS' Fire Behaviour Concept

Index	Description
Initial Spread Index (ISI)	This is a numerical rating of relative fire spread without the effect of slope or fuel consumption
Build Up Index (BUI)	It provides numerical rating of the amount of fuel available for combustion
Fire Weather Index (FWI)	It is a numerical rating of fire intensity. It is suitable as a general index of fire danger throughout the forested area in the region. Fire Danger is the ability of a fire to start, spread and do damage

---

[34] Malaysian Meteorological Department website https://www.met.gov.my/iklim/fdrs/afdrs
[35] *Ibid.*
[36] Derived from presentation of Veerachai Tanpipat, sourced from de Groot, 1988. Thailand and Upper ASEAN Early Warning or Fire Danger Rating System. Presentation file for SUPA and MAHFSA Joint Regional Training to Strengthen Capacities of Northern ASEAN Member State on Peatland Assessment and Mapping, Fire Detection and Monitoring, 9 September 2020

81.   Indonesia, Malaysia and Thailand, have been generating respective FDRS information for national reference and to support the regional level in different scale. Indonesia also generates FDRS codes and indices for provincial level with overlaid peat maps, as well as regional level for reference by neighbouring countries. Indonesia has also developed a national system that includes tracking of ground water level in peatland as one of key elements to tackle the peatland degradation and fire prevention measures. This system of Indonesia has incorporated additional parameters such as soil moisture, soil temperature and canal maps to generate more detailed site level fire risk information. Thailand in 2014 started calibration process with MODIS fire hotspots from Fire Information for Resource Management System (FIRMS)[37] and weather data from Global Fire Weather Database (GFWED)[38]. Development of FDRS is still in progress for Philippines. Some AMS have been using drones in their monitoring activities at local level. Rather few AMS have been using burn scar information to track the actual extent of fires – instead of using hotspot monitoring as a proxy for relative extent and frequency of fires.

f) ASEAN Guidelines on Peatland Fire Management

82.   At the regional level, AMS adopted the ASEAN Guidelines on Peatland Fire Management at the 11th Meeting of the COP to the AATHP held on 29 October 2015 in Hanoi, Viet Nam. The Guidelines were developed to serve as a reference for AMS in applying holistic Integrated Fire Management (IFM) approach coupled with Community-Based Fire Management (CBFiM) which includes prevention, preparedness, response, and recovery (PPRR). These Guidelines have stated that 70% of fire management resources should be allocated towards fire prevention efforts including reducing ignition sources on the ground and undertaking appropriate preventive measures especially on fire prone peatlands to avoid fire occurrence during prolonged dry season. Forecasting and advance planning for scenarios are crucial as preparedness as training of personnel and maintaining and resupplying adequate equipment for fire response, communication and site monitoring. If fire occurs at site, immediate response to small fires is the most cost effective approach to peatland fires; rapid response is only possible with pre-planning efforts and specialised equipment to be made available at site. After the fire incident, assessment is needed to evaluate the condition and prepare report on alleviating human, economic and environmental impacts. Subsequently, sites should be rehabilitated to restore hydrological conditions to prevent future fires. A regional training of trainers was co-organised by Singapore and Indonesia with technical support from GEC on 30 May – 1 June 2016 in Pontianak, West Kalimantan, Indonesia. This regional training was supported by the ASEAN Haze Fund, Governments of Indonesia and Singapore.

g) The Roadmap on ASEAN Cooperation towards Transboundary Haze Pollution Control with Means of Implementation

83.   The Roadmap (also known as ASEAN Haze-Free Roadmap) was developed by a task force consisting of senior officials and experts from AMS who are responsible for the fire management and transboundary haze pollution issues in the respective country, and invited experts and partners, for implementation from 2016 till 2020. The Roadmap serves as a strategic framework for implementation of collaborative actions to control transboundary haze pollution in the region. The overall goal of the Roadmap is to eliminate regional transboundary haze pollution through intensifying collective actions to prevent and control forest and/or land fires. It builds on the principle of the ASEAN Socio-Cultural Community (ASCC) Blueprint 2025 vision that aims for a sustainable community that promotes social development and

---

[37] https://firms.modaps.eosdis.nasa.gov/
[38] https://data.giss.nasa.gov/impacts/gfwed/

environmental protection, among others[39]. The strategies and indicators to measure progress of the Roadmap as in **Annex 2**.

84.   The Roadmap is currently being reviewed with the support of the ASEAN Haze Fund and the MAHFSA Programme. The overall objective of the review is to take stock progress in achieving the vision of a haze-free ASEAN. The expected output of the review is to produce a report that consists of a set of monitoring and evaluation guidelines and indicators agreed by AMS and developed based on the ASCC Blueprint 2025 Results Framework; and overall conclusions that state progress, area of improvement and recommendations in pursuing transboundary haze-free ASEAN and recommendations for a revised or renewed Roadmap.

h) Regional Climate Centre Network (RCC)

85.   World Meteorological Organisation (WMO) has undertaken a survey and found that a clear need for enhanced long-range forecast and climate monitoring for Southeast Asia. The Sixteenth Session of Regional Association V in May 2014 agreed to establish a Regional Climate Center (RCC) Network in the region; i.e. Southeast Asian sub-region network (SEA RCC-Network). The Network entered the demonstration phase in the second half of 2017 until official designation by WMO. Future plans for the RCC include provision of sub-seasonal-to-seasonal forecasts, development of new seasonal products, and further gridded data products[40]. The RCC is a Centre of Excellence that assists WMO members in the region to deliver climate services and products. As relevant climate processes often cross country borders, the RCC acts as an intermediary between Global Producing Centres (GPCs) at the global level and National Meteorological and Hydrological Services (NMHSs) at the national level. The RCC responsibilities are regional by nature and do not replace or duplicate work by the NMHSs. The WMO has mandated the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) to monitor climate information, Meteorological Service Singapore (MSS) to produce long-range forecasting and meteorological data for the region, and BMKG Indonesia to provide an operational data service. All these three agencies are sharing responsibility on training to provide information on methodologies and product specifications for mandatory RCC products and provide guidance on their use; and coordinate training for RCC users in interpretation and use of mandatory RCC products.

86.   Southeast Asia Climate Monitoring is a web application developed by PAGASA that provides operational and regularly updates information to help perform climate diagnostics including analysis of climate variability and extremes at regional and sub-regional scales; establish an historical reference climatology for the region and/or sub-regions; and implement a regional Climate Watch. The climate information includes rainfall, temperature, wind/SLP, sea surface temperature, typhoon tracks, runoff, soil moisture, vegetation health index, standard precipitation index and climate bulletin. MSS as Long-range Forecasting (LRF) Node to interpret and assess relevant LRF products from GPCs, distribute relevant information to RCC users and provide feedback to GPCs; generate regional and sub-regional tailored products relevant to user needs including seasonal outlooks; perform verification of RCC quantitative LRF products including the provision of basic forecasts on hindcast data; and generate outlooks, bulletins and 'consensus' statements on regional or sub-regional forecasts on monthly, quarterly and biannually bases. The products and services include rainfall outlook, temperature outlook, monthly El Nino or La Nina status, tropical cyclone outlook and latest

---

[39] Reference to the Roadmap on ASEAN Cooperation towards Transboundary Haze Pollution Control with Means of Implementation
[40] WMO RA V Southeast Asia Regional Climate Center Network. Available at: http://ccrs.weather.gov.sg/sea-rcc-network

ASEAN Climate Outlook Forum (ASEANCOF) Consensus[41]. BMKG is leading the function to develop regional climate datasets, gridded where applicable; and provide climate database and archiving services at the request of NMHSs. BMKG through its Southeast Asian Climate Assessment and Dataset (SACA&D) Project has been sharing information on changes in weather and climate extremes, as well as the daily dataset needed to monitor and analyse these extremes[42].

4.1.2 National Institutional Setting and Capacity for Coordination and Implementation

87.　There are a very wide range of different ministries and agencies in AMS with some role or responsibilities related to the management of peatlands, fire and haze. In order to implement policies and decisions, an administrative structure is necessary, and laws and regulations are also implemented within each country. In dealing with the management of natural resources, there are various jurisdictional aspects that may pose challenges between federal/central ministries and local agencies.

88.　All AMS have nominated a NFP or national institution for peatland and fire management and haze monitoring with support from various agencies. AMS with larger peatland areas (e.g. Indonesia and Malaysia) have specific programmes for peatland and fire management. Indonesia had setup the Directorate of Peatland Degradation Control (*Direktorat Pengendalian Kerusakan Gambut*/PKG) within Directorate General of Pollution Control and Environmental Degradation (*Direktorat Jeneral Pengendalian Pencemaran dan Kerusakan Lingkungan*/DITJEN PPKL) of the Ministry of Environment and Forestry (*Kementerian Lingkungan Hidup dan Kehutanan*/KLHK) to identify peatland ecosystems and its functions; develop Protection and Management Plan for Peat Ecosystems (RPPEG); rehabilitate hydrological function of peat ecosystems through canal blocking; implement community programme for rehabilitating peat ecosystems; and enhance synergy of rehabilitation of peat ecosystems in cultivated/developed area. PKG was nominated as the NFP for peatland matter. Another specialised agency i.e. Peatland Restoration Agency (*Badan Restorasi Gambut*/BRG[43]) was established in 2016 to focus on rewetting the 2 Mha of degraded peatland across seven prioritised peat provinces due to the massive peat fires that occurred in 2015. While in Malaysia, peatland matter has been under jurisdiction of Ministry of Energy and Natural Resources (*Kementerian Tenaga dan Sumber Asli*/KeTSA) including overseeing the implementation of the NAPP and National Policy on Biological Diversity 2016-2025 in which peatland restoration is incorporated as one of the Key Indicators. KeTSA is the NFP for peatland issues. The Department of Environment (DOE) of the Ministry of Environment and Water (*Kementerian Alam Sekitar dan Air*/KASA) as the NFP of COM AATHP has been coordinating national and state effort in preventing peatland and forest fires that links to smoke pollution through National Programme on Peatland Fire Prevention for Tackling Haze in Malaysia since 2009.

89.　Other AMS have specific mechanism to address peatland and fire management issues in their respective country. The Government of Thailand has set up a Forest Fire Control Unit under Department of National Park, Wildlife and Plant Conservation (DNP) in each province, with special support given to those provinces with extensive peatland areas. The Brunei Forestry Department's Disaster Management Committee Taskforce was established in 2017 to lead prevention, mitigation, preparedness, response and recovery measures including for forest fires. Philippines have National Steering Committee (NSC) or Task Force (TF) for

---

[41] WMO RA V SEA RCC-Network, Long-range Forecasting Node Demonstration Phase http://ccrs.weather.gov.sg/sea-rcc-lrf-node/
[42] Southeast Asian Climate Assessment and Dataset (SACA&D) website. http://sacad.database.bmkg.go.id/
[43] The Agency covers more scope starting in early 2021 and thus changed of name to Peatland and Mangroves Restoration Agency (Badan Restorasi Gambut dan Mangroves/BRGM)

peatland management. The agencies in the NSC are focusing on peatland management, policy and peatland assessment.

90.   For other AMS with smaller peatlands areas, such as Cambodia, Lao PDR and Myanmar have included peatland elements in a wider national plans and policies. Therefore, the agencies who have been working on peat and fire management are more commonly the agencies that handling environment, wetlands or biodiversity.

a) National Focal Points for related ASEAN Processes (list of agencies NMC and NFP for COM AATHP and ATFP)

91.   All AMS have respective national institutional setting for peatland management, as per nominated for ATFP (**Annex 4**), under the framework of the AATHP. The NFPs of the ATFP oversee and coordinate implementation of the APMS. Peatland management has never been a stand-alone responsibility of any one government agency, there have been many ministries and agencies sharing the responsibility and playing respective roles to manage the peatlands sustainably within the country. Similar with NFP for Peatlands, all AMS has nominated national institutional arrangements for fire and haze prevention management and monitoring.

92.   **Table 9** below lists the ministry or department nominated as NFP to represent each AMS for COM AATHP, ATFP and NMC for the AATHP. An analysis was done by using colour code to identify the similarities of nomination according to peatland, fire and haze management. Green indicates the same ministry or agency undertaking a lead role in the three functions, while the yellow indicates different ministries or agencies have been nominated.

Table 9: List of Ministry/agency of NMC, NFP of COM AATHP and ATFP of AMS

NFP of COM AATHP	NFP of ATFP	NMC
Brunei Darussalam		
Ministry of Development	Department of Environment, Parks and Recreation, alternate Forestry Department, Ministry of Development	Department of Environment, Parks and Recreation, Ministry of Development
Cambodia		
Department of Freshwater Wetlands Conservation, Ministry of Environment	Department of Freshwater Wetlands Conservation, Ministry of Environment	Ministry of Water Resources and Meteorology
Indonesia		
Directorate of Forest and Land Fire Management (DFLFM), Ministry of the Environment and Forestry (MOEF)	Directorate of Peatland Degradation Control, Ministry of the Environment and Forestry (MOEF)	Directorate of Forest and Land Fire Management (DFLFM), Ministry of the Environment and Forestry (MOEF)
Lao PDR		
Ministry of Agriculture and Forestry	Department of Water Resources, Ministry of Natural Resources and Environment (MONRE)	Meteorology and Hydrology Department, Ministry of Natural Resources and Environment (MONRE)
Malaysia		
Department of Environment, Ministry of Environment and Water (KASA)	Ministry of Energy and Natural Resources (KeTSA)	Department of Environment, Ministry of Environment and Water (KASA)

NFP of COM AATHP	NFP of ATFP	NMC
Myanmar		
Environmental Conservation Department (ECD), Ministry of Natural Resources and Environmental Conservation (MONREC)	Environmental Conservation Department (ECD), Ministry of Natural Resources and Environmental Conservation (MONREC)	Department of Meteorology and Hydrology, Ministry of Transport
Philippines		
Department of Environment and Natural Resources (DENR)	Biodiversity Management Bureau (BMB), Department of Environment and Natural Resources (DENR)	Forest Management Bureau, Department of Environment and Natural Resources (DENR)
Singapore		
National Environment Agency	National Environment Agency	Meteorological Service Singapore, National Environment Agency
Thailand		
Pollution Control Department (PCD), Ministry of Natural Resources and Environment (MNRE)	Department of National Park, Wildlife and Plant Conservation (DNP), Ministry of Natural Resources and Environment (MNRE)	Department of National Park, Wildlife and Plant Conservation (DNP), Ministry of Natural Resources and Environment (MNRE)
Viet Nam		
Forest Protection Department, Ministry of Agriculture and Rural Development (MARD)	Forest Protection Department, Ministry of Agriculture and Rural Development (MARD)	Centre for Environmental Monitoring, Ministry of Natural Resources and Environment (MONRE)

Full details of the National Focal Points are given in **Annex 3, 4 and 5**.

93.   In summary, none of the AMS has nominated the same department to represent the country as NFP for COM AATHP, ATFP and NMC. Five (5) AMS namely Brunei Darussalam, Indonesia, Philippines, Singapore and Thailand have nominated different departments under the same Ministry (Ministry of Development for Brunei Darussalam, MOEF for Indonesia, DENR for Philippines, National Environment Agency for Singapore and MONRE for Thailand) as NFP and NMC, in relation to peatland, fire and haze management in their respective countries. There are 4 AMS with NMCs in different ministries to the NFPs (i.e. Cambodia, Lao PDR, Myanmar and Viet Nam). There are 2 AMS with ATFP NFPs in different ministries to the AATHP NFPs (i.e. Lao PDR and Malaysia). Only 2 of the AATHP NFPs are from the same ministerial department as the NMC, namely Indonesia (i.e. DFLFM of MOEF) and Malaysia (i.e. Department of Environment of KASA). This complex arrangement is in relation to different national institution arrangements and respective mandate by national laws and regulations in each AMS. This complexity leads to challenges in coordination, information sharing and reporting at both national and regional levels. This also may pose potential gaps in sharing feedback from respective ASEAN level meetings to the national level.

4.2 Regional Monitoring and Early Warning Systems

94.   Two key monitoring and early warning information types currently being used in the ASEAN region in relation to fires and haze are hotspot data and FDRS warnings. The CDNGA has gathered information on the current types and extent of use of hotspot tracking and FDRS being used by AMS and regional entities including the NFPs for AATHP and ATFP, NMCs and other agencies. The analysis also uses information on which dataset have been used and referenced by respective AMSs. This section will update the preliminary assessment result undertaken in 2019 (**Annex 1**). More information about data catered at national level by each AMS is provided in the respective country profile (**Annex 6**).

95.   ASEAN is a region with specific issues such as peat forest fires, land forest fire and transboundary haze. Therefore, several monitoring systems have been developed in relation to these issues to provide information such as hotspot, weather forecast and fire risk, which geographically focusing within the region. Several systems that have been providing regional early warning information related to forest fire and haze are ASMC, BMKG, LAPAN, DNP, GISTDA and MET Malaysia (**Table 10**).

Table 10: Regional prediction, warning and monitoring system available in ASEAN

	ASMC ASEAN SPECIALISED METEOROLOGICAL CENTRE	ASMC
	BADAN METEOROLOGI, KLIMATOLOGI, DAN GEOFISIKA BMKG Cepat, Tepat, Akurat, Luas, dan Mudah Dipahami	BMKG
	LEMBAGA PENERBANGAN DAN ANTARIKSA NASIONAL National Institute of Aeronautics and Space of Indonesia	LAPAN
	Forest Fire Control Forest Protection and Fire Control Office Department of National Parks,Wildlife and Plant Conservation	DNP
	GISTDA สำนักงานพัฒนาเทคโนโลยีอวกาศและภูมิสารสนเทศ (องค์การมหาชน)	GISTDA
	OFFICIAL WEBSITE OF MALAYSIAN METEOROLOGICAL DEPARTMENT METMalaysia MINISTRY OF ENVIRONMENT AND WATER	MET Malaysia

96.   **Table 11** summarizes hotspot and FDRS information provided by these main regional systems. Generally, these are efficient systems that providing hotspot and FDRS information for the region. A "Hotspot" is a satellite image pixel that has a higher temperature compared to its surroundings as determined through analysis of satellite data. The pixel is represented as a point with specific coordinates and is used as an indicator to forest fire occurrences. Thermal anomalies exploited by fire detection algorithms cannot 100% determine whether a particular

pixel observed by the satellite sensor is or not be associated with a forest fire but is a potential fire (**Figure 8**). The main providers of the regional hotspot information are ASMC and BMKG/LAPAN. The hotspot information is available in near-real time and updated frequently depending on the time of the overpass of the respective satellites. It is available in various spatial resolutions and shared to public through an official website.

97.   FDRS is an early warning system necessary in predicting fire risk. The ASEAN FDRS was developed in the year 2000, based on Canadian Forest Fire Danger Rating System. BMKG and MET Malaysia are the main providers of FDRS warnings covering the ASEAN region. The FDRS in ASEAN was developed mainly based on the local conditions in southern ASEAN sub-region (i.e. weather, temperature and rainfall conditions leads to start of fires). The algorithms are particularly adapted to suit the situation in Sumatra, Borneo and Peninsular Malaysia which are near the equator and naturally do not have long dry seasons but are susceptible to large-scale peatland fires following relatively short dry periods. They are less suited to the Mekong region which naturally experience longer dry seasons and the landscapes can withstand longer dry periods without great increases in fire danger. This has meant that the FDRS information generated by MET Malaysia and LAPAN/BMKG have tended to overestimate the fire risk in Northern ASEAN sub-region. As a result, DNP Thailand has developed a refined FDRS that is more appropriate for the Northern ASEAN sub-region.

Table 11: Summary of hotspot and FDRS related information offered by regional systems in their respective website

Hotspot			
	ASMC	**BMKG/LAPAN**	**GISTDA**
Coverage	ASEAN	Indonesia	Northern ASEAN region
Satellite (Sensor)	• Aqua (MODIS) • Terra (MODIS) • Suomi-NPP (VIIRS) • NOAA20 (VIIRS)	• Aqua (MODIS) • Terra (MODIS) • Suomi-NPP (VIIRS) • NOAA 20 (VIIRS) • Himawari-8 • Landsat-8 (OLI)	• Aqua (MODIS) • Terra (MODIS) • Suomi-NPP (VIIRS)
Temporal update	Frequent	Frequent	Frequent
Spatial resolution	• 1km (MODIS) • 375m (VIIRS)	• 1km (MODIS) • 375m (VIIRS) • 2km (Himawari-8)	• 1km (MODIS) • 375m (VIIRS)
Downloadable	Yes	Yes	Yes
Access to archive data	Yes	Yes	Yes
Type of shared hotspot data	Text file and static map	KML and excel format	Static map, shapefile GIS format, excel format
Language	English	English/ Malay	Thai
FDRS				
	ASMC	**BMKG/LAPAN**	**DNP**	**MET Malaysia**
Coverage	ASEAN (link to MET Malaysia)	ASEAN	Northern ASEAN region	ASEAN
Future Forecast for FDRS	No	7 days	5 days	No
Access to archive data	No	Yes	Yes	No

Hotspot				
	ASMC		**BMKG/LAPAN**	**GISTDA**
Type of shared FDRS data	Static map	Static map	Vector file in Google Earth format (Keyhole Markup Language (KML) format)	Vector file in Google Earth format (KML format)
Language	English	English/Bahasa	English/Thai	English/Malay
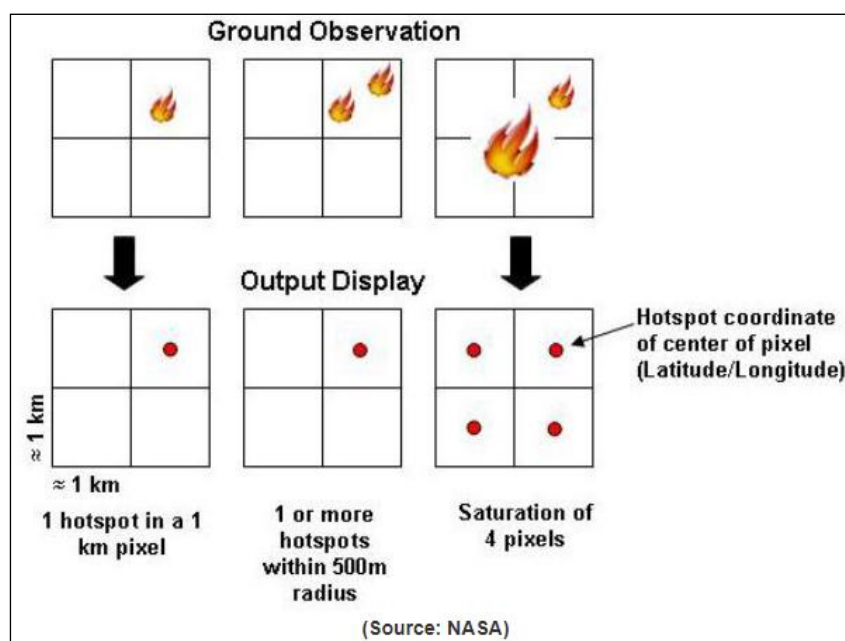
Figure 8: Hotspot identification by ASMC (Source: ASMC website)

4.2.1 Regional Systems

98.   A number of regional systems have been established to provide and disseminate hotspot as well as FDRS information as follows:

a) ASMC

99.   ASMC or ASEAN Specialised Meteorological Centre is a regional meteorological centre established in January 1993. It was established through an ASEAN regional programme hosted by Meteorological Service Singapore under National Environment Agency of Singapore. The Meteorological Service Singapore hosts the ASMC which serves as the designated regional centre for monitoring and assessing land/forest fires and smoke haze and providing early warning of transboundary smoke haze in the region. The alerts are disseminated through the ACC THPC, which is currently provided on an interim basis by the ASEC. ASMC's remit also covers research and development in tropical weather, climate systems, climate variability/change and regional capability building. ASMC's Regional Capability Building Programme aims to help AMS address the evolving needs and challenges in four key areas namely weather forecasting, sub-seasonal to seasonal prediction, climate projections and fire/smoke haze monitoring.

100.   ASMC leverages the latest satellites from the United State of America, Japan, Korea and China to improve the detection of land fires/smoke haze. It also operates an advanced dispersion modelling system customised for the Southeast Asia region to forecast the transport of smoke haze. ASMC offers several hotspot options from sensor of the MODIS and Visible Infrared Imaging Radiometer Suite (VIIRS) covering ASEAN region. Real-time hotspot information is being updated daily at 0200, 0500 and 0900 Coordinated Universal Time (UTC) (depend on the alert level in early warning three-tier system, **Table 6**). The MODIS sensor aboard Terra[44] and Aqua[45] satellites provides hotspot with 1km spatial resolution with 4 revisits daily. VIIRS sensor aboard Suomi-NPP and NOAA-20 satellites provide hotspot with 375m spatial resolution and 4 revisits daily. Generally, most of the analyses undertaken by ASMC are based on NOAA-20. ASMC also provides daily regional haze projection and linking the regional FDRS information to MET Malaysia website.

b) BMKG/LAPAN

101.   BMKG or *Badan Meteorologi, Klimatologi dan Geofisika* is an Indonesian government agency that provides information on meteorology, climatology and geophysics based in Jakarta. It has a long history that started as an individual observation in 1841. The agency changed its name several times and has been known as BMKG since 2008. Its main function is to provide information of weather, climate, air quality, earthquake and tsunami, forest fire, tropical cyclone and fire danger rating. BMKG produces wide range of weather-related information compared to other systems in ASEAN. This is to meet the domestic needs in facing various natural phenomena in Indonesia such as tsunami, volcano eruption, seismic activity and earthquake threat. Information being monitored and produced by BMKG is being integrated by MOEF for further fire prevention measures.

102.   BMKG also offers several national hotspot options from MODIS and VIIRS that have been processed and shared by National Institute of Aeronautics and Space (*Lembaga Penerbangan dan Antariksa Nasional*/LAPAN)[46]. Additional hotspot information processed by BMKG is from Himawari-8 covering Indonesia. As mentioned earlier The MODIS sensor provides hotspots with 1km spatial resolution while the VIIRS sensor provides hotspots with 375m spatial resolution. Himawari-8 satellite is a geostationary satellite sitting above Southeast Asia that provides hotspot with 2km spatial resolution and temporal resolution every 10 minutes. BMKG also provides haze projection for Indonesia. BMKG shared national and regional FDRS information with 7 days forecast[47].

103.   LAPAN is an Indonesian government space agency established in 2013. BMKG and LAPAN are two important agencies that compliment fire prevention and monitoring in Indonesia and provide additional information for regional use. There are four main areas being conducted by LAPAN, which are remote sensing, aerospace technology, space science, and aerospace policy. LAPAN is an agency responsible to acquiring, processing and analysing of remote sensing data followed by dissemination of the information to relevant ministries, agencies and public. In dealing with disaster, LAPAN committed to provide the space-based information especially in the context of preparedness and emergency response. LAPAN provides fire prevention monitoring information related to drought, fire hotspot, climate monitoring and prediction. Hotspot information is being shared through official website and mobile application and is being integrated by MOEF for further fire prevention measures. LAPAN also shares hotspot information of MODIS and VIIRS to BMKG.

---

[44] Terra is in a circular sun-synchronous polar orbit that takes it from north to south (on the daylight side of the Earth) every 99 minutes (Source: https://terra.nasa.gov/about)

[45] Aqua was formerly named EOS PM, signifying its afternoon equatorial crossing time (Source: https://aqua.nasa.gov/)

[46] http://103.51.131.166/guide/Panduan%20Website%20LAPAN%20Fire%20Hotspot%20v2.0%20(Juli%202020).pdf

[47] https://www.bmkg.go.id/cuaca/kebakaran-hutan.bmkg?index=dc&wil=kalteng&day=obs

104.   LAPAN offers several real-time hotspot options from sensors of MODIS, VIIRS and Operational Land Imager (OLI) covering ASEAN region[48]. The OLI sensor aboard satellite of Landsat-8 provides hotspot with 30m spatial resolution and temporal resolution every 16 days. A mobile application called Pandora has been developed by LAPAN to provide FDRS information, but the FDRS information is not currently shared on the LAPAN website.

c) DNP/GISTDA

105.   DNP or Department of National Park, Wildlife and Plant Conservation is an agency under Ministry of Natural Resources and Environment (MNRE) of Thailand, established in 2002. Its main focuses are in conservation, promotion and restoration of natural resources, wildlife and plants in forest areas. One of the issues being managed by the Department is to respond to natural disasters and climate change. FDRS was introduced to Thailand in 1980s and in 1996 the system was used in dry dipterocarp forest at Doi Suthep-Pui National Park. A preliminary study was undertaken to demonstrate Fire Weather Index (FWI) calibration was done in Thailand. In 2015, DNP started the daily operation at Geo-Informatics Division and presented to Prime Minister at Government House under the Ministry of Science and Technology. In 2016, DNP informed all related agencies that there was funding to enhance the system. In 2019, the system was moved to Forest Fire Control Division to handle issues related to forest fires, then in 2020 Thailand initiated a back-up system at Fire Control Division, Royal Forestry Department.

106.   The DNP worked collaboratively with support from university and research institutes to establish a FDRS to support northern ASEAN sub-region to undertake prevention measures from fires. Through DNP website, relevant information shared to public about FDRS covering 5 countries, namely Cambodia, Lao PDR, Myanmar, Thailand and Viet Nam. Inputs to FDRS are measured from MODIS and forecasted weather data by Hydro-Informatics Institute at 3 km grid resolution. The early warning system was developed with a prediction of 5 days. The data is provided in vector file in Google Earth format (i.e. Keyhole Markup Language (KML) format) for easy analysis.

107.   Apart from DNP, the Geo-Informatics and Space Technology Development Agency (GISTDA), a national monitoring system under the supervision of the Ministry of Science and Technology, provides fire related information from remote sensing and GIS analysis. Fire hotspots covering northern ASEAN sub-region from MODIS information are updated 4 times daily while VIIRS from Suomi-NPP are updated twice daily. Air quality observation from Particulate Matter 2.5 micrometers (PM2.5) and interactive wind direction information are among the datasets offered in this system. There is also a comprehensive statistical analysis report provided in Portable Document Format (PDF) for public access. However, the website is only available in Thai language which complicates the communication process in the sub-region.

d) Malaysian Meteorological Department (MET Malaysia)

108.   MET Malaysia or Malaysian Meteorological Department is the agency responsible for the provision of meteorological services, climate and geophysics in Malaysia. Among the services offered are weather forecast, earthquake, surface observations and climate. Regional FDRS for early warning information provided was developed through regional cooperation since 2003. The inputs to national FDRS are being collected from 168 local weather stations in Malaysia. Regionally, MET Malaysia has been collecting data from 250-300 principal meteorological stations to generate FDRS information for the region[49]. However, Cambodia is

---

[48] From Questionnaire feedback LAPAN cover ASEAN. However, investigation found it only cover Indonesia. http://modis-catalog.lapan.go.id/monitoring/#
[49] http://www.columbia.edu/~rf2426/index_files/deGrootetal2006MITI.pdf

not included in the FDRS calculation due to no weather information being uploaded to the WMO platform by the country. Prediction of FDRS for 3 days at once was available, however, the feature was stopped and it is currently under development/refinement. The FDRS information has been disseminated or linked to other relevant agencies including ASMC and Environment Division of the ASEC. Daily data is available in picture file and vector file in Google Earth format (i.e. Keyhole Markup Language (KML)) for easy analysis and reference. However, no archive and prediction data is currently available. Sometimes, the FDRS shared in vector file in Google Earth format (i.e. the KML) is also overlaid with hotspot layer.

4.2.2 Data Monitoring Practices in the Region

a) Hotspots

109.   Hotspot is a satellite pixel information with significantly higher temperature than the surrounding which indicating a heat source and a potential of fire activity. There are several hotspot sources available with geographically focusing to the ASEAN region. The main providers of regional hotspot information are ASMC and LAPAN. These systems provide hotspot information from several sensors at various scales and frequent update. The information is publicly available through the respective agencies' official websites.

110.   **Table 12** shows hotspot information source and utilisation by AMS. Most AMS refer to ASMC for hotspot information. ASMC provides daily hotspot information with a comprehensive analysis and projection for the region. Several AMS have national capacity to analyse hotspot information. However, Lao PDR and the Philippines have low exposure to forest fire hotspot information. As a country without peatland, Singapore has been supporting the region on enhancement of the hotspot monitoring and collaborating in capacity development.

Table 12: Information type on hotspot used by AMS

Country	Current hotspot information source	How is hotspot information used
Brunei Darussalam	Pending	Pending
Cambodia	• ASMC	• Ground verification and suppression with patrollers • Inform stakeholders and site managers within protected area under the mandate of MOE • Technical report to decision maker • Guidance in fire prevention and patrolling
Indonesia	• LAPAN • MOEF	• Ground verification and suppression with Integrated Prevention Patrol Programme • Inform stakeholders at local and national level • Technical report to decision maker • Further analysis and scientific research to improve data and information quality
Lao PDR	No information was used	No information was used
Malaysia	• ASMC • FIRMS • FORFIS	• Ground verification and suppression with patrollers • Inform stakeholders at local and national level • Technical report to decision maker • Integrate with GIS for further analysis[50]

---

[50] https://enviro2.doe.gov.my/ekmc/wp-content/uploads/2019/07/Modul-5-6-PEMANTAUAN-PT-HOTSPOT-PELAPORAN.pdf

Country	Current hotspot information source	How is hotspot information used
Myanmar	• ASMC • FIRMS	• Ground verification and suppression with patrollers • Inform stakeholders at local and national level • Technical report to decision maker • Integrate with GIS for further analysis
Philippines	• ASMC	No input from Philippines
Singapore	• ASMC	Analyse, assess and disseminate regional haze situation for national/regional level
Thailand	• ASMC • GISTDA	• Ground verification and suppression with patrollers • Inform stakeholders at local and national level • Technical report to decision maker • Integrate with GIS for further analysis and scientific research
Viet Nam	• ASMC • FireWatchVN[51]	• Ground verification and suppression with patrollers • Inform stakeholders at local and national level • Technical report to decision maker • Integrate with GIS for further analysis

111.   Most AMS use hotspot information to trigger action such as ground verification and suppression activity with field patrolling team. The information has also been shared with stakeholders at local and national levels. Hotspot information as an important input to technical report has been provided to decision makers for appropriate immediate actions or measures to be undertaken by related stakeholders. Further analysis has also been undertaken on the hotspot information by integrating with GIS.

112.   Cambodia refers to ASMC for hotspot information. The information shared with stakeholders and site managers within protected area under the mandate of MOE. Analysis from hotspot is also being used as guidance in fire prevention and patrolling.

113.   Indonesia has established fire information system developed by MOEF (http://sipongi.menlhk.go.id/home/main), which shares important information on daily, monthly and annual hotspot counts as fire indicators for the whole Indonesia in the form of data, graphs and maps. For fire indicators, all fire related institutions in Indonesia use hotspot data source from LAPAN.

114.   Malaysia refers to ASMC, FIRMS and Forest Fire Information System (FORFIS) for hotspot information. FORFIS is a national system developed by Malaysia Centre of Remote Sensing (MACRES) for patrolling activity reference. The system provides analysis of satellite image and haze occurrences information that accessible by relevant agencies. The hotspot count is being used to activate national SOP for prevention of peatland fire.

---

[51] Le, T.H., Nguyen, H.C., Nguyen, N.H., Bui, Q.H., Nguyen, T.N.T., Nguyen, T.T., Nguyen, B.T., Do, K.P., Nguyen, V.D., Phan, V.T. and Pham, T.T. 2014. A Review of Forest Fire Information Technologies in Vietnam. https://www.researchgate.net/publication/317871188_A_Review_of_Forest_Fire_Information_Technologies_in_Vietnam; https://www.restec.or.jp/geoss_ap1/materials/PDF/ForestFire/2day/2day_8_Hien.pdf

115.   Myanmar refers to ASMC and FIRMS for hotspot information. ECD has been recording daily hotspot information from ASMC and FIRMS. Further GIS analysis undertaken by overlaying the hotspot with National Land Use Map. The information has been used as input to monthly information and being shared with other relevant ministries.

116.   Thailand refers to ASMC and GISTDA for hotspot information. It provides analysis for various application including forest fire monitoring and hotspot. It is publicly accessible (at http://fire.gistda.or.th/) but currently only available in Thai language.

117.   Viet Nam refers to ASMC and FireWatchVN for hotspot information. FireWatchVN is a national system for early detection of hotspots from VIIRS, MODIS and Feng Yun. It also provides fire risk information. It is publicly accessible at http://firewatchvn.kiemlam.org.vn/gioi-thieu. The information is being used to support national rangers and relevant agencies in forest fire prevention measures. The system provides fire alarm notification to relevant agencies through short message service (SMS) and email.

118.   Trends of hotspot detected in the region and the analysis provided in **Annex 7**.

b) FDRS

119.   Although almost all AMS are practicing hotspot monitoring, there is lesser use of FDRS. The findings from questionnaire are shown in **Figure 9**. From the inputs provided by AMS, most countries in the Mekong region have been referring to DNP for FDRS information. Only Malaysia and Singapore have been referring to MET Malaysia. Indonesia and Singapore have been referring to FDRS from BMKG/LAPAN. However, based on the feedback/input from the AMS, four countries (namely Cambodia, Myanmar, Philippines and Viet Nam) are not practicing FDRS monitoring or only to a limited extent.
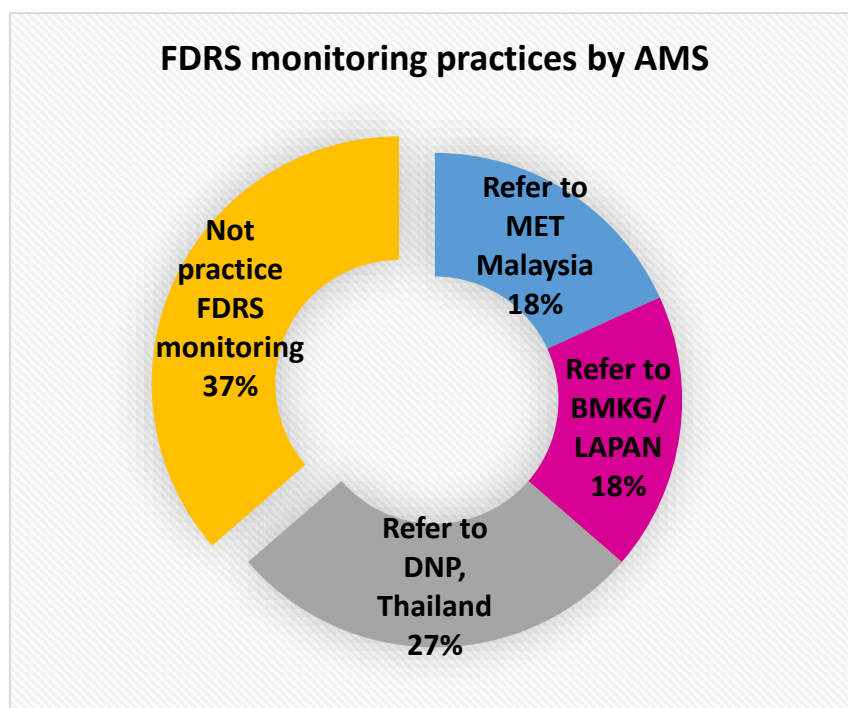

Figure 9: Proportion of FDRS monitoring activity by AMS

c) Air quality

120.   Transboundary haze is one of the major sources of air pollution in the region. To overcome the problem, air pollution monitoring is very important. **Table 13** shows air quality monitoring capacity by relevant agency in AMS – not all AMS has the capacity in air quality monitoring. Several AMS such as Lao PDR and Myanmar have yet to establish air quality monitoring system. In other hand, air quality monitoring system is relatively new in Viet Nam. Since it is still in the development phase, the number of air quality monitoring station is increasing over time[52]. However, the distribution of ground-based air quality monitoring stations in Viet Nam is focusing mainly in Hanoi and were not well distributed across the country yet. Therefore, increases the challenge in monitoring the occurrence of transboundary haze. For Indonesia, air quality information retrieved through a network of 75 active monitoring stations. However, the number of stations equipped with PM2.5 monitoring is still very low in comparison to the size of the country.

121.   The established systems in AMS have been updated either hourly or daily. Most of the countries with established systems disseminate the information to the public through official platforms. From **Table 13**, some of the countries do not have the capacity and specific platform to disseminate air quality information. The systems used to measure the air quality are varies between countries. This shows that the region has yet a harmonised information system and generally has low capacity in air quality monitoring.

Table 13: Information by national agencies related to air quality capacity

Country	Monitoring station	Parameter measured	Website	Update frequency	System
Brunei Darussalam	7	PM10, PM2.5	http://www.env.gov.bn/Theme/Home.aspx	Daily	Pollutants Standards Index (PSI)
Cambodia	41	O3,CO, NO2, SO2, PM10, PM2.5, VOC	https://www.facebook.com/ Ministry-of-Environment-314699302002531/	Daily	Air Quality Index (AQI)
Indonesia	46	O3, NO2, SO2, PM10, PM2.5, Rainwater Chemistry, GHG, Suspended Particulate Matter (SPM)	http://iku.menlhk.go.id/map/ and https://www.bmkg.go.id/kualitas-udara/informasi-partikulat-pm25.bmkg	Hourly	Air Pollution Standard Index (PSI) or *Indeks Standard Pencemar Udara (ISPU)*
Lao PDR	Not routinely performed	Not routinely performed	Not routinely performed	Not routinely performed	Not routinely performed
Malaysia	68	O3,CO, NO2, SO2, PM10, PM2.5	http://apims.doe.gov.my/	Hourly	Pollution Standard Index (PSI)
Myanmar	2	O3,NO2, SO2, PM10, PM2.5	None	Hourly	National Ambient Air Quality Standards (NAAQS)

---

[52] Referred to https://www.rmit.edu.au/about/our-values/sustainable-development-goals/goal-3/air-quality-monitoring-stations-vietnam
https://www.envea.global/hanoi-11th-air-quality-monitoring-station-installed-at-french-embassy/
https://www.giz.de/en/worldwide/75901.html

Country	Monitoring station	Parameter measured	Website	Update frequency	System
Philippines	94	O3, CO, NO2, SO2, PM10, PM2.5	https://air.emb.gov.ph/	Daily	Air Quality Index (AQI)
Singapore	22	O3, CO, NO2, SO2, PM10, PM2.5	https://www.haze.gov.sg/ and https://www.nea.gov.sg/index	Hourly	Pollutant Standard Index (PSI)
Thailand	111	O3, CO, NO2, SO2, PM10, PM2.5	http://air4thai.pcd.go.th/webV2/region.php?region=0	Hourly	Air Quality Index (AQI)
Viet Nam	34	O3, CO, NO2, SO2, PM10, PM2.5	https://moitruongthudo.vn/	Daily	Air Quality Index (AQI)

d) Extent of peatlands and peatlands affected by fire (burned area mapping)

122.   The extent of most of the peatlands in the ASEAN region has largely been determined especially for the lowland peatlands. Atlases of Peatlands were developed for key regions of Indonesia (Sumatera, Kalimantan and Indonesian Papua) in 2005-2008. Some significant gaps include upland and montane peatlands which have been little studied in the region (and are estimated to be in the region of 2-3 Mha) and also peatlands in the Mekong countries (Cambodia, Lao PDR and Myanmar) and Philippines where more than 20 new peatlands covering about 20,000ha have been identified since 2006. Peatland mapping in Indonesia has been completed since 2011 at a scale of 1:250,000 with the extent of peatland approximately 15-20 Mha, within 865 peatland hydrological units (PHUs) covering 24,667,804 ha, distributed particularly in big islands of Sumatera, Kalimantan, Sulawesi and Papua. The countries in northern ASEAN sub-region, i.e. Cambodia, Lao PDR and Myanmar which generally have smaller peatlands (which are nonetheless important for biodiversity and conservation reasons), are mainly still in the stage of assessment and mapping of their peatlands.

123.   **Figure 10** shows findings from the questionnaire related to extent of peatlands data and its utilisation within the region. Extent of peatland data and its utilisation are generally high for AMS with significant peatland area such as Indonesia and Malaysia. Cambodia, Lao PDR, Myanmar and Viet Nam have low extent of peatland data and mostly recorded low utilisation of the data. As a country with no peatlands, the assessment is not applicable for Singapore. In the other hands, no feedback received from Brunei Darussalam.

Figure 10: Extent of peatland data availability and its utilisation by AMS

124. **Figure 11** shows the findings from the questionnaire related to extent of peatlands affected by fire or burned area. Information availability on peatlands affected by fire and its utilisation in AMS are assessed in this exercise. The findings show there are generally high availability and utilization of burned area information for AMS with significant peatland area such as Indonesia and Malaysia. However, the information is relatively in medium and low levels in other AMS. This indicates that most AMS apply medium to low practice of burned area monitoring and assessment. Some AMS such as Cambodia depend on manual observation of ground estimate from field patroller to assess the burned area. Many AMS have limited technical capacity to assess burned area information. As a country with no peatlands, the assessment is not applicable for Singapore, and pending feedback from Brunei Darussalam.

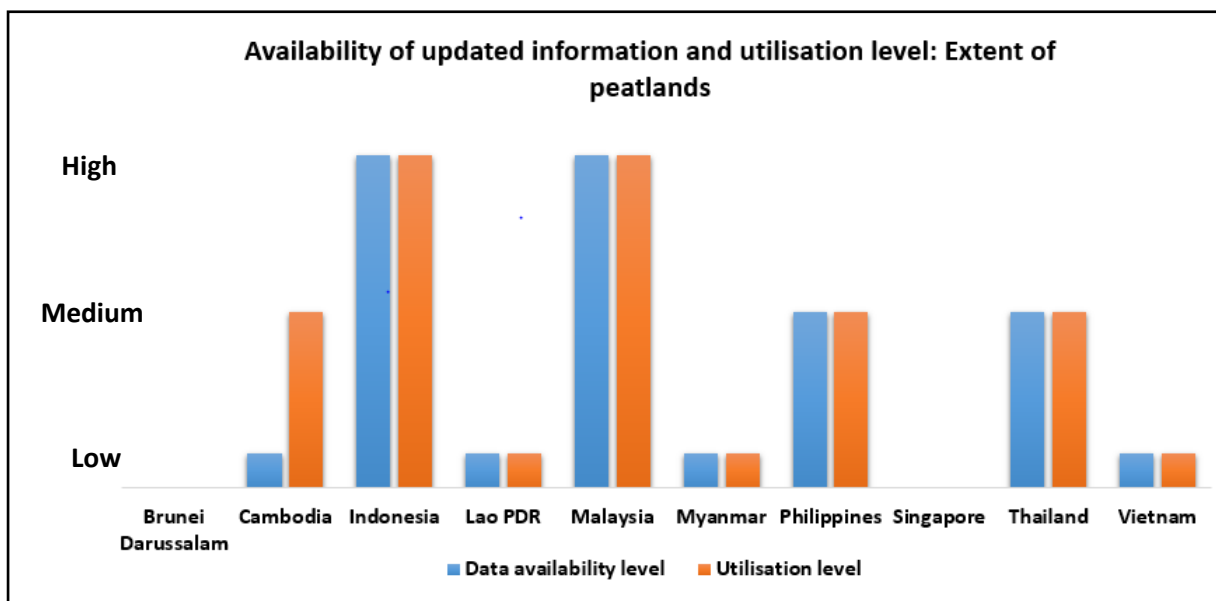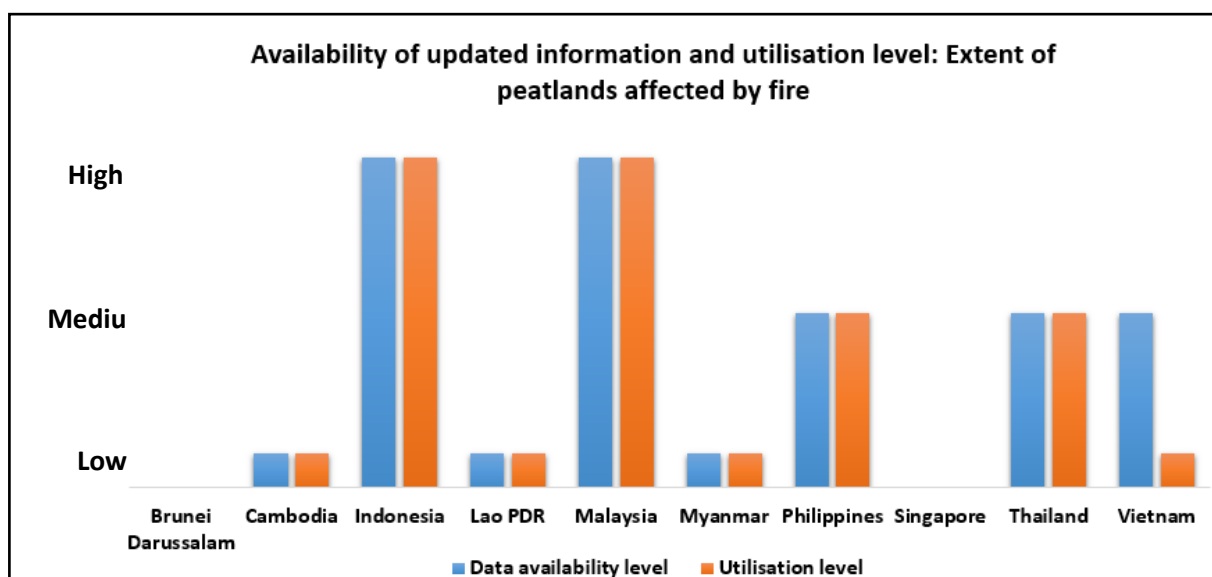**Figure 11**: Availability of information and utilization level in AMS for extent of peatlands affected by fire.

4.3 Overall Review of Priorities of AMS for Peatland and Fire Management

125.   The priorities for peatland and fire management in the ASEAN region have been set by the AMS in the framework of two sets of documents:
   a) APMS and the associated APSMPE; and
   b) ASEAN Haze-Free Roadmap.

126.   Although both documents were due for review in 2020, they have been used as a framework to assess current priorities of AMS and current availability of information needed to track progress against the APSMPE Key Targets and the Roadmap Strategies.

127.   Assessment undertaken on current relative priorities to the issues included in the APSMPE and the ASEAN Haze-Free Roadmap and elaborated further in the next sub-section. This then guides the prioritisation of support to be given to AMS for capacity development.

4.3.1 Regional priorities (link to APMS, ASEAN Haze-Free Roadmap, Chiang Rai Plan of Action

a)   APMS

128.   As part of the Final Review of the APMS conducted in 2020, ATFP NFP provided feedback on the future national level priorities in relation to the 13 Focal Areas of the APMS. The top priorities, based on the number of countries selecting them as priority were:
   •   Further action to determine the exact extent and current status of peatlands at national level (9 AMS)
   •   Public and stakeholder awareness and participation (8 AMS)
   •   Peatland fire prevention (7 AMS)
   •   Development of policies and regulations for peatland management (7 AMS)
   •   Biodiversity Conservation (6 AMS)
   •   Integrated management of peatlands (6 AMS)
   •   Peatland restoration (6 AMS)
   •   Regional Cooperation (5 AMS)
   •   Best management practices (5 AMS)
   •   Financing the Action (5 AMS)

b)   ASEAN Haze-Free Roadmap

129.   It is understood that the ASEAN Haze-Free Roadmap is currently under review till October 2021, of which a set of monitoring and evaluation guidelines and indicators will be developed based on consultation with AMS and based on the ASCC Blueprint 2025, and overall conclusion on implementation of the Roadmap, as well as recommendation for a revised or renewed Roadmap for the region. This CDNGA report is anticipated to be shared with the Review Team of the Roadmap in order to share the information gathered and analysis undertaken based on the inputs from AMS, rather than duplication of work to collate similar information on gaps and priorities of AMS on tackling the land (including peatland) management and transboundary haze pollution issues.

130.   In general, the AMS[53] have prioritised six out of eight strategies as top priorities:
   •   Strategy 1: Implementation of the AATHP (9 AMS)
   •   Strategy 2: Sustainable management of peatlands for peatland fires prevention (7 AMS)

---

[53] Pending input of Brunei Darussalam on the questionnaire. Singapore only provided inputs in respond to Strategies 1 and 2.

- Strategy 3: Sustainable management of agricultural land and forest for large scale forest and/or land fire prevention (7 AMS)
- Strategy 5: Enhancing cooperation, exchange of information and technology, and strengthening of capacity of institutions at all levels (7 AMS)
- Strategy 6: Enhancing public awareness and cross-sectoral and stakeholders participation (8 AMS)
- Strategy 8: Reducing health and environmental risks and protection of global environment (7 AMS)

c)   Chiang Rai Plan of Action

131.   To support the implementation of the ASEAN Haze-Free Roadmap in Mekong region, in March 2017 there were workshops conducted and organised by Thailand to develop Chiang Rai Plan of Action through consultations with relevant AMS, agreeing on threshold of accumulated hotspot counts reduction as main target. In addition, actions had also been identified and proposed for specific Strategy 2 (on Agricultural and Forest Fire Management), Strategy 5 (on Information and Technology), Strategy 6 (on Public Awareness and Engagement) and Strategy 8 (on Reduction of Health and Environmental Risks) in accordance of sub-regional condition that have significant differences compared to Southern ASEAN sub-region (**Figure 12**).
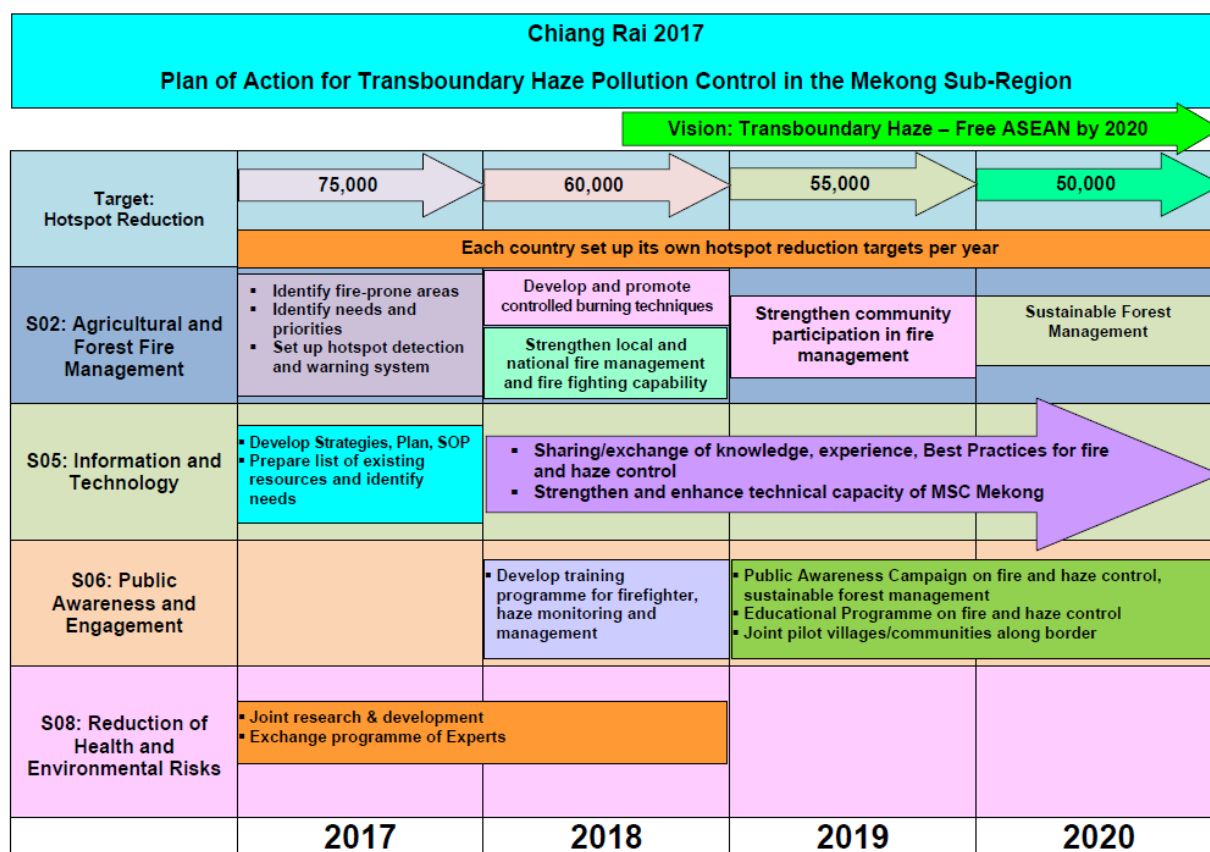

Figure 12: 2017 Chiang Rai Plan of Action (Source: ASEC, 2020)

4.3.2 Country Priorities in relation to the Targets in APSMPE and APMS

132.   Through the feedback from the questionnaires, the AMS provided feedback on their priorities in relation to the targets in APSMPE shown in **Table 14.**

133.   In general, AMS have given medium to high priority. Some AMS with small peatland area given low priority on zero and rehabilitation of fire prone areas. Quick findings are as listed below:

- Cambodia: Generally medium to low priority.
- Indonesia: All high.
- Lao PDR: Low to medium. Low priority on zero burning. High priority on rehabilitation/conservation and NAPP/APMS
- Malaysia: Generally medium to high priorities depends on institutions' role and responsibility. For example: Department of Environment gives low priority on rehabilitation while Forestry Department of Peninsula Malaysia (FDPM) gives high priority on rehabilitation, thus the average is medium. In additional, justification for FDPM is only inside permanent forest reserve whilst the land outside forest reserve is under jurisdiction of the state government.
- Myanmar: Mostly medium to high. Low on rehabilitation of fire prone area.
- Philippines: Despite small areas of peatland, they give high priority in all except zero burning. Zero burning was not identified as country's priority in APSMPE as there has been no large-scale agriculture on peatlands in the country.
- Singapore: As the country with no peatland, Singapore is committed to support AMS' implementation of the AATHP. The individual targets are not applicable to Singapore.
- Thailand: All high. For zero burning, national policy focuses on controlled-burning in order to eliminate residual and prevent widespread fire. Zero burning is set as a long-term goal.
- Viet Nam: All high except zero burning identified as medium.

Table 14: AMS priorities in relation to the target in APSMPE

APSMPE Key Targets	Current AMS priority for APSMPE									
	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
KT1: All peatland areas in ASEAN are identified and inventorised	Pending	Medium	High	Medium	High	High	High	NA	High	High
KT2: Zero-burning is uniformly practiced and controlled-burning only used in exceptional cases to prevent any uncontrolled wildfires on peatlands and eliminate any widespread smoke haze	Pending	Medium	High	Low	High	Medium	Low	NA	High	Medium
KT3: Fire prone sites are rehabilitated by focusing on root causes of fire	Pending	Low	High	High	Medium to High	Low	High	NA	High	High
KT4: Peatlands are sustainably managed, sustainable livelihoods enhanced, and sustainable economic use mainstreamed	Pending	Medium	High	Medium	Medium	Medium	High	NA	High	High
KT5: Peatlands are conserved to contribute to significantly reduced emissions of greenhouse gases and increased peatland biodiversity in the region	Pending	Medium	High	High	Medium	Medium	High	NA	High	High
KT6: APMS and National Action Plans on Peatlands are implemented; national and regional capacity is enhanced	Pending	Medium	High	High	High	High	High	NA	High	High

4.3.3   Country Priorities for the future of the APMS

134.   The details of the priorities identified by each AMS in relation to the future phase of the APMS from 2021 to 2030 are listed in country profile in **Annex 6**.

135.   A total of 169 priorities has been listed for country priorities for the future of the APMS. Such of priorities stated by AMS were ranging from peatland management (include fire and rehabilitation), recognition peatland sites, biodiversity, regional cooperation, financing, research and innovative technologies and technique.

136.   Significant different between northern and southern ASEAN sub-regions can be clearly observed in term of peatland management. Most of the northern AMS have indicated priority for substantial work needed for mapping peatland areas in respective country. This is different to southern AMS, which the peatlands already well mapped out.

4.3.4   Country priorities in relation to the ASEAN Haze-Free Roadmap

137.   Based on the feedback in the questionnaires, all AMS gave medium to high priority in all criteria for the ASEAN Haze-Free Roadmap key targets as shown in **Table 15**. Except for Lao PDR which set low priority to Strategy 4 and 5. High priority were given by all AMS for Strategy 1 and 6.

Table 15: AMS priorities in relation to the ASEAN Haze-Free Roadmap

Roadmap Strategies	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
S1: Implementation of the ASEAN Agreement on Transboundary Haze Pollution (AATHP)	Pending	High	High	High	High	High	High	High	High	High
S2: Sustainable Management of Peatlands for Peatland Fires Prevention	Pending	High	High	Medium	High	Medium	High	High	High	High
S3: Sustainable Management of Agricultural Land and Forest for Large Scale Forest and/or Land Fires Prevention	Pending	Medium	High	High	High	High	High	NA	High	High
S4: Strengthening Policies, Laws, Regulations and their Implementations, including to facilitate exchange of experience and relevant information among enforcement authorities of the Parties in accordance with the AATHP Article 16 (f)	Pending	Medium	High	Low	High	High	High	NA	High	High
S5: Enhancing Cooperation, Exchange of Information and Technology, and Strengthening of Capacity of Institutions at All Levels	Pending	High	High	Low	High	High	High	NA	High	High
S6: Enhancing Public Awareness and Cross-Sectoral and Stakeholders Participation	Pending	High	High	High	High	High	High	NA	High	High
S7: Securing Adequate Resources from Multi-Stakeholders for Transboundary Haze Prevention	Pending	Medium	High	Medium	High	High	High	NA	High	High
S8: Reducing Health and Environmental Risks and Protection of Global Environment	Pending	High	High	High	High	Medium	High	NA	High	High

5. Capacity Development Needs and Gap Analysis

5.1 Fire Prediction, Warning and Monitoring Systems at Regional Level

138.   It is understood that there are existing regional mechanisms referenced in the institutional arrangement under the framework of the AATHP. The AMS have been reporting to ASEC on implementation of the APMS to ATFP, overall implementation of the effort guided by AATHP to respective TWG/MSC and TWG/MSC-Mekong and provide recommendations to COM of AATHP for consideration and guidance for next steps.

139.   As specified in the ASEAN SOP, at the start of dry season, the Interim ACC will alert the AMS to submit weekly Situation Report (Form 1) to ACC on every Monday. Whenever air quality reaches unhealthy level in many areas of the region or when there is significant increase of hotspots activities that reach to Alert Level 2 or 3, the interim ACC will alert the NMCs to provide the Situation Report (Form 1) on a daily basis. Then, the interim ACC will consolidate and analyse the Situation Reports and circulate the consolidated report (Form 2) to the NFPs at the end of the day through email or other means of communication.

140.   However, based on feedback thus far available, these have not been systematically followed through. From the feedback provided by the AMS, some of the challenges in undertaking these practices are lack of involvement from NMCs to monitor and communicate the suggested elements as per requirement of the SOP. Some AMS are not aware of the procedure suggested in the ASEAN SOP.

141.   Among the challenges encountered by AMS to collect information are:
   • Lack of network/internet connection to assess the information;
   • Lack of communication with ground verification by patrollers; and
   • Lack of staff in NMC to collect and analyse the information.

142.   Among the challenges encountered by AMS to submit Form 1 to interim ACC are:
   • Lack of communication with ground patrollers;
   • Lack of feedback from ground patrollers; and
   • Lack of staff in NMC to compile submit the Form 1.

143.   In addition, it is stated in the ASEAN SOP that the Panel of ASEAN Experts on Fire and Haze Assessment and Coordination should be on standby if there is a need to deploy experts to support integrated fire suppression, as per request by AMS. There is a standing agenda item at COM AATHP to update the lists of the NFPs, NMCs and competent authorities for the AATHP; and senior representatives to the COM. Nevertheless, it is understood that there have been some delays in updating this information and arranging the members to be in standby.

144.   As a formal ASEAN regional centre, ASMC provides comprehensive information to fire and haze warning and monitoring. In AMS that currently do not have a forest fire information system, ASMC helps countries engage in regional collaboration. Apart from ASMC, other service providers at the regional level that support early warning system are BMKG, DNP and MET Malaysia. Despite efficient information for fire prevention, there is a need for enhancement of weather-related information to be used by these regional systems. The region has insufficient near real time data on climate indicators such as temperature, precipitation, vegetation stress indices, soil moisture and drought, which link closely to land and forest fire. Modelling tools and data assimilation schemes are expected to significantly support future

projections of the intensity of climate change phenomenon, taking into account the contribution of forest fires such as greenhouse gas (GHG) and carbon emission. Improved climate prediction will support the region in climate risk management and adaptation strategies. These data will benefits diverse sectors such as agriculture, natural resource management and human health.

145.   Based on analysis so far, there is a need to simplify and enhance data and result sharing practices at regional level and national level, by all service providers, NMCs and related agencies in AMS. Improved data sharing practices will increase access to information, which will lead to better decisions and facilitate systematic monitoring. Data sharing by the service providers and NMCs need to be transparent, user-friendly and provide free access to large archives of information as well as spatial data. This will require exploitation of dense satellite time-series and efficient management of large data volumes. Data sharing practices will optimise the benefits of the data to public especially for research purposes.

5.2 Monitoring Systems at Country Level

5.2.1 Data access from source and dissemination to stakeholders

146.   Good fire management within the peatlands is crucial to protect air quality and sustain the peatland ecosystems for future. There are several systems available in ASEAN to support fire management activity at national and local levels. AMS are able to access daily information of fire risk and haze such as hotspot, FDRS, weather forecast and haze projection. This information is available publicly at regional and national levels for some AMS.

147.   Indonesia has developed some good systems to support national fire management activity. Currently, work is in progress to combine all the systems into a single integrated system.

148.   In general, the information at regional level may flow to national and local levels if there is designated agency/officer to capture and disseminate the information, with assumption that the officer is from office of NFP or NMC. It is also important that there is a designated intranet, or other system, to distribute relevant weather information to the nominated desk officers for further dissemination. In most AMS (except Lao PDR and Philippines), the hotspots information is being sent to local or ground levels for verification (**Figure 13**). Regional information of hotspot, FDRS codes and indices, broad regional weather forecast and haze projection provided by several systems such as ASMC, BMKG, DNP and MET Malaysia is vary. However, some countries such as Thailand and Viet Nam have their respective national systems and capacity to collect the information. Others such as Malaysia, utilise data from ASMC and FIRMS and add into a national FORFIS which also provides SPOT data to monitor haze. Apart from the regional information sources, NFPs and national relevant agencies also collect specific local weather information especially current weather situation and air quality from multiple national agencies for further analysis. Some AMS might have limited access to this information due to less exposure on how to use the information or limited data available at national level.
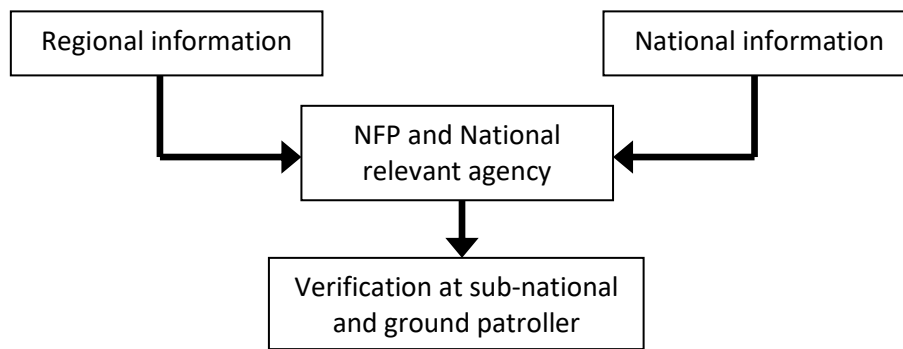
Figure 13: General circulation of information from sources to ground level for verification

149. Relevant agencies at national level have been further disseminating this information to sub-national agencies and local patrollers for verification. Most countries have ground patrol team and they have been verifying the hotspot coordinates provided through the systems. However, the information dissemination process are varied – some AMS such as Indonesia, Malaysia, Thailand and Viet Nam are using systematic online system for ground patroller to do daily check on the information. However, some other countries are using regular communication medium such as telephone and fax to distribute the information. Some countries are using smartphone application such as Telegram and Whatsapp for faster and regular communication with the ground patrollers. In most countries, Fire Department Agencies have been supporting the work by closely monitoring the information and planning for action in case of fire occurrence. Apart from relevant national agencies, ground patrolling activity have been undertaken at protected areas and other key sites by management agencies sometimes with support of regional or international frameworks such as Ramsar Convention or the ASEAN Heritage Park Network. Monitoring is part of required activities to ensure the protected areas are well-managed. Most challenges faced on verification are false alarm/alert of hotspot information and inaccessible remote locations. Therefore, drone and unmanned aerial vehicle (UAV) assessment will be a good support of ground verification activity.

150. In line with the ASEAN SOP, it is required that weather information at national level is monitored and reported to the interim ACC. The weather information suggested is weather forecast, rainfall, temperature, wind speed, wind direction, humidity and climate outlook. From inputs provided by the AMS and reference to available information on open sources, all AMS have the general capacity to monitor these weather information (however the number of locations that such information is gathered and the availability of real time data varies widely among the countries). Apart from the weather information, air quality information is a necessary element that not all AMS has the capacity to monitor. Several AMS have been monitoring particulate matter with diameter of less than 10 microns (PM10) and some AMS have undertaken some enhancement to monitor the particulate matter of less than 2.5 microns (PM2.5). The air quality monitoring system used to measure the air quality is varied between countries that has been posing challenges to further analyse the information at regional level. In addition, some AMS have limited weather stations installed in the country and the stations some were installed in cluster and may not cover sufficient area to reflect air quality condition in the country. This shows that the region has no harmonised information and generally has low capacity in air quality monitoring information.

5.2.2 Monitoring and reporting of fires from local to national then regional levels

151.   **Figure 14** shows the general land and forest fire incident reporting mechanism from the local level to regional level that has been practiced in the ASEAN region. Reports from the ground are prepared by authorised patrollers at the local level and shared to the responsible coordinating agency or council. In Myanmar, there are some Voluntary Fire Fighting units and some Civil Society Organisations (CSOs) helping in fire prevention, reporting and control in many townships. A hotline number is being used to notify relevant agencies on forest fire occurrences in Thailand.

152.   After receiving verification reports from the ground, NFP and national relevant agency will integrate the data for further analysis in GIS and undertake statistical measurement to inform other agencies, stakeholders and decision makers. These reports are important in order to activate different level of fire prevention or suppression programs to tackle the fire and its associated smoke haze problem. For an example, Myanmar will hold a National Consultation Meeting for controlling haze pollution in dry season – five states and regions located in the borders of Myanmar will conduct actions to reduce the number of fire hotspots and control haze pollution with the implementation of action plan for transboundary haze pollution control through Action Plan for Transboundary Haze Pollution Control in State/ Region of Myanmar. In Lao PDR, the Minister of Agriculture and Forestry will issue an instruction on preventing bushfire during dry season. Malaysia will activate national peatland fire prevention program to pump water from tube-wells to rewet the fire prone peatlands. Viet Nam will use the report to determine fire prone areas for appropriate response and plan. Philippines will share the report in National Technical Working Group on Wetland held twice a year. Apart from national fire prevention programme, this report will be used to initiate national level haze risk and health advisory to the public.
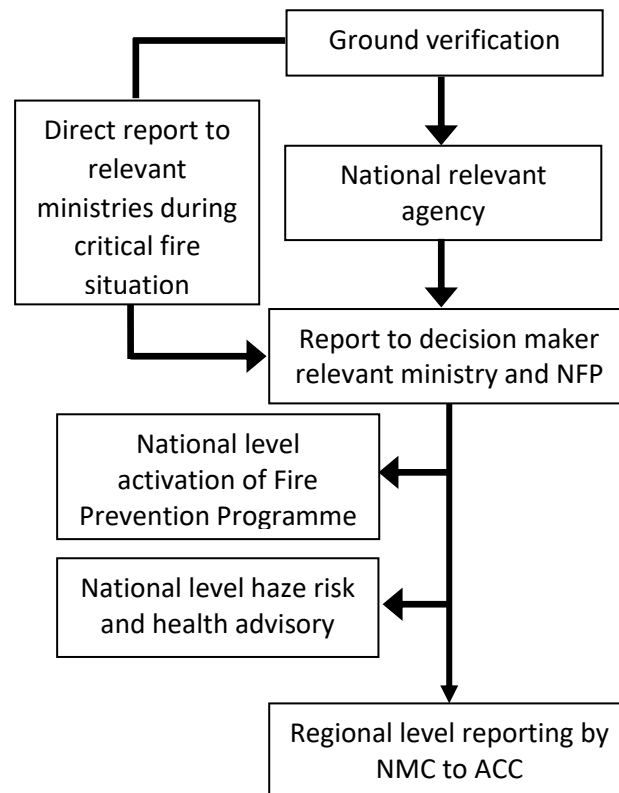

Figure 14: Reporting process from ground level to regional level

153.   From the CDNGA feedback, most AMS has national fire prevention program and reporting procedure. However, documentation practices of all the activities by AMS remain unclear and are not being shared to public user as well as to regional levels. Some AMS prepare the documentation and reporting in local language only, which become a challenge to assess the information by wider viewers. There is a need to further disseminate regional guidelines to national and local levels to improve the understanding and necessities of the ASEAN SOP regional reporting. Among the challenges faced by AMS in reporting are language barriers and complex content of current information requested that is too technical. This has caused a minimum submission of the ASEAN SOP reporting Form 1 from national to regional level. AMS also require simpler mechanism or platform for communication and reporting.

5.3   Priority Needs on Peatland Management

154.   There were priority needs on peatland management identified in 2001 following the large scale peatland fires and smoke haze in the region in 1997-1998. The APMI was prepared in 2003 and then APMS was developed and adopted for implementation in 2006. Since then, the region has been finding ways to better manage and protect peatland ecosystems spread across the region. Since 2013, effort was made to further prioritise AMS needs on peatland management – hence the development of the framework of APSMPE for 2014-2020. Nearly US$240 million was allocated by governments and international partners to support projects related to the APSMPE. The projects were mainly focusing on peatland inventories and assessment, capacity building to increase capability and skills of personnel to manage peatland ecosystem sustainably, develop and implement peatland related integrated management plans, rehabilitation and conservation of peatland ecosystems, best management practices including integrated agriculture, zero burning and sustainable livelihoods from peatlands, development and implementation of peatland policies and action plans, peat fire prevention and monitoring network, and peat carbon sink study.

155.   The Final Review of the Implementation of the APMS 2006-2020, adopted in January 2021 reiterated the importance to continue and expand the work on sustainable management of peatland resources in ASEAN. A range of top priorities were identified and a new Phase of the APMS for the period 2021-2030 is expected to be prepared soon.

5.3.1 Peatland Assessment Methodology

156.   All AMS have indicated high priority to undertake further inventory to identify peatland of the country and to assess function and the biodiversity within the peatland ecosystems. There have been differences between countries and agencies in methodologies used for the inventories and assessments due to different levels of understanding of peat ecosystems that most linked to different classification with various definitions and references, different priorities of peatland use (availability for conservation or protection versus development or land-use change).

157.   Many AMS have been referring to a country-based historical reconnaissance soil map and have been updating the map in several years interval to update the land-use or soil types However, detailed peatland assessments with transect lines and soil sampling for laboratory analysis should provide more accurate findings and site-based data to finalise national peatland map with support of utilisation of GIS and remote sensing. The utilisation of the remote sensing and GIS will help to pre-analyse and interpret possible peatland areas prior to field assessment for ground-truthing, as well as fine-tuning the potential peatland map after

the ground checks. The field assessment with transect line sampling with assist to evaluate soil profile and check on peat depth of the area. If more sampling can be undertaken for analysis, the analysis will be more accurate, and a higher resolution map can be produced. In addition, it is understood that there may be some areas that are not accessible due to its natural condition, an aerial survey using drone or small unmanned aerial vehicle (UAV) is preferred. This aerial survey may help to identify general management issues such as canal systems, land-use change, fire scar, and possible connectivity to good vegetation or forested areas.

5.4   Priority needs for fire and haze management

158.   Beside peatland fires in Southern ASEAN sub-region, forest and land fires in the Mekong region have become increasingly serious such as in late 2019 and early 2020 when Northern ASEAN was in a prolonged drought season for almost 5 months. The extensive fires led to extensive transboundary smoke haze from land and forest fires.

5.4.1 Fire prevention

159.   After 20 years of addressing significant land and forest fires in the ASEAN region, it has become accepted that the most important strategy to address this challenge is to focus on fire prevention rather than attempt to control the fires when they occur or mitigate the impact of the smoke haze.

160.   The ASEAN Guidelines for Peatland Fire Management, adopted in 2015, recommended that 70% of the resources for fire management should be allocated for prevention and 10% each for preparedness, response and recovery. Effective prevention will significantly reduce the risk of fires occurring and so negate the need for expenditure on other actions. However in most AMS, it is still very difficult to secure funds for prevention activities and relatively easy to secure resources for fire control.

161.   Indonesia has made major progress in the last five years to ramp up prevention action for peatland fires. It established a BRG in 2016 to spearhead rewetting of 2 million ha of fire prone peatlands. It has implemented its national regulation of Protection and Management of Peatland Ecosystems including developing a National Peatland Protection and Management Plan (RPPEG, 2020-2049) and enhancing water management and monitoring on 3.6 million ha of peatlands under the management of private sector. These have been important contributions to the reduction in prevalence of peatland fires in the country.

162.   Although Malaysia and some other AMS have initiated some prevention measures on a smaller scale, there is much that still needs to be done to effectively prevent peatland fires across the region.

163.   Different prevention approaches are needed in the Mekong region where peatland fires are not extensive, and the main fires are related to land clearing of mineral soils and disposal of agricultural residues. Much more effort is needed in providing incentives and alternatives to traditional land clearing as well as introducing agroforestry systems and addressing land tenure issues.

5.4.2 Recovery from post-fire

164.   It is important to support ecological recovery of burnt sites as this will help to reduce future fire risk. Restoring hydrological functioning should be the first consideration in the peatland rehabilitation. Activities such as replanting of fast growing indigenous tree species, and fire patrolling could be carry out in peatland rehabilitation programme. Peatland rehabilitation approaches have been demonstrated well in Philippines, Thailand and Viet Nam, as well as Indonesia and Malaysia, but need to be scaled-up to cover affected areas. It is critical to engage local communities in the rehabilitation and long-term stewardship of such lands.

165.   For improvement, science-based rehabilitation methods that include specific site matching, water management and planting/natural regeneration techniques should be continued and scaled up. IFM should be promoted in order to avoid repeated fire events. Good IFM will provide a clear planning and coordination of relevant stakeholders based on guiding principles such as:
- **Hydrology:** Maintaining near natural water table should be the focus of recovery and fire prevention action.
- **Resource:** Sufficient allocation funds for recovery programmes which should use most cost-effective solutions.
- **Adoption of an Integrated Approach**: Implementation of plans will be complex and will involve a large number of sectors – each with its own interests and responsibilities.
- **Socio-Economics:** Local communities should be the key stakeholder involved in restoration and rehabilitation programmes.

166.   Currently, there is insufficient attention to tracking fire scars and subsequent recovery measures by AMS. Burn scar monitoring has received low attention by AMS due to lack of capacity and understanding of the importance of this information. Free accessible burn scar information are available at https://firms.modaps.eosdis.nasa.gov/map/. Timely and accurately burned area mapping is important for long-term monitoring of changes and used as an indicator to rehabilitation measure as well as input to fire management plans.

5.5 Country profiles

167.   Through the CDNGA process, feedback from each AMS on the national practices, monitoring systems and priorities for capacity development has been compiled as a country profile in **Annex 6**. Each country profile was shared with the respective AMS for verification through email on 23 February 2021 and feedback/inputs were incorporated in this report.

168.   Based on the assessment, the AMS generally have not made optimal use of the daily FDRS available at regional and international levels to support efficient forest fire preventive strategies. Even though almost all AMS monitor hotspots, there is low of awareness and minimum utilisation of the FDRS by the AMS. Most AMS also did not practice monitoring over burned areas. Some AMS were found to have limited capacity in distributing fire-related information to relevant agencies and publics. In country with limited capacity, no official website was available to assess this information, while some countries only use social media such as Facebook to share the information. Without proper channel, longer time needed for information dissemination and for the message received, understood as well as implemented at ground level. The information is not able to reach targeted audience in a timely manner due to complex mechanisms in communication challenges such as language barrier, complicated institutional arrangement and policy gaps.

169.   Most AMS have established ground patrol teams. Generally, reporting to relevant national agencies has been made following the ground verification process of fire incident. Some AMS such as Philippines also has the capacity to undertake drone monitoring in addition to ground patrols to report on conditions and necessary measures that could be taken to stop the fire or prevent additional ignitions. Authorised patrollers in Malaysia and Viet Nam have been reporting the verification details through developed system namely FORFIS and FireWatchVN, respectively. For other AMS, the reporting process will be through regular communication platform such as telephone, mobile application and email.

170.   During critical dry season, immediate mitigation steps were taken by authorising rangers and local authorities in Cambodia to report the forest fire occurrences directly to the ministries without through administrative procedure. In Thailand, activation of local fire patrol such as Red Ants (local community members trained as local fire-fighters) to assist the government departments to prevent fire and if fire occurs at location, immediate deployment of local fire fighters to suppress and control the fire. However, the documentation, reporting and archiving of the information from ground to national level remain unclear in most country.

171.   In Indonesia, multi-stakeholder and integrated patrolling programme (Integrated Prevention Patrol) combines *Manggala Agni* (Forest and Land Fire Brigades), army, police, voluntary groups (Fire Care Community/*Masyarakat Peduli Api*), local community and other stakeholders has been carried out since 2016 in fire prone provinces. Indonesia has also established a fire information system (http://sipongi.menlhk.go.id/). For fire indicators, all fire related institutions use only one hotspot data source from the LAPAN (http://modis-catalog.lapan.go.id/monitoring), which is derived from various satellites including Aqua, Terra, SNPP, NOAA-20 and Landsat 8.

172.   Generally, all AMS have the capacity to monitor daily weather data. Four of the appointed NMCs in AMS (namely Cambodia, Lao PDR, Myanmar and Singapore) are also the responsible agencies to provide national weather and meteorological information. However, many national meteorological agencies in AMS did not integrate hotspot and FDRS in their monitored daily information. There is still insufficient monitoring on climate indicators such as temperature, precipitation, vegetation stress indices, soil moisture and drought, which link closely to land and forest fire. While in other AMS, the appointed NMC need to communicate with their national meteorological agency for daily weather data. This complication might contribute to the low involvement of NMC in fire prevention activity which may also be linked to the low feedback for Situation Report (Form 1). Based on information available and analysis AMS have low capacity in monitoring air quality. There is lack of harmonised measurement system for AMS with established air quality monitoring system (i.e. AQI or PSI). This has been a challenge to monitor haze situation in the region.

173.   In order to support AMS in better data collection and improve result management system, effort to engage relevant agencies has been undertaken. An informal Whatsapp group has been established since March 2020 for NFPs or representatives from Cambodia, Lao PDR and Myanmar. Other participants are MAHFSA Programme Coordinator, IUCN Mekong Peatlands Project, ASEAN Secretariat and GEC. Hotspot, FDRS and relevant weather information disseminated through this group. Relevant information related to forest fire and climate change also shared in the group. The same concept can be applied to support other AMS. The group can be established as country-based platform which will involve only relevant agencies in the country using suitable platform, communicate in local language and handle by NFP or NMC.

174.   Since the current mechanism suggested by ASEAN SOP many years ago, there is a need to improve the mechanism by taking advantage of current technology that provides faster information dissemination and reporting after verification. In addition, the ASEAN Fire Alert Tool should be promoted to allow land managers within the ASEAN region to register to the PhoneApp, in order to receive daily alerts for specified sites of administrative regions giving numbers of hotspots and status of FDRS warning as generated by the sources such as BMKG, MET Malaysia and ASMC.

5.6 CDNGA Capacity Development Packages – National

175.   Based on the Country profiles and the feedback from the AMS, a list of priority topics for capacity development have been identified for each AMS as described in the respective country sections in **Annex 6**. These capacity priorities are summarised in **Table 16**.

Table 16: Summary of the capacity development priorities for AMS as detailed in the country profiles (Annex 6)

AMS	Focus 1: Peatland inventory, mapping, assessment of degradation status, Monitoring (APSMPE T1)	
6	CA, LA, MA, MMR, PH, VN	Peatland assessment and mapping
	Focus 2: Peatland Fire Prevention Measures (APSMPE T2/Roadmap S2)	
9	BD, CA, ID, LA, MA, MMR, PH, TH, VN	Training on fire risk warning (including Fire Danger Rating System operation and promotion) and fire prevention
9	BD, CA, ID, LA, MA, MMR, PH, TH, VN	Technology transfer in fire prevention and rehabilitation effort including using of satellite
8	CA, ID, LA, MA, MMR, PH, TH, VN	Training for rangers and forest fire-fighter team on fire prevention and management
2	ID, MA	Ground water level monitoring in peatland areas
	Focus 3: Peatland Fire and Haze Occurrence (APSMPE T2/Roadmap S2)	
5	BD, ID, MA, PH, TH	Monitoring and reporting of peatland fire and haze occurrence (Result Management System)
1	ID	Establishment of monitoring base camp
	Focus 4: Resources allocate and generated for peatland management and fire prevention	
5	BD, ID, MA, PH, TH	Explore collaboration on peatland management and fire prevention
2	ID, LA	Procurement and operate of tools and equipment for combating of fire
9	BD, CA, ID, LA, MA, MMR, PH, TH, VN	Awareness raising on peatland value, sustainable use and ecosystem services to communities and public
	Focus 5: Implementation of NAPPs, APMS, Roadmap	
9	BD, CA, ID, LA, MA, MMR, PH, TH, VN	Capacity development in rehabilitation and conservation
9	BD, CA, ID, LA, MA, MMR, PH, TH, VN	Awareness enhancement and peer learning from regional BMPs for community activities
9	BD, CA, ID, LA, MA, MMR, PH, TH, VN	Knowledge exchange to enhance peatland governance and policies
8	BD, CA, ID, LA, MA, MMR, PH, TH	Peatland and climate change

	Focus 5: Implementation of NAPPs, APMS, Roadmap	
2	LA, PH	Procurement and operate of tools and equipment for combating of fire (not peatland)
1	MMR	Monitoring of land and forest fire and haze occurrence

* BD – Brunei Darussalam; CA – Cambodia; ID – Indonesia; LA – Lao PDR; MA – Malaysia; MMR – Myanmar; PH – Philippines; TH – Thailand; and VN – Viet Nam

*NOTE: The Capacity Development Packages proposed to the respective AMS in draft country profiles shared in February 2021 for input verification (total of 9 AMS with the proposal of the CD packages as Singapore will continue to support other AMS). Further adjustments have been made to **Table 16** above based on the inputs and experts' knowledge.

176. Apart from the capacity development priorities mentioned in the **Table 16**, there are additional capacity development proposed by AMS and other stakeholders during the regional workshop in March 2021. Participants of the workshop have identified 19 additional topics (as listed in **Annex 8**) divided into 8 categories, as listed below:
   i. Awareness
   ii. Peatland mapping
   iii. Policy advocacy or development
   iv. Finance and business models
   v. Sustainable uses of peatlands
   vi. Technology on fire detection and monitoring, as well as application to local level
   vii. Alternatives to slash and burn
   viii. Latest techniques or update on controlled burning method

5.7 Potential partners for Capacity Development Activity

177. Under the restricted movement and travel during Covid-19 pandemic, more options as well as platforms have been identified to be used to conduct capacity development sessions online or by remote. The capacity development can be undertaken either virtually, physically or mix-mode combining both virtual and physical. However, some capacity development especially that involving communities, needs to be undertaken physically at site level. Due to this circumstance, several potential partners have been suggested by the AMS and other stakeholders to potentially undertake the capacity building packages at the local level (**Table 17**). This list has been primarily been identified by AMS during the virtual regional workshop on 12 March 2021.

Table 17: Identified potential partners to undertake capacity development packages for northern and southern ASEAN sub-regions as well as national level and other partners

Potential Partners active in Northern ASEAN	
• UPLB-SESAM[54], Philippines (expert in economic valuation and environmental policy) • SEMEO-SEARCA[55] (expert in peatland awareness and education)	• RECOFTC[57], Thailand (expert in community engagement) • TWF[58], Thailand (expert in awareness raising on peatland value to communities and public)

---

[54] University of the Philippines Los Banos-School of Environmental Science and Management
[55] Southeast Asian Regional Center for Graduate Study and Research in Agriculture
[57] Regional Community Forestry Training Center for Asia and the Pacific
[58] Thai Wetland Foundation

Potential Partners active in Northern ASEAN	
• ASMC[56] (expert in fire and haze monitoring assessment)	

Potential Partners active in Southern ASEAN	
• ASMC (expert on fire and haze monitoring assessment) • UNOPS/UNEP[59], Jakarta, Indonesia (expert in understanding and managing peatland hydrology)	• CIFOR, Indonesia (expert in managing peatland) • WII/YLBA[60] (expert in integrated best practice on peatland restoration including rewetting, rehabilitation and community revitalization)

Potential Partners active at National level	
• MoEF Indonesia (managing peatland hydrology) • DOST-PAGASA, Philippines (for the establishment of FDRS) • EcoKnights, Malaysia (raising awareness) • DEPR/JASTRe, Brunei Darussalam (collaboration on peatland management with forestry and fire services as well as education institution) • Forest Foundation Philippines (expert in community development, research, funding of peatland related projects) • Forest Protection Department (FPD) of Vietnam (expert in Fire management and Mapping of peatland)	• Winrock International, Indonesia (Peat Hydrology Monitoring on Jurisdictional Approach at district level; Sustainable business models (Private-Public Partnerships) on peatlands; Sago and paludiculture business development on peatlands) • Sodagho Siak, Riau, Indonesia (Best management practices in Zamrud National Park) • IIRR Philippines (peatland management) • Natural Resources and Environmental Statistic and Research Institute (NRESRI) Department of Agricultural Land Management (DALaM) and Department of Forestry, Lao PDR

Other potential partners	
• SNV (expert in sustainable business models) • Mekong Wetlands University Network • The Nature Conservancy (Improving Emission Factor of peat restoration in Borneo and developing peat restoration opportunity map in tropical peatlands) • MIT Alliance for Research and Technology, Singapore (Understanding and managing peatland hydrology)	• Wetlands International (Peatlands rehabilitation & paludiculture) • University of Riau (Peatland Hydrology Management and Restoration for fire prevention. Coastal restoration of island peat erosion) • People for Peat (Capacity building for sustainable businesses) • National University of Singapore (Integrated Tropical Peatlands Research Programme (INTREP), biophysical functioning of peatlands in the tropics)

---

[56] ASEAN Specialised Meteorological Centre
[59] United Nations Office for Project Services
[60] Wetlands International Indonesia/Yayasan Lahan Basah

6. Enhancing regional data collection and result management

178.   A key element of the support under the MAHFSA programme is to assist AMS in improved data collection and better results management. From the gaps found during CDNGA, several options have been identified to improved data collection and better results management. These options cover regional and national issues. These options can be undertaken simultaneously or sequentially and explained further in this chapter.

6.1   Utilisation of dissemination tools

179.   Nowadays, automated information dissemination tools are critical to effectively support data collection and result management. Common dissemination tools available are telephone, fax, email, social media platform, web portal, communication platform such as Whatsapp and Telegram. Mobile phone applications are convenient dissemination tools suitable for fire prevention and monitoring activities. These technologies offers many advantages as they will ensure the information reaches generated by specialised centres (e.g. ASMC, DNP or MET Malaysia) reaches users at regional, national and local levels in a timely manner. It is not limited by geographical location and can be accessed anywhere at any time with the appropriate technology. Information will reach a maximum number of people by manipulating this technology.

180.   Using mobile devices for information collection also offers advantages over traditional forms of information collection. Since mobile technology can be taken anywhere, information can be collected in real-time in the field. Mobile phone applications help to make the collection of information easier and more efficient than traditional collection methods.

181.   Several mobile phone applications has been developed to support forest fire prevention activity as well as information dissemination. Recently, IPB University, Indonesia collaborated with MOEF to develop a mobile phone application to support fire prevention measures in Indonesia. Hotspot information received through the application will be verified by patrollers in the field. Patrollers will then share verification with supporting information such as coordinate, photos and current weather by single click to MOEF at national level for further action.

182.   The ASEAN Fire Alert PhoneApp Tool is another mobile smartphone application that was initially developed in 2015 (**Figure 15**). The main information provided by this application is hotspot and FDRS. The hotspot information are from ASMC and LAPAN, while the FDRS information are from MET Malaysia. Users will receive alert tailored to their location of interest. The alert consists of daily changes in fire danger risk as well as detection of fire hotspots on or adjacent to their registered location of interest. This application provides information for the whole ASEAN region.

183.   Dissemination of information and data collection using mobile phone applications has evolved rapidly. Recent advanced applications enable users to upload photographs, automatically collect location data, record messages, and share the information to relevant agency as well as linked the update to media social platform to reach more people for awareness purposes.

Figure 15: ASEAN Fire Alert PhoneApp Tool is available in Android and iOS versions

6.2   Strengthen the capacity of NFP and NMC for COM AATHP at national level

184.   Although there is a regional policy framework and ASEAN SOP has been established, there are still challenges in monitoring the status and actions take related to forest fire and transboundary haze. Low capacity to fulfil the ASEAN SOP were observed with the national monitoring centres in several AMS facing problems to submit regular Situation Reports (Form 1). The capabilities of NFP and NMC at national level must be strengthened and it is a priority to establish proper dissemination information system. As a start, each designated agency must be fully understand of their responsibilities to implement this system.

185.   According to the AATHP, the respective NFP will administer and implement the actions specified in the agreement according to national policies and regulations[61]. Under the AATHP, each NMC should undertake monitoring measures[62] of fire-prone areas, land and/or forest fires, the environmental conditions conducive to such land and/or forest fires, and haze pollution arising from such land and/or forest fires. Apart from monitoring, the NMC, at regular intervals, should communicate the monitored data to the ACC directly or through the NFP.

186.   From observation, there are insufficient inter-agency communication in Some AMS. Some AMS or agencies are not fully aware of the ASEAN SOP requirements. This might due to complex institutional arrangement at national level that acts as a barrier to the communication. However, the appointed NFP must work to bridge the communication gaps between the agencies and enable clear information provision. The effort should be supported by establishment of proper and documented dissemination system at national level. The NFP should govern the system that clearly define the responsible agencies with delegation of task from national to ground level and reporting back to regional level. Once the administration of the system has been developed and the responsible agencies appointed, everything else will depend on detailed planning of effective dissemination information. NFP should play a bigger role to administer the system, while NMC should actively play the monitoring role.

---

[61] ASEAN SOP: page 2, section A1.1; AATHP: Article 6
[62] AATHP: Article 7

6.3   Develop national mechanisms to utilise the existing FDRS

187.   Findings from CDNGA activity shows that there are low utilisation of FDRS information in ASEAN. FDRS is a powerful indicator to monitor fire risk. Moreover, when FDRS is monitored together with hotspots and other weather information. The main purpose of the system is to provide a way to efficiently allocate an appropriate level of resources across a region or country from day to day or place to place, based on the forecasted fire danger levels. FDRS originated from Canada and USA, has been widely use globally. The ASEAN FDRS is based on the Canadian FDRS which has been adapted to the conditions in ASEAN. Scientific research about FDRS has started since 1965[63]. The principle of the system is to sound the alarm before fires start and difficulty of control reach extreme levels, thus allowing time for fire managers to prepare and take preventative action. Advantages of using the system are listed in **Table 18**.

Table 18: Comparison of fire management with and without the use of a fire danger rating system (Van Wilgen and Burgan, 1984)[64]

Management using formal FDRS	Management without formal FDRS
1. Fire danger is accurately quantified	1. Fire danger is estimated
2. Fire danger can be calculated by newly appointed officer	2. Estimations of fire danger rely largely on experience
3. Use of the system will force agency to keep records of climatic data, which are of importance to all management procedures. Input to FDRS measurement such as rainfall, temperature, humidity are provided in service provider website along with FDRS data.	3. No (or very few) climatic records are kept
4. Management decisions are based on quantified indices and are therefore less variable	4. Management decisions are based on experience and vary greatly among individuals

188.   There are three FDRS systems that have been developed in the region by different agencies namely by MET Malaysia, BMKG and DNP/GISTDA. Philippines has an initial design of the system but yet to be finalised, which has been developed by PAGASA with support from other agencies. Each of these systems has its own uniqueness and cover different geographical region but are still very reliable in supporting fire prevention in the region. To fully utilize the system, formal mechanisms are needed to coordinate implementation among agencies and between regions. The mechanism need clear strategy to set the direction in fire risk management.

189.   The mechanism should start with capacity development to use and understand FDRS. Capacity to understand fire risk and use FDRS must be strengthened at national to local level with community involvement in key AMS. The NMCs must be committed to monitor and disseminate the information to local level with proper documentation and verified feedback received from the ground. The risk monitoring should tailor to provincial area. High attention should be given to specific province with protected area, peatland or fire prone areas.

---

[63] Taylor, S.W. and Alexander, M.E. 2006. Science, technology, and human factors in fire danger rating: the Canadian experience. Available at:
https://www.researchgate.net/publication/237505534_Science_technology_and_human_factors_in_fire_danger_rating_the_Canadian_experience/link/551469470cf2eda0df316fb3/download
[64] Van Wilgen, B. and Burgan, R.E. 1984. Adaptation of the United States Fire Danger Rating System to fynbos conditions. Part II. Historic fire danger in the fynbos biome. South African Forestry Journal 129, 66–78.

Effectively communicating fire danger to local level and public is an important part of fire prevention programs.

190.   Users in AMS have several options of FDRS to use. Based on the information gathered for the CDNGA, AMS in Northern ASEAN region are more inclined to refer to DNP/GISTDA. To improve the FDRS utilization, more language-friendly website by DNP/GISTDA are suggested. The website offers a good package of fire prevention information such as FDRS for Northern ASEAN sub-region countries, hotspot from several satellites, daily air pollution index and monthly report updates. However, the website is only available in Thai language. Option for other language should be offered so the information can reach wider viewer.

6.4   SOP for local action for fire prevention

191.   Cooperation from local agencies and the community is critical to a successful implementation of the fire prevention effort. Most of peatland area is located outside protected areas and has no designated fire patrolling team. Land managed by private sector plantations may have fire management teams, but capacity and equipment availability may not be adequate. Most local communities in peatland areas do not have training or resources to prevent peatland fires. Suitable SOP to practice fire prevention measures should be developed tailored according to local requirements.

192.   Several SOPs for fire prevention monitoring practices has been developed such as for community-based fire patrolling team in Selangor and Pahang, Malaysia. Indigenous community live nearby peatland area were educated about peatland vulnerability to fire and hydrological management for peat area. The SOP include installing FDRS signboard, designed patrolling path to monitor fire prone area, measure ground water level, verify hotspot, informed fire risk level to the community through FDRS signboard and reporting current condition to relevant agencies.

193.   Good fire prevention SOP also has been developed by private sector such as Sinar Mas Forestry which operates more than 1 million ha of plantations on peat in Indonesia. They have adopted Zero Burning Policy in their operation. For fire management, Sinar Mas has trained more than 3,000 Emergency Response Team personnel that ready to be deployed in a fire emergency. Monitoring were executed by patrolling team verifying hotspot information on the ground. Monitoring towers have also been constructed to support the efforts. Sinar Mas places great emphasis to educate the staff, stakeholders and nearby community about the dangers of peat fires. They consistently engaged with farmers and communities to support no burning approach to clear land. The fire reports are updated regularly in an online Sustainability Dashboard for transparency.

194.   Good fire prevention SOP will cover common core component such as monitoring, water supply, life safety, resource mobilization, training, access road, equipment maintenance and communicating the observation to relevant agencies.

6.5   Strengthening the communication between NMC and local level

195.   The establishment of AATHP was not enough to put a fire prevention program into operation in each AMS. The policy and law need to be translated into action and reach all relevant agencies from national to provincial and ground patroller. Therefore, cooperation

must be strengthened between agencies at national level especially the NMC to communicate the monitored data and fire prevention strategies with local level. The monitored data includes hotspots, FDRS, weather and air quality.

196.   The NMCs should have an updated database of responsible agencies at provincial or local levels. Provincial agencies should be well informed of the strategies. Proper platform to disseminate daily information is important to ensure the information reach every entity in the network most importantly ground level. Communication platform can be common social messaging application (such as Whatsapp, Line and Skype) or mobile tool application (as discussed in **Section 6.1**).

197.   Prevention measures must be taken at the start of the dry season – based on short to medium term weather forecasts as well as national and local level monitoring. In addition tracking of increasing trends of FDRS or fire hotspots should be used to intensify action. Alert reminders should be issued to provincial agencies when risk increase, while verifying information from the province/patrollers remain actively undertaken and reported back to NMC. Ideally, the NMC should set national trigger threshold of rainfall or Fire danger or number of hotspot detected in specific location such as protected area and peatland to concentrate their effort and resource. Effective communication should involve two-way interaction namely from national to local level and from local level back to national. NMC should provide format of feedback needed from the local level. There is a need to keep the feedback simple and direct. The NMC will analyse the feedback from ground level before communicating the Situation Report (Form 1) to regional level.

6.6   Accessing fire and haze related information through a centralised website

198.   Currently, there are number of different sources of information related to FDRS and predictions in the ASEAN region including ASMC, BMKG, MET Malaysia and DNP/GISTDA. In addition, the information on the ASEAN SOP and Alerts are given of the ASEAN Haze Online website. It is proposed to create an interface on the ASEAN Haze Online website where all the updated information on FDRS, hotspots and haze – can be centrally accessed. This will not mean recreating or duplicating the separate existing websites – but creating an interface where all the information from the other websites can be accessed.

199.   It is suggested that this website to share daily updates of FDRS, hotspot information and the regional haze situation (**Figure 16**). The daily update will include hotspots from various satellite (such as NOAA-20, SNPP, MODIS, Landsat and Himawari), FDRS, haze trajectory, temperature, rainfall, humidity and air quality. The input for this update are taken and compile by ASEC (as interim ACC) from ASMC, BMKG, MET Malaysia and DNP/GISTDA websites. Sharing the information from multiple sources through this website is more efficient compared to each individual having to check and download information from several websites. The website will also act as an archive database for all fire-related data in ASEAN and enable user to download the data from user-friendly system to support further analysis. Overall, the platform and website will act as a central database for land and forest fire related information within the region. The website would enable exchange of information and recommendations from the APMS and ASEAN Haze-Free Roadmap review. It will be the central resource for all activities and latest update related to peatland and forest fire within the region. It is proposed that this enhanced result management system and data collection will be integrated with the updated ASEAN peatland and fire website that will be developed under Component 3 of the MAHFSA programme.
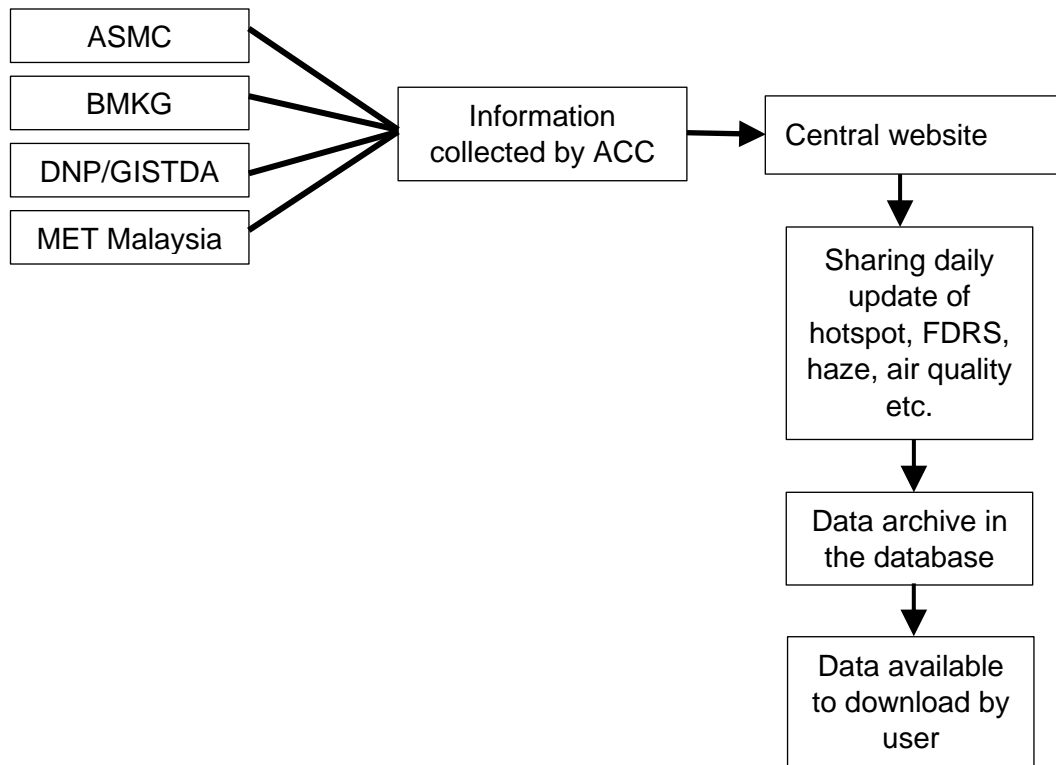
Figure 16: Suggested enhanced result management system using centralised website platform

200.   The utilisation of the centralised website will provide alternative ways for AMS to collect fire prevention and early warning information. It will promote continuous and smooth platform of harmonized information on forest fires in the region. The platform will support an archived database for all data related to forest fire in the region. Currently, no archive data available for FDRS in MET Malaysia, while ASMC archive database only cover data for the last 6 months. In Indonesia, the hotspot data are not centralised into one database. BMKG provides hotspots from VIIRS, MODIS and Himawari, while LAPAN provides hotspot from VIIRS, MODIS and Landsat. Therefore, the establishment of compiling all data from several sources into one database under a centralised ASEAN website will be a value-added to the region. This database will be the first step for the region to archive forest fire information for future use. The information will be a support for climate change projection and encourage more scientific research based on reliable data.

201.   The format of data shared is an important aspect to look at in order to support AMS with less capacity in fire monitoring and improve data collection activity. To facilitate easy tracking of potential fire location by AMS, all information are suggested to be shared in vector file in Google Earth format (i.e. KML) and Microsoft Excel (*.csv format). Vector file in Google Earth format (i.e., KML) data are flexible to be opened in various platforms from Google Earth, Arc GIS or free source GIS platforms such as QGIS. Non-technical users including ground patrollers can open the vector file in Google Earth format (i.e., KML) data in Google Earth software, which is a free and user-friendly software that also available in mobile phone mode. In addition, Google Earth is also able to support simple analysis such as measure the affected area, calculate distance, and examine the nearest road network. This software also supports multi-language. **Figure 17** shows the example of FDRS and hotspot data from MET Malaysia

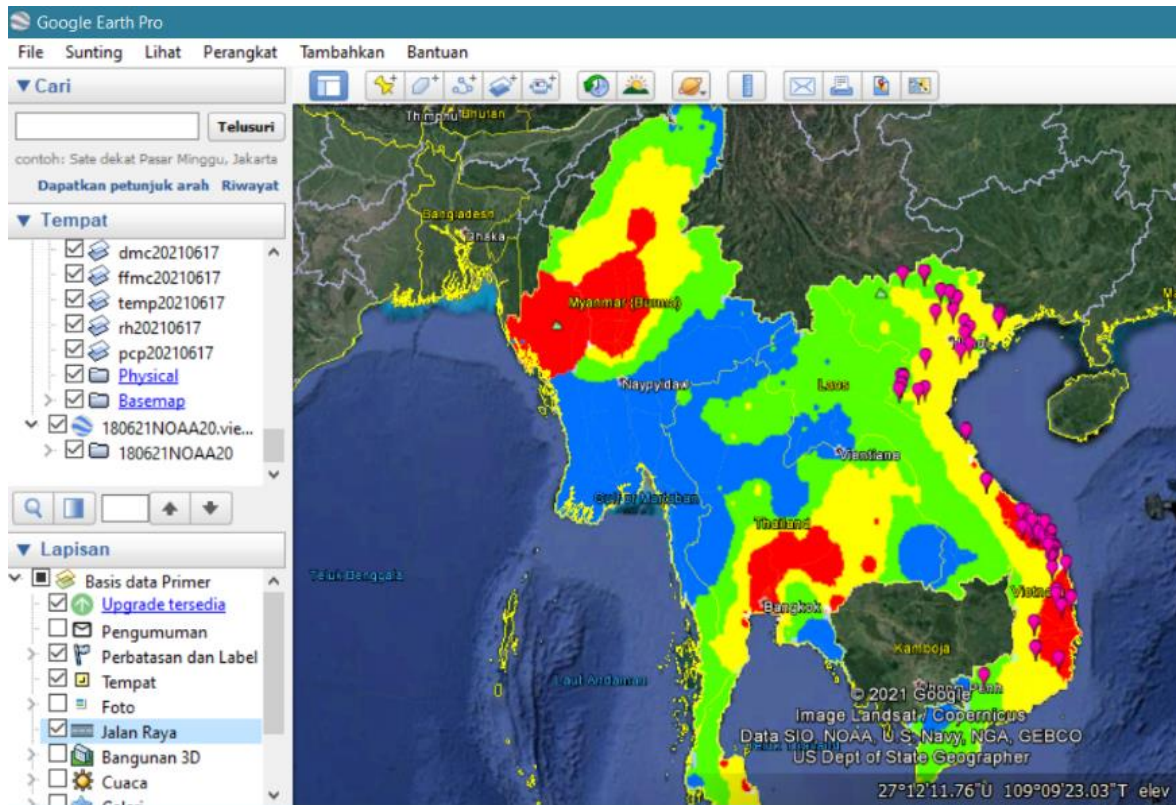opened in Google Earth software. In this figure, the Google Earth software has been set in Bahasa Indonesia.

Figure 17: Google Earth in Bahasa Indonesia shows FDRS and hotspot (vector file in Google Earth format (i.e. KML) for Northern ASEAN region on 18 June 2021
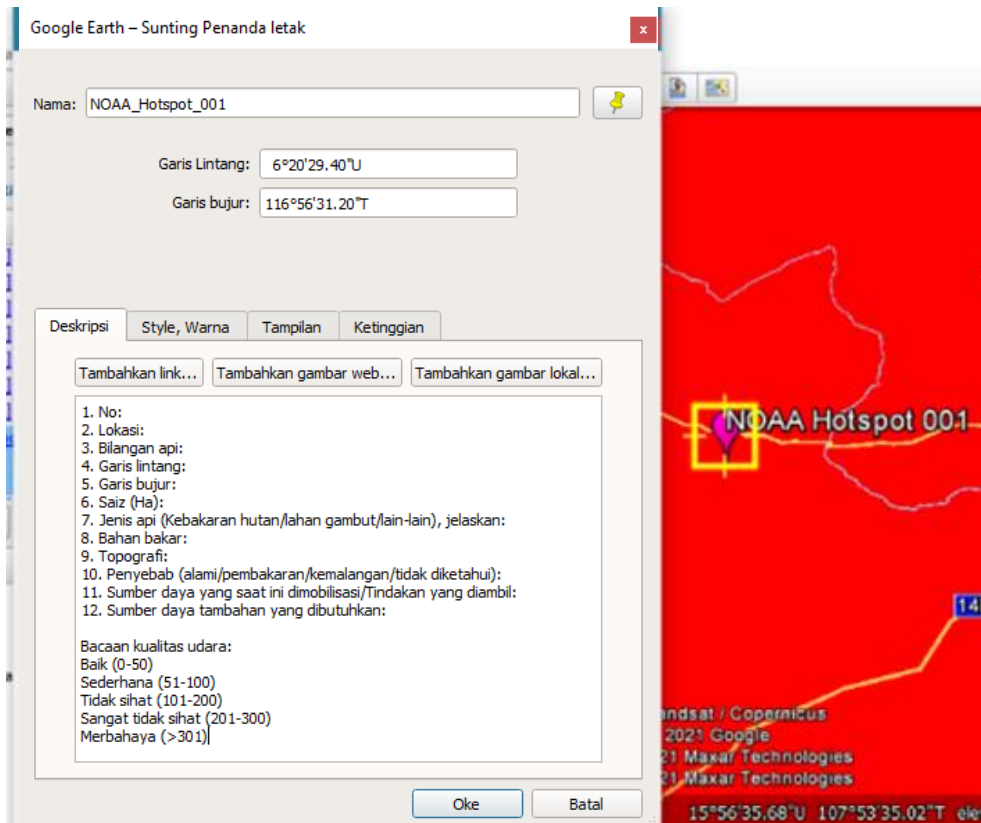
Figure 18: Google Earth enables users to edit and add information to the data. The information added in this example is according to ASEAN SOP.
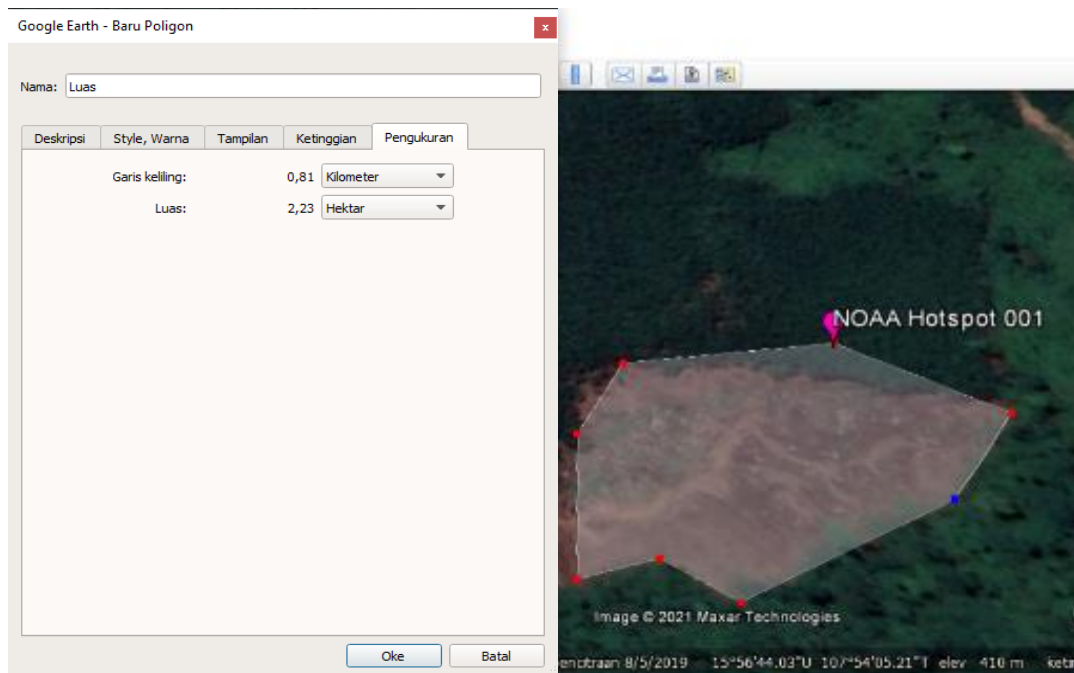

Figure 19: Google Earth enable user to apply simple analysis such as to measure distance, area, locate the nearest road network and view historical image since 1985 until 2021

202.   Google Earth also enable the user to easy adding or editing information to the vector file in Google Earth format data. **Figure 18** shows the example of adding information to the hotspot information according to attribute suggested in ASEAN SOP Guideline. Easy to edit format data will encourage AMS to share feedback of Situation Report (Form 1). Google Earth also enable user to carry out simple analysis such as to measure area and distance (**Figure 19**). Capacity development training will be provided to the involved agencies on how to open and manipulate the data in Google Earth.

203.   It is suggested that in future all the related service provider (i.e., ASMC, BMKG, DNP/GISTDA, MET Malaysia) should provide the data in vector file in Google Earth format and Microsoft Excel (*.csv format) to enable easy comparison and integration of data. This format is widely use regionally and globally. Findings from CDNGA indicate that most of the service providers have been providing data in vector file in Google Earth format, except ASMC. ASMC sharing hotspot data in text file (*.txt format) and no haze layer available to be downloaded for further analysis by users. Therefore, it is suggested for ASMC to share the information of hotspot and haze in the proposed format.

7. Conclusions

204. Conclusions with elaboration at the regional and national levels are given in the **Table 19** below:

Table 19: Conclusions of the CDNGA

Conclusions	Regional	National
Sustainable Peatland Management (SPM)		
1. SPM is a priority and is relevant to many ASEAN targets and frameworks	SPM is in line with other key policies and plans of ASEAN has been highlighted in the COM/COP meetings of the AATHP as well as ASEAN Working Groups on Nature Conservation and Climate Change. The recently adopted Final Review of the APMS has also emphasized the ongoing relevance and importance of sustainable peatland management and the APMS.	AMS have recognised the importance of sustainable management of peatlands. Through the adoption of the ASEAN Peatland Management Strategy 2006-2020 (APMS), AMS have shown their collective commitment to sustainable management of peatlands and their associated biodiversity as well as preventing peatland degradation, fires and haze. The AMS have also worked to facilitate the implementation of the APMS at national level to develop national and/or provincial/state/local level strategies or action plans for sustainable peatland management.
2. The final review of the APMS has recommended a second Phase of the APMS for 2021-2030 be developed to address a broad range of priorities	Top priorities for the next 10 years of AMS for peatlands include: a. Peatland assessment activity include identification of upland peat, detail assessment on landscape or peatland hydrological unit. b. Multi-stakeholder awareness and participation including regional knowledge exchange and experience sharing. c. Development and strengthen of national peatland related policies and regulations d. Integrated management and use of peatlands through best management practices, rehabilitation and restoration, paludiculture, community livelihood.	The top priorities verified by AMS through the Final Review of the APMS Implementation, based on the number of countries selecting them as priority are: a. Further action to determine the exact extent and current status of peatlands at national level (9 AMS) b. Public and stakeholder awareness and participation (8 AMS) c. Peatland fire prevention (7 AMS) d. Development of policies and regulations for peatland management (7 AMS) e. Biodiversity Conservation (6 AMS) f. Integrated management of peatlands (6 AMS) g. Peatland restoration (6 AMS) h. Regional Cooperation (5 AMS) i. Best management practices (5 AMS)

Conclusions	Regional	National
	e. Biodiversity conservation will enriched endemic flora and fauna to provide multitude benefit through ecosystem services	j. Financing the Action (5 AMS)
3. Significant Capacity Gaps are present among AMS in relation to sustainable peatland management	Key Capacity Gaps include: a. inadequate institutional framework and capacity at regional level to support APMS implementation b. Lack of overview of status and importance of key peatlands to support regional programmatic planning and information sharing c. Lack of resources for regional training and exchange on best management practices for peatlands include restoration, hydrological monitoring, peatland assessment, and community livelihoods	Key Capacity Gaps identified include a. Peatland identification, delineation and assessment b. Assessment and conservation of peatland biodiversity c. Understanding and managing peatland hydrology d. Peatland restoration approaches e. Delineation and management of upland or mountain peatlands f. Sustainable community livelihoods in relation to peatlands
Fire and Haze Prevention		
4. Prevention of land fires, forest fires and haze is a top priority of all AMS and is relevant to many ASEAN targets and frameworks	Fire and haze prevention strategy in AMS is guided by the AATHP and the sub-regional frameworks for Southern and Northern ASEAN.	• Fire prevention needs to be promoted further through national Standard Operating Procedures (SOPs) and strategies by integrating action from all relevant agencies as well as private sector and communities. • Investment, incentives, capacity development and multi-stakeholder partnerships must be put in place to encourage smallholders and local community to effectively prevent fires and implement sustainable land management approaches.
5. A broad range of actions are needed to prevent and manage fire and haze in the ASEAN	Top priorities for the next 10 years for fire and haze prevention are:	Top priorities for the next 10 years for fire and haze prevention are: a. Fire prevention through rewetting (for peatlands), multi-stakeholder partnership with reference to

Conclusions	Regional	National
region over the next 10 years	a. Implementation of the ASEAN Agreement on Transboundary Haze Pollution (AATHP) and establish ACC, b. Promotion of the ASEAN Guidelines on Peatland Fire Management and the ASEAN SOP c. Promotion of sustainable management for peatland fire prevention d. Promotion of sustainable management of agricultural land and forest to prevent large scale forest and/or land fires e. Enhancing cooperation, exchange of information and technology, and strengthening of capacity of institutions at regional and international levels to replicate best practices with support from solid scientific research f. Enhancing public awareness and cross-sectoral and stakeholders participation at regional level g. Reducing health and environmental risks and protection of regional and global environment	PPRR concept, and national/sub-national multi-agency fire patrol and prevention arrangements b. Alternative community land development strategies through zero-burning practices for peatlands, and controlled burning for non-peat area. c. Implementation of local and national plans that support environmental protection and conservation, such as National Biodiversity Strategy and Action Plan (NBSAP), National Action Plan on Peatlands (NAPP), and others. d. Implement existing national/sub-national guidelines on management practices for sustainable management of peatland fire prevention e. Sustainable management of agricultural land and forest to prevent large scale forest and/or land fires f. Enhancing cooperation, exchange of information and technology, and strengthening of capacity of institutions at all levels from local to national to replicate best practices with support from solid scientific research g. Enhancing public awareness and cross-sectoral and stakeholders participation at local, sub-national and national levels h. Reducing health and environmental risks and protection of local environment
6. The most important aspect of fire management is fire prevention rather than fire fighting	• Action is needed at the regional level to document and share effective approaches for fire prevention for both peatlands and mineral soil areas. • Monitoring and reporting of progress in fire prevention needs to be enhanced at regional levels	• 70% of resources need to be allocated to fire prevention (currently the majority of resources and capacity in most AMS are still mainly allocated for response to fire rather than prevention).

Conclusions	Regional	National
		• Enhancement are needed in mitigation, preparedness, human resource development, providing scientific input and awareness creation.
7. Inadequate preparation prior to dry season leads to ineffective fire control	There is currently inadequate utilisation of regional early warning system such as short to medium term forecasts and FDRS in the preparation and strategy for fire prevention.	Lack of preventive and preparedness measures to ensure better response. Prevention measures in peatlands include rewetting, enhancing water storage and management Preparedness activities for control of land fires such as mobilising stakeholders, as well as preparation for all types of fire such as enhancing frequency of patrols, making the equipment ready to use, rehearsal and drill practices, reuniting fire protection committees are very essential to prevent and prepare for any forest fire incident.
Fire and Haze Prediction, Warning and Monitoring Systems		
8. There are a growing number of effective tools in ASEAN for fire prediction and early warning	There are several platforms available to provide information regarding hotspot and fire risk at regional level. The platforms are operated by ASMC, BMKG, DNP and MET Malaysia. Each system has unique advantages and features especially in the algorithm used, spatial resolution, temporal resolution and geographical focus. The systems are accessible by the public and should compliments each other.	There are several platforms available to provide information regarding hotspot and fire risk at national levels. The platforms are MSS, BMKG, DNP, FireWatchVN, GISTDA, FORFIS and MET Malaysia. Each system has unique advantages and features.
9. There is inadequate utilisation of FDRS and warning systems at local level in most AMS	The system for disseminating FDRS information from service providers to AMS needs to be enhanced and made proactive rather than assuming all stakeholders will access the information on the websites directly	There is relatively low utilisation of the FDRS information at national and local levels which reflect to the low understanding and knowledge of the fire risk system. The understanding of the warning system needs to be enhanced to sustain support and coordination between relevant agencies.
10. The coverage and utilisation of air quality	Air quality information is among the elements to be monitored following guidance by ASEAN SOP. However, the capacity to track air quality information is	Each AMS may have customised air quality information. Some AMS do not have sufficient air quality monitoring stations/sensors to monitor situation. Some other

Conclusions	Regional	National
monitoring systems in ASEAN is insufficient	low in several countries in the region. There is no standard air quality measurement applicable in the region as there are various indices being used in measurement with different classification categories.	challenges include: lack of capacity; lack of technology support in particular Northern ASEAN (i.e. Cambodia, Lao PDR, Myanmar and Viet Nam)
11. Hotspot monitoring is not the best tool to determine progress in preventing fire and haze	Hotspot is only an indicator of the presence of fires and sometimes lead to false positives. Further refinements are needed to enhance the use of hotspots in tracking fire extent and severity. Currently minimum attention has been given to burn scar monitoring which is a more accurate measure of the extent of fires compared to the hotspots.	Burn scar monitoring has received low attention by AMS due to lack of capacity and understanding of the importance of this information.
Institutional framework		
12. The delay in the establishment of the ACC has impacted the implementation of the AATHP	Absence of a fully established ACC has led to delays in establishment of necessary communication and coordination mechanisms to stimulate action to prevent and control fires and haze.	-
13. The Capacity and functioning of the NMCs in relation to tracking of the Roadmap indicators needs further enhancement	-	The designated NMCs in some AMS lack the required budget, personnel, equipment or training to undertake some of their functions. In addition communication between NMC with the relevant departments/agencies in the national and local level offices also poor in some cases, which prevents their valuable support in predicting, preventing, detecting and managing land and forest fire and its suppression. There are also gaps in communication between NMC and NFP in some countries.
14. The current reporting and information sharing by NMCs and its	The sharing of information by NMC to the regional level is limited and does not yet meet the requirements under the SOP under the AATHP. There is lack of	Different level of verification at the local level to national level and thus limiting reporting process from national to regional levels.

Conclusions	Regional	National
subsequent use and analysis is insufficient to fully track fires and haze and determine the effectiveness on management measures	proper communication between NMC, NFP, regional service providers and ASEC. Communication issue from NMC to ACC/ASEC has caused gaps in information sharing and using knowledge available for better forest and land fire management planning. At the regional level, there is not yet enough capacity to synthesise and guide necessary action.	Need to simplify reporting mechanism including to overcome language barrier and too technical content
Sub-Regional and country variations		
15. The capacity and level of support needed varies between AMS	Coordination at regional level through ATFP and COM to AATP has been ongoing and AMS have been reporting on country progress on APMS and Roadmap Implementation. However, follow up on capacity and support needed maybe limited after the meetings and could possibly base on existing regional programmes or bilateral projects being supported by International Development/Dialogue Partners.	Several countries such as Cambodia, Lao PDR, Myanmar, Philippines and Viet Nam need support in the peatland assessment. Cambodia, Lao PDR and Myanmar have lower resources and capacity in fire prevention. Further enhancements are necessary in to build capacity and technical knowledge and secure resource for action.
16. There is a significant difference between Northern and Southern ASEAN in both land and forest fires and peatland management	The nature, root causes and drivers of land and forest fires vary significantly between Southern and Northern ASEAN with several factors such as timing of forest fire season with corresponding of the dry season, common land management approaches and crop types and type of fuel varying significantly.	-
17. There is significant expertise and experience in some AMS that could be deployed to enhance capacity in other AMS	Some AMS such as Indonesia, Malaysia and Thailand have moderate to high capacity in peatland management and fire prevention and control which could be shared to support other AMS with less experience and capacity.	
18. Conflicts between activities and approaches by different sectors	-	There is insufficient coordination of inter-sectoral engagement and partnership for fire/haze as well as peatland management. While there is a growing trend of engagement for fire/haze and peatland management

Conclusions	Regional	National
enhance the risks for land degradation and fires		issues by range of government agencies from different sectors (e.g. forestry, agriculture, environment, water management, and community development), private sector (plantation, forestry and tourism sectors), academia/research, Civil Society Organisations (CSOs) and communities. However, the engagement needs to be enhanced for a greater impact and significant result.
19. There is growing potential for support to address land and forest fires in the region through multi-agency support	Several programmes are undertaken by different organisation such as IFAD, GEF, EU and FAO. SUPA programme supports regional capacity building through several dialogue activities and peatland assessment. Mekong Peatlands Project supports peatland assessment and develop NAPP in Cambodia, Lao PDR and Myanmar.	Multi-agency support by different organisation to strengthen the capacity and framework of AMS to fight against forest fire and haze issue in the region.
20. More effective engagement of local communities is needed to transform agriculture and land management practices to prevent fires and haze	-	Enforcement measures alone are not effective to prevent large scale land clearing with fire especially by local communities. It is critical to complement this with measures to find economically viable alternatives for land management for communities that eliminates or minimises the use of fire.

8. Recommendations

205. Recommendations with focussed actions at the regional and national levels are given in **Table 20** below:

Table 20: Recommendations of the CDNGA

Recommendations	Regional	National
Institutional framework		
1. The establishment of ACC must be expedited	The AATHP specifies for the establishment of the ASEAN Coordinating Centre on Transboundary Haze Pollution Control (ACC) to facilitate the structures and actions under the AATHP. The ACC was expected to be established soon after the entry into force of the AATHP in 2003, but it was delayed for the ratification of Indonesia in 2014. Unfortunately six years later, discussions for the establishment of the ACC are still ongoing. The delay in establishing the ACC has necessarily affected the level of progress with the AATHP and the Roadmap.	-
2. Enhance the function of NMC at national level and for regional reporting and communication	The ASEC/ACC should enhance communication and establish stronger linkages with the NMCs to share the required information at agreed regular intervals	NMC should enhance national monitoring measures. It is acknowledged that several AMS have limited capacity in information assessment at national level especially information related to air quality. However, every AMS has the capacity to provide daily weather information which is very critical during dry season. Sharing information practices and communication between NMC, NFP and other relevant agencies are missing in many cases and need to be enhanced.
3. The Institutional framework for the implementation of the APMS should be further strengthened	The ASEAN Task Force on Peatlands (ATFP) has endorsed the development of a Phase 2 of the APMS for the period 2021-2030. Measures need to be put in place to strengthen the implementation framework including the ATFP, ATFP National Focal Points and	-

Recommendations	Regional	National
	other important institutions and stakeholders involved in the strategy implementation. The details of action needed can be elaborated during the process of formulation of the Phase 2 of APMS in 2021.	
Sustainable peatland management		
4. Action should be taken to address the Significant Capacity Gaps in AMS in relation to sustainable peatland management	APMS Implementation needs to be enhanced for the following priorities identified through APMS Final Review: i. Further action to determine the exact extent and current status of peatlands at national level (9 AMS) ii. Public and stakeholder awareness and participation (8 AMS) iii. Peatland fire prevention (7 AMS) iv. Development of policies and regulations for peatland management (7 AMS) v. Biodiversity Conservation (6 AMS) vi. Integrated management of peatlands (6 AMS) vii. Peatland restoration (6 AMS) viii. Regional Cooperation (5 AMS) ix. Best management practices (5 AMS) x. Financing the Action (5 AMS)	Action should be taken to address key capacity gaps identified through the APMS review including a. Peatland identification, delineation and assessment especially in AMS in the northern ASEAN region b. Assessment and conservation of peatland biodiversity c. Understanding and managing peatland hydrology d. Peatland restoration approaches e. Delineation and management of upland or mountain peatlands f. Sustainable community livelihoods in relation to peatlands
Fire and Haze Prevention		
6. Enhanced action should be taken to implement the Roadmap for a Haze-Free ASEAN and improve capacity for prevention of land and forest fires, and haze	Prioritise the ASEAN Haze-Free Roadmap Implementation: Strategy 1: Implementation of the AATHP (9 AMS) i. Strategy 2: Sustainable management of peatlands for peatland fires prevention (7 AMS)	Much more effort needs to be put on fire prevention rather than fire response in AMS. This should be supported through assigning clear institutional responsibilities and resources for prevention as well as implementation of training programmes on fire prevention, linked to enhanced policies and regulations.

Recommendations	Regional	National
	ii. Strategy 3: Sustainable management of agricultural land and forest for large scale forest and/or land fire prevention (7 AMS) iii. Strategy 5: Enhancing cooperation, exchange of information and technology, and strengthening of capacity of institutions at all levels (7 AMS) iv. Strategy 6: Enhancing public awareness and cross-sectoral and stakeholders participation (8 AMS) v. Strategy 8: Reducing health and environmental risks and protection of global environment (7 AMS)	
7. The ASEAN Guidelines on Peatland Fire Management should be actively promoted and implemented	The ASEAN Guidelines on Peatland Fire Management were adopted in 2015 and a regional Training of Trainers (TOT) was conducted in 2016, however, implementation of the Guidelines needs to be enhanced and promoted further.	National training and training of training programmes on peatland fire management need to be developed and implemented
Fire and Haze Prediction, Warning and Monitoring Systems (Results management and warning system)		
8. Fire prediction and early warning tools should be enhanced and promoted in ASEAN	Closer links and exchange should be undertaken between various platforms for fire prediction, warning and monitoring to enhance the effectiveness of the tools and improve the dissemination and use by end users. Top priorities for the next 10 years for results management and warning systems are: a. Effective and timely fire prediction and warning to reach the regional and national levels by optimize the utilisation of existing results information from service providers e.g. ASMC, MET Malaysia, BMKG, DNP, NASA, etc.	Closer links and exchange should be undertaken between various platforms for fire prediction, warning and monitoring to enhance the effectiveness of the tools and improve the dissemination and use by end users. Top priorities for the next 10 years for results management and warning systems are: a. Effective and timely fire prediction and warning to reach the subnational and local levels by optimize the utilisation of existing results information from service providers e.g. ASMC, MET Malaysia, BMKG, DNP, NASA, etc.

Recommendations	Regional	National
	b. Enhance implementation of the ASEAN SOP c. Transparent on information sharing on national and regional effort in tracking hotspot and smoke haze occurrence d. Provide update at regional level on land and forest fires (including peat fires) and smoke haze based on agreed targets	b. Strengthen internal institutional framework to enhance information sharing and monitoring mechanisms at national, sub-national and local levels
9. Capacity should be enhanced to access and use FDRS and fire warning systems at local level in most AMS	While a range of FDRS results are available on a daily basis in the ASEAN region, the use of these key products for prevention and preparedness for fire management is limited due to limited capacity and lack of user-friendly tools or information in local language.	Capacity needs to be enhanced at the local level to use this information in a proactive manner to support fire prevention and control.
10. Expand the coverage and dissemination of information related to air quality monitoring systems in ASEAN	Air quality information is among the element to be monitored following guidance by ASEAN SOP. However, the capacity to track air quality information is low in many AMS. Standardisation or harmonisation of air quality parameters between AMS would enhance information exchange and overall analysis.	Many systems are not equipped with PM2.5 monitoring capacity yet. Work is needed to expand the coverage including the provision of low cost air quality monitoring devices for local level monitoring by community and other stakeholders.
11. Develop and promote use of alternate systems to hotspot monitoring to track and determine success of fire prevention measures in ASEAN	-	A broader range of parameters need to be determined and systematically used to track and determine the success of fire prevention measures including tracking of burn scars differentiated by land type (e.g. forest, agricultural land and peatlands). In addition, the scale of efforts for fire prevention such as zero burning agriculture, peatland rewetting etc. should also be monitored and reported.
12. A sub-regional capacity development programme should be initiated in Northern	The nature and root causes of fire is different in Northern and Southern ASEAN. While there is significant capacity for fire management in the Southern ASEAN region, there are significant gaps in	

Recommendations	Regional	National
ASEAN (Mekong region and Philippines)	the north that could be addressed by a dedicated programme to build capacity in the sub-region. There are similarities in the situation in these countries.	
Capacity Building and Exchange		
13. A regional exchange programme on peatland and fire management should be developed to enhance exchange and skills in ASEAN	Knowledge of peatland and fire management especially from country with established system and success stories must be exchanged throughout the region and global level to enhance the coordination and cooperation in peatland and fire management.	-
14. Best management practices should be compiled and disseminated and a network of BMP sites should be established to support peer to peer learning	Documented BMPs to be promoted at regional level.	Many best management practices (BMPs) have been developed in different AMS but are poorly documented and not disseminated. BMPs should be collated and used to develop manuals, training and outreach materials. BMP demonstration sites are very key to help facilitate rapid and practical learning by local and national stakeholders.
15. Existing national and regional training centres or programmes should be enhanced through provision of new training modules and Training of Trainers (TOT) Programmes Online and video-based training should be expanded to enable rapid outreach even during periods of travel restrictions	There are a variety on national and regional training programmes and centres in the ASEAN region. Training modules on peatland and fire management should be developed jointly to expand the delivery partners for training in the region. A key lesson learned from the COVID-19 pandemic is that online and video-based training is cost effective and can significantly expand the reach and effectiveness on training programmes	There are a variety on national and regional training programmes and centres in the ASEAN region. Video based materials can be easily adapted to local language versions.
16. Strengthen capacity and exchange through effective knowledge management systems and enhance the	There is a rapidly growing number of knowledge products in ASEAN with more than 1,600 publications on peatlands and more than 1,000 on fire. These knowledge products need to be properly curated and	There is a need at national level to compile relevant publications and journal of which useful to be referenced domestically to improve local knowledge using existing case studies. Numerous support from

Recommendations	Regional	National
synergy and avoid duplication between multiple initiatives for capacity building in the region	disseminated to avoid duplication and enhance capacity.	various organisation needs to be undertaken by harmonising the effort to avoid redundancy and maximise the benefit to AMS.
17. Outreach and media engagement needs to be enhanced on fire and haze prevention and peatland management in ASEAN	A regional communication strategy and communication materials should be developed to support outreach and stakeholder engagement .	In order to spread the message and maximise the engagement of different stakeholders, it is important to use outreach programmes and engage the media to disseminate messages of peatland and fire management
18. Targeted capacity building initiatives are needed for local government and communities to enhance capability for sustainable land management	-	Local communities and local government are at the front line of peatland and forest management and their actions are critical to prevent land and forest fires. Capacity building programmes need to be developed to target these key groups.

9. Focus and Scope for MAHFSA Capacity Building Action

206.   Given the vast scale of the capacity development needs and gaps in the ASEAN region in relation to peatland and fire management, as well as the relatively limited scale and scope of support available under the MAHFSA Component 1, MAHFSA has selected several actions to be supported by the programme – subject to verification with the respective AMS. Virtual regional workshop has been organised on 16 March 2021 with relevant stakeholders from the region to verify the findings of the CDNGA, particularly on the capacity building recommendations. From the workshop, six capacity development package were prioritised by AMS for regional level (**Table 21**). The packages fall within the scope of 5 different focus. The table also indicates the suggested institution or personnel to be trained varying from national experts, relevant agencies, field patrollers and community. The table also suggests the possible trainers for each package.

Table 21: Top six capacity development packages for regional level prioritised by the AMS, with regards to the focus areas for potential support under the MAHFSA programme.

Focus 1: Peatland inventory, mapping, assessment of degradation status, Monitoring (APSMPE T1)	
1. Capacity development	*Peatland assessment and mapping (for northern ASEAN region)*
Possible trainers	• GEC, IUCN, SUPA 1
Institution/people to be trained	Agencies, national experts/partners in Northern ASEAN sub-region
Focus 2: Peatland Fire Prevention Measures (APSMPE T2/Roadmap S2)	
2. Capacity development	*Training on fire risk warning (including Fire Danger Rating System operation and promotion) and fire prevention*
Possible trainers	• Agencies operating FDRS (i.e. DNP Thailand, MET Malaysia and BMKG Indonesia) , GEC, CIFOR
Institution/people to be trained	• National Focal Points • National Monitoring Centres • Supporting agencies • Relevant provincial agencies • Field patrollers
3. Capacity development	*Peatland fire prevention measures at site and community level*
Possible trainer/facilitators	• GEC, CIFOR, Wetlands International • MOEF and BRGM, Indonesia • KeTSA and KASA, Malaysia
Institution/people to be trained	• National Focal Points • Supporting agencies • Field patrollers • Stakeholders • Community
Focus 3: Peatland Fire and Haze Occurrence (APSMPE T2/Roadmap S2)	
4. Capacity development	*Monitoring and reporting of peatland fire and haze occurrence (Result Management System)*
Possible trainer	• Interim ACC/ ASMC, GEC
Institution/people to be trained	• National Focal Points

	• National Monitoring Centres • Supporting agencies • Field patrollers
Focus 4: Resources allocate and generated for peatland management and fire prevention	
5. Capacity development	***Awareness raising on peatland values, sustainable use and ecosystem services to communities and public***
Possible trainers	• GEC, CIFOR, RECOFTC, IUCN, Wetlands International, SUPA 2
Institution/people to be trained	• Supporting agencies • Stakeholders • Community
Focus 5: Implementation of NAPPs, APMS, Roadmap	
6. Capacity development	***Best Management Practices for sustainable community land management***
Possible trainer/facilitators	• GEC, CIFOR, RECOFTC, SUPA 2 • MOEF, Indonesia
Institution/people to be trained	• Supporting agencies • Stakeholders • Community

207.   The top six capacity development packages prioritised by the AMS and stakeholders will be used to construct the regional capacity development packages. Each capacity building package will include development of training curricula and technical training materials; verification methodology of knowledge retention including evaluation plan for the performance of trainees for both the pre- and post-training session.

208. In addition to the specific training proposed in **Table 21,** the MAHFSA project will work with ASEC, AMS and other partners to support the development of the result management systems discussed in Chapter 6. This will include enhancement of the systems for reporting and dissemination of information related to fire danger and occurrence, fire risk and prevention and control actions. In addition, systems for monitoring progress in meeting the targets under the APMS and Roadmap will be enhanced.

209.   Specific action and focus at the country level will be discussed further with each respective AMS. It is anticipated that training provided will be linked to the development of result management systems at the country level – e.g., training on peatland assessment may be linked to support for peatland assessments and development of national database or inventory on peatlands; or training on Fire Danger Rating Systems will be linked to development of national or agency SOPs related to FDRS promotion and fire prevention action.