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Meeting of the Parties to the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters

Seventh session
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Report of the seventh session of the Meeting of the Parties

Addendum

Updated recommendations on the more effective use of electronic information tools

The Meeting of the Parties recommends that Parties, signatories and other interested States undertake the following measures:

I. Purpose

1. The present Recommendations aim to assist Parties, signatories and other interested States in supporting the implementation of the Convention through the promotion of the development, maintenance, upgrade and use of electronic information tools by applying common approaches and standards. In addition, they will support efforts to implement other relevant international commitments;

2. For the purposes of the Recommendations, supporting explanatory notes on terms and approaches are provided in the annex to the present document;

II. General policy

3. Develop and adopt national/state strategies aimed at promoting electronic tools to facilitate administrative processes and services relevant for assisting the public, especially those in vulnerable situations, to exercise their rights under the Convention, such as "e-government", "open government", "open data", "open science" and the "digital transformation";

4. Take the necessary legislative, regulatory, institutional, practical and other measures to implement the above-mentioned strategies so as to make public administration more transparent, accountable and efficient in: providing environmental information of appropriate quality and dealing with requests for such information from the public; facilitating public participation in decision-making; and assisting the public in obtaining access to justice;

5. In developing and implementing strategies and measures, ensure participation by the public, as provided for in the Convention, and take account of barriers that may restrict public access to information and participation through electronic means , in order to ensure that such access and participation are maintained or enhanced, and not diminished;

6. While applying the above-mentioned measures, take into account the cross-cutting nature and comprehensive scope of environmental information under the Convention, and promote interoperability and data exchange between different information systems – such as environmental, geospatial, statistical, meteorological, health, Earth observation and other relevant systems – guided by the best available international standards (see also sections III and IV below and the annex to the present document);

7. Develop, where missing, continuously maintain and update a nationwide digital environmental information system using the best available state-of-the-art digital technologies, in accordance with the approach of "open by design and by default" (see also section IV below and the annex to the present document, sections II, III and IV). The system should contain up-to-date and historical data and information, as described in paragraph 23 below, and be well structured to: inform evidence-based decision-making and policy development relating to environmental matters; enhance early notification measures; support measuring and reporting of progress towards the achievement of relevant internationally and nationally agreed goals and targets; identify emerging environmental risks and vulnerabilities; support a multi-hazard early warning system; and promote environmental awareness among the public and other stakeholders;

8. Take the necessary measures to reduce and remove social, financial, legal, procedural and technological barriers that restrict public access to environmental information through telecommunications networks, such as high connection costs and poor connectivity, and a lack of computer literacy; enhance the inclusive use of digital technologies and electronic information tools to promote the exercise of their rights under the Convention by groups and communities in vulnerable situations, such as children, older persons, women in some societies, migrants, persons with disabilities, indigenous peoples, persons with low literacy skills or facing language barriers, ethnic or religious minorities, economically disadvantaged groups and persons without feasible access to the Internet, television or radio;[1]

9. Promote and use electronic information tools to facilitate procedures related to public access to information upon request by establishing electronic public records systems that allow for the publication of documents and information of public authorities through the Internet, and to process public requests for information electronically;

10. Promote the additional use of electronic information tools to facilitate public input to and monitoring of decision-making in environmental matters, among other things, to:

(a) Alert the public to opportunities to participate;

(b) Ensure that the public can provide publicly documented feedback on proposed activities, plans, programmes, policies and legally binding instruments electronically;

(c) Ensure that submissions received electronically are given equal weight to comments received non-electronically, and that their submission and processing can all be dealt with electronically;

11. Ensure that the public have access to electronic information tools and services supporting the public in exercising their rights in accordance with the Convention, without discrimination as to citizenship, nationality or domicile and, in the case of a legal person,

[1] See also Human Rights Council resolutions 20/8 on the promotion, protection and enjoyment of human rights on the Internet (see A/HRC/RES/20/8), 23/2 on the role of freedom of opinion and expression in women's empowerment (see A/HRC/RES/23/2) and 31/32 on protecting human rights defenders, whether individuals, groups or organs of society, addressing economic, social and cultural rights (see A/HRC/RES/31/32); and paragraph 20 of the Maastricht Recommendations on Promoting Effective Public Participation in Decision-making in Environmental Matters (see ECE/MP.PP/2014/2/Add.2).

without discrimination as to where it has its registered seat or an effective centre of its activities;

12. Ensure the mobilization and sufficient allocation of resources to design, develop, continuously maintain and upgrade electronic information tools to support the implementation of the Convention using best available state-of-the-art digital technologies; use the gains from a reduction in the administrative burden of public authorities, especially from processing information requests, and the associated cost savings from improved efficiency to contribute to resource mobilization;

13. Promote and contribute to international policy dialogue on the use of electronic information tools for public access to environmental information and public participation in decision-making in environmental matters through the exchange of experience and the dissemination of good practices, the transfer of know-how and the provision of technical assistance, as well as actively contribute to the development of a global environmental data strategy under the auspices of the United Nations Environment Programme;

14. Use and further develop existing schemes for the transfer of technology and expertise so as to overcome or reduce the digital divide and all aspects related thereto – for example, through bilateral and multilateral projects or partnerships – and promote digital inclusion, especially in remote areas, and gender and intergenerational equality. Where resources are available, establish and, in the case of donor countries, international financial institutions and other partner organizations, provide financial and technological support for, new schemes for the transfer of technology and expertise;

15. Base the provision, form and content of electronic information tools on user needs identified through surveys, the evaluation of the effectiveness of the tools, citizen science data, user feedback mechanisms, foresight methodologies and other user research tools in accordance with good practices; monitor and assess the impact of the information delivered, in order to raise environmental awareness; facilitate effective access to information, public participation and other public engagements in environmental matters;

16. Ensure that the mandatory systems established to provide an adequate flow of information to public authorities about proposed and existing activities which may significantly affect the environment are continuously maintained and upgraded using best available state-of-the-art digital technologies and international interoperability and other standards;[2]

17. Improve accessibility to environmental data and its quality, interoperability and governance to maximize the benefits of a nationwide digital environmental information system; encourage the integration of big data, including, but not limited to, remotely sensed data, citizen science data and data from other complementary sources, as appropriate, into a nationwide digital environmental information system to facilitate environmental monitoring, timeliness, openness and spatial-temporal coverage of data and its cost-efficiency, usefulness for discovering trends, reanalysis, forecasts and projections, and for cross-thematic analysis;

18. Support and use open science and open research data initiatives, based on robust and scientific methodologies, to inform environmental policymaking and facilitate transparent public discussions;

19. Promote the use of citizen science, crowdsourcing and local and indigenous knowledge through electronic information tools to support the performance of public functions, the provision of public services related to environmental monitoring, effective public participation in decision-making in environmental matters and to promote environmental awareness among the public (see section V below);

20. Promote multilingual electronic information tools by providing information in the national language(s) and at least basic information of interest to the international community in the official languages of the United Nations;

[2] Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention), art. 5 (1) (b) and (9).

21. Disseminate good practices related to the application of the Convention at the national/state, subnational and local levels in areas outlined in paragraph 23 below, and share information on such good practices through the Convention's clearing-house mechanism;[3]

22. Provide information on the implementation of the present recommendations, including on the obstacles encountered and how they could be overcome, through the Convention's national implementation reports, so as to support the review of progress in the implementation of the Convention and the exchange of experiences under its relevant bodies in this area;[4]

III. Priority types of information and its accessibility

23. Ensure, where necessary through the introduction of appropriate legislative or regulatory measures, that, subject to article 5 (10) of the Convention:

(a) Public access to environmental information is provided in searchable electronic form and made available through the Internet, so that information required to be publicly available under the Convention is to be provided in searchable electronic form where so requested and where the information exists in that form or can be readily converted to that form at reasonable cost;

(b) Documentation which is required to be drawn up and/or submitted in the context of decision-making procedures in environmental matters that are subject to the provisions of articles 6, 7 and 8 of the Convention is required to be provided in electronic form and is progressively made accessible to the public through the Internet;

(c) A nationwide digital environmental information system supports public access to real-time and other dynamic and historical, up-to-date, accurate and quality-controlled, comprehensive, standardized and functional environmental information and this information is made discoverable and accessible through the Internet in machine-readable open forms and formats meeting the needs of different users;

(d) The following types of information are made publicly accessible, in a timely manner, through the Internet, preferably through a one-stop web access point:

(i) Reports on the state of the environment;[5]

(ii) Texts, including consolidated versions, of legislation, regulations, rules and other legally binding instruments relating to the environment and their drafts;[6]

(iii) Texts, including consolidated versions, of policies, plans and programmes relating to the environment, and environmental agreements and their drafts;[7]

(iv) International treaties, conventions and agreements on environmental issues, decisions and reports relevant to their implementation and compliance at the national/state level, including findings and recommendations of the Convention's Compliance Committee concerning the Party in question, and environmental performance reviews conducted upon request of the country;[8]

(v) Data on releases and transfers of pollutants within the scope of the Convention;[9]

[3] See ECE/MP.PP/2005/2/Add.4, decision II/3, para.2; and section VII of the present recommendations.

[4] See Format for Aarhus Convention implementation report (ECE/MP.PP/2011/2/Add.1, decision IV/4, annex, questions XI–XIV).

[5] Aarhus Convention, art. 5 (3) (a) and (4).

[6] Ibid., arts. 5 (3) (b) and (5) (a) and 8 (b).

[7] Ibid., art. 5 (3) (c) and (5) (a).

[8] Ibid., art. 5 (5) (b) and (c); and the Almaty Guidelines on Promoting the Application of the Principles of the Aarhus Convention in International Forums (ECE/MP.PP/2005/2/Add.5, annex).

[9] Aarhus Convention, art. 5 (9).

(vi) Documentation related to environmental impact assessments, state ecological expertise, licensing or permitting processes subject to the provisions of article 6 of the Convention (for example, public notices, applications, risk assessment and other studies, all other relevant documentation, comments of third parties, draft and final decisions and attached conditions) where it is held in, or can be readily converted to, electronic form. Where it is not available in electronic form and cannot be converted to electronic form at reasonable cost, a reference to where such documentation can be accessed;[10]

(vii) Documentation related to strategic environmental assessment or other processes of preparing plans, programmes or policies relating to the environment subject to the provisions of article 7 of the Convention (for example, public notices, all other relevant documentation, including risk assessment and other studies, economic analysis and assumptions, comments of third parties, draft and final decisions) where it is held in or can be readily converted to electronic form. Where it is not available in electronic form and cannot be converted to electronic form at reasonable cost, a reference to where such documentation can be accessed;[11]

(viii) All information which could enable the public to take measures to prevent or mitigate harm arising from an imminent threat to human health or the environment, whether caused by human activities or due to natural causes;[12]

(ix) Information on mechanisms related to access to justice, and decisions and reports of courts, information commissioners, Ombudsmen and other national human rights institutions and review bodies related to environmental matters;[13]

(x) Environmental monitoring data[14] held by or on behalf of public authorities, including spatially attributed historical and dynamic data, both primary and processed, regarding quality and pollution of air, soil, water, radiation and other elements and factors of the environment;

(xi) Other environmental information, such as big data or space-based data, and data contained in electronic databases, registers, cadastres and inventories;[15]

(xii) Product-specific data and information, such as those on material and energy efficiency, toxicity, material composition, durability, environmental impact, repairability and recycling, to enable consumers as well as other actors in value chains (for example, market surveillance and waste management) to improve their environmental performance;[16] cooperation with the private sector being essential in ensuring provision of this information. Examples include product databases, digital product passports, eco-labelling, energy efficiency and eco-auditing schemes and environmental product declarations;

(xiii) Good practice information and guidelines on better environmental management, sustainable consumption and production, best available techniques, green procurement, green and circular economy and sustainable development;[17]

(xiv) Environmental monitoring, pollution, waste-related and other environmental data and information provided by citizen science or crowdsourced by a public authority, obtained with the use of public funds or supplied to the public authority by a third party;[18]

(xv) Information on environmental enforcement and compliance;[19]

[10] Ibid., arts. 5 (3) (d) and 6.
[11] Ibid., arts. 5 (3) (d) and 7.
[12] Ibid., art. 5 (1) (c).
[13] Ibid., art. 9, in particular (4) and (5).
[14] Ibid., art. 5 (2) (b) and (c), (3) (d), (7) (a) and (9).
[15] Ibid., art. 5 (2) (b) and (c), (3) (d), (7) (a) and (9).
[16] Ibid., art. 5 (6) and (8).
[17] Ibid., art. 5 (7) (b).
[18] Ibid., art. 5 (1) (b) and (9).
[19] Ibid., arts. 5 (7) (c) and 9 (3).

(xvi) Information on funded environmental projects, including international projects, revenues and expenditures of environment-related funds, public procurement and other public records on the performance of public functions or the provision of public services relating to the environment by government at all levels;[20]

(xvii) Standardized metadata so that the data source, date of its production and update, restrictions, production, verification and validation methods, processes, legal obligations, and context of data and information collection and management are transparent, allow data discoverability and mining, machine-to-machine communication, use and reuse (see also section IV of the annex to the present document);[21]

(xviii) Metainformation, including catalogues of data sources and details of the scope of information held by public authorities and mechanisms for the provision of access to environmental information;[22]

(e) The report on the state of the environment,[23] to be published and disseminated in accordance with article 5 (4) of the Convention, and to include information on the quality of the environment and information on pressures on the environment, should be based on national/state environmental indicators and on the relevant indicators of Sustainable Development Goals, or on environmental indicators agreed under ECE[24] or under other international processes. The report should provide references to underlying data sets from a nationwide pollutant release and transfer register and other sources, as appropriate. The report should be prepared through an inclusive consultation process with all interested members of the public and other stakeholders;

(f) Ensure that summaries and press releases relating to the information listed in subparagraphs (d)–(e) above provide a reference to the sources where these underlying data and information can be traced and accessed by the public;

(g) Open licences should be issued to promote the use and reuse of environmental information. However, in some cases justified by a public interest objective, a licence may be issued imposing conditions on the reuse by the licensee dealing with issues such as liability, the protection of personal data, the proper use of documents, guaranteeing non-alteration and the acknowledgement of source. If public authorities license environmental information for reuse, the licence conditions should be objective, proportionate and non-discriminatory and in accordance with articles 4–8 of the Convention;

IV. Tools and infrastructure

24. Environmental information can be disseminated to the public using various electronic information tools, as appropriate, including:

(a) Websites of public authorities performing public functions, or providing public services related to the environment at the national, subnational and local levels;

(b) Single one-stop web access point (hereinafter – environmental portal) for environmental information, including types of information listed in section III above;[25]

(c) Open Data portal;

(d) General government or e-government portal;

(e) Portals of other key providers of information as relevant with respect to legislation, case law, law-making, justice and other legal, policy and public records information;

[20] Ibid., art. 5 (2) (b) and (c), (3) (d), (7) (c) and (9).
[21] Ibid., art. 5 (2) (b) and (c), (3) and (9).
[22] Ibid., art. 5 (2).
[23] Ibid., art. 5 (3) (a) and (4).
[24] See http://www.unece.org/env/europe/monitoring/iandr_en.html .
[25] ECE/MP.PP/2017/2/Add.1, decision VI/1, para. 3.

(f) Mobile applications;

(g) Social media and online media;

(h) Email alerts;

(i) Short message services (SMS)and mobile messaging applications;

(j) Tools to access environmental information through bar-code or quick-response (QR)-code scanning, chatbots, services in microservices architectures, widgets and application programming interfaces (API);

(k) Tools to access environmental information through touch-tone dialling;

(l) Public electronic information kiosks;

(m) Telephone hotline;

(n) Television teletext;

(o) Digital twins and augmented reality;[26]

25. Develop, if missing, and continuously maintain and upgrade an environmental portal based on the nationwide digital environmental information system, to: ensure effective public access to information through the Internet; promote environmental education and awareness; and support effective public participation in decision-making and other public engagements in environmental matters (see section V of the annex to the present document);

26. Ensure that databases, registers, lists, inventories, cadastres and other resources containing environmental information listed in section III above are developed, continuously maintained and converted, where possible, or upgraded in digital form by default as integral parts of the nationwide digital environmental information system. A microservice architecture or modular approach can be used to allow an autonomous upgrade of different integral parts as needed;

27. Ensure that the environmental portal:

(a) Is user-friendly and promotes user customization and accessibility;

(b) Aggregates data and information resulting from different sources or provides visible links to other thematic portals (see section V of the annex to the present document);

(c) Supports the implementation of the national "e-government", "open government", "open data", "open science" and "the digital transformation" frameworks;

(d) Supports the implementation of the Shared Environmental Information System principles (see section III of the annex to the present document);

(e) Supports the implementation of the Group on Earth Observations data-sharing principles and data-management principles covering the entire data life cycle (see section II of the annex to the present document);

(f) Promotes machine-to-machine communication and interoperability with statistical, geospatial, health and other information systems throughout the technical, semantic and legal dimensions;

(g) Allows for the use of cloud computing services and other best available state-of-the-art digital technologies;

28. Promote the development, continuous maintenance and upgrade of online portals providing access to legislation, case law, law-making, justice and other legal, policy and public records information systems using best available international standards and state-of-the-art digital technologies. Resources of such systems should be properly categorized according to the relevant environmental matters and made discoverable and accessible to the public in accordance with the Convention through these portals and environmental portal;[27]

[26] Aarhus Convention, art. 5 (3).

[27] Ibid., arts. 5 (3) (b) and (c) and (5) and 7–9.

29. To support effective public participation in decision-making in environmental matters,[28] the following tools can be used, without neglecting the need for traditional means of communication, such as official noticeboards, placards at proposed activity sites, notices in appropriate print and online local, regional or nationwide newspapers and television media:

(a) Electronic official noticeboards of the public authorities;

(b) Public advisory e-committees;

(c) Web meetings;

(d) Public e-consultations platforms, including opinion polls and virtual surveys;

(e) E-petitions platforms;

(f) Social media groups;

(g) Mobile messaging applications, including chatbots;

(h) Teleconferences;

(i) Participatory mapping, crowdsourcing, and citizen science platforms;

30. In case of any imminent threat to human health or the environment, ensure that all information is disseminated immediately and without delay to members of the public who may be affected.[29] Encourage the establishment of a multi-hazard early warning system; the use of emergency telephone numbers, mobile messaging applications, including chatbots, radio emergency networks, media, including traditional media and social media, online portals and mobile applications used for the routine dissemination of environmental information to provide information in case of imminent threat to human health or the environment in forms and formats meeting the needs of different users;

31. Electronic information tools progressively should contain an open application programming interface to provide data and metadata as appropriate, supported by clear technical documentation that is complete and available online. The set-up and use of the application programming interface should be based on several principles: availability; stability; maintenance over life cycle; uniformity of use and standards; user-friendliness; and security. If open application programming interfaces are not possible, electronic information tools should contain a publicly available justification;

32. Ensure the availability of machine-readable, user-friendly and open formats for the data and information listed in section III above in a way that they can be shared and reused (see section IV of the annex to the present document);

33. Ensure continuous maintenance and update with sufficient frequency of electronic information tools and their content, including links, information on the reliability of the information sources and dates of the last updates. If a public authority can no longer make available certain environmental information or electronic information tools for use or reuse, or has to cease updating that information or those tools, it should make this publicly known and give reasons, at the earliest opportunity, by electronic means where possible;

34. Promote and support efforts towards the development of methodologies, crowdsourced mobile applications and tools to provide the public with accessible, comprehensive, up-to-date and comparable information on the environmental impact of products that enables consumers to make informed environmental choices;

35. Encourage the use of pilot and lab-based projects and state-of-the-art public engagement processes to develop and upgrade electronic information tools or to apply new or emerging digital technologies, including cloud and edge computing services, open data cubes, artificial intelligence, machine learning, chatbots, hyperautomation, blockchain,

[28] Ibid., arts. 5 (3) (d) and (7) and 6–8; and Maastricht Recommendations on Promoting Effective Public Participation in Decision-making in Environmental Matters (ECE/MP.PP/2014/2/Add.2).

[29] Aarhus Convention, art. 5 (1) (b) and (c), (6) and (9).

linked data, text mining, autonomous technologies for drones and other unmanned aerial vehicles, low-cost and mobile sensors, and the Internet of things;

V. Engagement of the public, operators and other interested stakeholders

36. Provide opportunities for public participation in the design, development and upgrade of electronic information tools taking into account good practices to ensure that the needs of different users are met;

37. Take appropriate measures in accordance with best available international standards to render electronic information tools more accessible to the users – in particular to older persons, persons with disabilities, persons with low literacy skills or facing language barriers and other persons in vulnerable situations – by making them user-friendly, operable, understandable and robust;

38. Implement the onboarding for different types of potential users (for example, decision-makers, the scientific community and researchers, education professionals, business operators, journalists, NGOs promoting environmental protection, Aarhus Centres, indigenous peoples, children and youth, citizen science participants and other groups of the public with specific interests) tailored to each electronic information tool;

39. Ensure that electronic information tools have an open source user-feedback mechanism, which provides possibilities to all interested users comment on data and information accessibility, content, quality, sustainability of use and reuse, as well as on issues or events that condition the interpretation of the data;

40. Promote the use and reuse of environmental information by the public and other interested stakeholders by organizing hackathons, datathons, forums, promotion campaigns, start-up incubators, public-private partnerships and other forms of engagement;

41. Encourage the collection of local and indigenous knowledge, citizen science and crowdsourced data provided or generated by members of the public through citizen science observatories, projects, or other relevant participatory initiatives, and promote the interoperability and integration of such data with other sources of environmental data and information, in accordance with best available international standards;

42. Promote and support efforts towards the development of methodologies and mobile applications and tools to support the public in the collection and sharing of environmental data and information;

43. Promote the accessibility, reuse and interoperability of research data, taking into consideration the principles for scientific data management and stewardship and other best available international standards (see sections II–IV of the annex to the present document);

44. Encourage operators whose activities have a significant impact on the environment to develop and use, as appropriate, web-based, mobile and social media applications taking into account the best available state-of-the-art digital technologies and international interoperability and other standards (see para. 35 above and section IV of the annex to the present document) to:

(a) Inform the public regularly of the environmental impact of the operators' activities and products and other environmental information collected under a legal obligation to do so;

(b) Provide the public authorities with an adequate flow of information about these activities through the mandatory system (see para. 16 above) regularly and in case of any imminent threat to human health or the environment;[30]

[30] Ibid., art. 5 (1) (b) and (c), (6) and (9).

VI. Governance, institutional development and capacity-building

45. Establish, in physical and/or virtual environments, environmental information centres or equivalent settings that will promote public access to information and public participation in decision-making in environmental matters;

46. Promote access to electronically stored environmental information by establishing and maintaining Internet access points for the local population at information sites available for public use, including in Aarhus Centres, public libraries, environmental information centres, museums, archives and at other sites;

47. Ensure that "e-government", "open data" and "open science" governance frameworks integrate environmental matters;

48. Identify points of contact and data stewards who will be responsible for information management, dissemination of environmental information and maintenance of electronic information tools;[31]

49. Promote the development and wider use of electronic information tools based on best available state-of-the-art digital technologies as an effective instrument for putting into practice the Convention's provisions, including through public-private partnerships;

50. Develop human capacity for the use of electronic information tools to promote the implementation of the Convention through comprehensive and forward-looking training and education programmes for public officials, the scientific community and researchers, education professionals, business operators, journalists, NGOs promoting environmental protection, Aarhus Centres, indigenous peoples, children and youth, women, citizen science participants and other groups of the public with specific interests;

51. Undertake measures to develop the institutional capacities of public authorities to collect, update, organize and store environmental data and information in electronic and digital forms as the default in the nationwide digital environmental information system and to disseminate them through electronic information tools;

52. Develop and apply comprehensive environment-related educational and capacity-building programmes that also cover the use of electronic information tools and the best available state-of-the-art digital technologies;

53. Share good practices, case studies, project outcomes and other useful material through the Convention's clearing-house mechanism (see section VII below);

VII. Clearing-house mechanism

54. Maintain a national website, preferably as an environmental portal (see para. 25 above and section V of the annex to the present document), with information related to the nationwide implementation of the Convention, which will serve as the national node of the Convention's clearing-house mechanism and provide its link to the Convention's secretariat for uploading to the central node;

55. Designate contact points responsible for collecting, managing and updating the information contained in the national node and for providing the necessary information for the central node of the Convention's clearing-house mechanism, and undertake measures to disseminate information to the public on the clearing-house mechanism;

56. Develop capacity for public officials managing and updating information for the national node, and for providing the necessary information for the central node of the clearing-house mechanism.

[31] Ibid., art. 5 (2) (b).

Annex

Supporting explanatory notes

I. Terminology

1. To facilitate the use of the above-mentioned recommendations, the following terms apply:

(a) "Aarhus Convention" and "Convention", which mean the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, done at Aarhus, Denmark, on 25 June 1998;

(b) "Accessibility", which means the set of principles and techniques to be observed when designing, developing, maintaining and upgrading electronic information tools in order to make them more accessible to users, in particular persons with disabilities;

(c) *"*Akoma Ntoso*",* which defines a set of simple technology-neutral electronic representations in Extensible Markup Language (XML) format of parliamentary, legislative and judiciary documents;

(d) "Application programming interface" (API), which means a set of functions, procedures, definitions and protocols for machine-to-machine communication and the seamless exchange of data. Application programming interfaces can have different levels of complexity and can mean a simple link to a database to retrieve specific data sets, a web interface, or more complex set-ups;

(e) "Artificial intelligence", which refers to systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals;

(f) "Augmented reality", which refers to an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory and olfactory;

(g) "Blockchain", which refers to a growing list of records, called blocks, that are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp, and transaction data. By design, a blockchain is resistant to modification of the data;

(h) "Chatbot", which refers to a menu-based or actionable software application used to conduct an online chat conversation via text or text-to-speech with the aim of providing direct contact with users;

(i) "Citizen science", which means a form of open collaboration in which members of the public participate voluntarily in the scientific process, engineering research or environmental monitoring in various ways;

(j) "Citizen science observatories", which refers to community-based environmental monitoring and information systems that invite individuals to share observations, typically via mobile telephone or the web;

(k) "Crowdsourcing", which means a method of obtaining needed services, ideas or content by soliciting voluntary contributions from members of the public, especially from an online community;

(l) "Data", which refers to all types of data, including:

(i) "Dynamic data", which means documents in a digital form, subject to frequent or real-time updates, in particular because of their volatility or rapid obsolescence (for example, data generated by sensors are typically considered to be dynamic data);

(ii) “Primary data”, which means the environmental data received earlier and fixed in any form that could be available for processing;

(iii) “Big data”, which means data that contain greater variety arriving in increasing volumes and with ever-higher velocity;

(iv) “Research data”, which means documents in a digital form, other than scientific publications, which are collected or produced in the course of scientific research activities and are used as evidence in the research process, or are commonly accepted in the research community as necessary to validate research findings and results;

(v) “Citizen science data”, which means data collected by members of the public, often in collaboration with or under the direction of professional scientists, non-governmental organizations and scientific institutions;

(vi) “Citizen-generated data”, which means data produced through citizen sensing, citizen science and other forms of civic monitoring that share the common denominator that the data collection process is primarily carried out by volunteer individuals actively joining the initiative;

(m) “Data catalogue”, which means a collection of metadata, combined with data management and search tools, that helps analysts and other data users to find the data that they need, serves as an inventory of available data, and provides information to evaluate fitness data for intended uses;

(n) “Data cube”, which means a multidimensional ("n-D") array of values and refers to an approach to storing, processing and analysing large collections of environment-related Earth observations and other data. The technology is designed to monitor changes in the state of the environment by being agile and flexible with vast amounts of layered grid data;

(o) “Data harvesting”, which means a process that copies data sets and their metadata between two or more data catalogues;

(p) “Data mining”, which means the practice of examining large databases in order to generate new information;

(q) “Data management”, which refers to management of information and data for secure and structured collection, update, storage, processing and access. Data management tasks include the creation of data governance policies, analysis and architecture; database management system integration; data security and data source identification, segregation and storage;

(r) “Datathon”, which means collaborative computer programming for a data analysis event, typically lasting several days and involving data scientists, software developers, members of the public, etc.;

(s) “Digital transformation”, which refers to the economic, societal and environmental effects of digitization and digitalization;

(t) “Digitization”, which means the technical process of converting analogue information into digital form;

(u) “Digitalization”, which means the organizational or business process of technologically induced change within organizations, markets and branches;

(v) “Digital divide”, which means any uneven distribution in the access to, use of, or impact of information and communication technologies between any distinct groups;

(w) “Digital environmental information system”, which is an electronic system that enables sharing of all types of digital data, information, and knowledge relevant to environmental matters to be made available, discoverable and accessible in accordance with the Convention;

(x) “Digital twin”, which refers to a digital replica of potential and actual physical assets, processes, people, places, systems and devices that can be used for various purposes.

The digital representation provides both the elements and the dynamics of how a given Internet of things device operates and lives throughout its life cycle;

(y) “Discoverability”, which refers to users’ ability to find data, information, applications or services;

(z) “Earth observations”, which refers to data and information collected about Earth, whether atmospheric, oceanic or terrestrial;

(aa) “E-government initiatives”, which encompass the activities of public authorities to deploy information and communication technologies for the improvement of knowledge and information in the service of the public;

(bb) “Environmental information”, which means environmental information as defined by article 2 (3) of the Convention;

(cc) “Environmental indicator”, which means an indicator supporting all phases of environmental policymaking, from designing policy frameworks to setting targets, and from policy monitoring and evaluation to communicating to policymakers and the public;

(dd) “Hackathon”, which means a collaborative computer programming or open-hardware event, typically lasting several days and involving computer programmers, software developers, hackers, makers, etc.;

(ee) “Hyperautomation”, which refers to the application of state-of-the-art digital technologies, including artificial intelligence and machine learning, to increasingly automate processes and augment human resources;

(ff) “Internet of things”, which means the interconnection through the Internet of computing devices embedded in everyday objects, enabling them to send and receive data;

(gg) “Interoperability”, which means the ability of a computer system or software to work with other systems or products without special effort on the part of the user. It includes the technical, semantic and legal dimensions;

(hh) “Linked data”, which refers to a method of publishing structured data using standardized vocabularies that can be connected together and read automatically by machines with the support of standard web technologies;

(ii) “Machine learning”, which means the scientific study of algorithms and statistical models that computer systems use to perform a specific task without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of artificial intelligence;

(jj) “Machine-readable format”, which means a file format structured so that software applications can easily identify, recognize and extract specific data, including individual statements of fact, and their internal structure;

(kk) “Metadata”, which means a set of data that describes and gives information about other data;

(ll) “Microservice architecture”, which refers to a kind of service-oriented architecture that arranges an application as a collection of loosely coupled services;

(mm) “Mobile application”, which means application software designed and developed, by or on behalf of public authorities, for use by the public on mobile devices such as smartphones or tablets. It does not include the software that controls those devices (mobile operating systems) or hardware;

(nn) “Onboarding”, which means the process of familiarizing a new user with electronic information tools, taking into account the user’s needs, behaviour, experiences and goals;

(oo) “Open data”, which denotes data in an open format that can be freely used, reused and shared by anyone for any purpose;

(pp) “Open format”, which means a file format that is platform-independent and made available to the public without any restriction that impedes the reuse of information;

(qq) “Open licence”, which means standardized public licences available online that allow data and other content to be freely accessed, used, modified and shared by anyone for any purpose, and that rely on open data formats (for example, custom-made licences, creative commons licences, open government licences for public sector information);

(rr) “Open government data initiatives”, which encompass activities to make data or information produced or commissioned by public authorities available for everyone to access, reuse and redistribute without any restrictions;

(ss) “Open science initiatives”, which encompass activities to make the primary outputs of publicly funded scientific and research results – publications and research data – publicly accessible in digital format with no or minimal restriction as a means of accelerating research;

(tt) “Participatory mapping”, which means the use of a growing toolbox of techniques that can help members of the public record and share spatial knowledge through the use of participatory methods and cartographic representations, often in a digital form;

(uu) “Pollutant release and transfer register”, which refers to a coherent, nationwide system of pollution inventories or registers on a structured, computerized and publicly accessible database compiled through standardized reporting. Such a system may include inputs, releases and transfers of a specified range of substances and products, including water, energy and resource use, from a specified range of activities to environmental media and to on-site and off-site treatment and disposal sites;[1]

(vv) “Public record”, which means any information or documents that are made by a public authority or public official and are required by law to be kept and maintained;

(ww) “Public-private partnership”, which refers to a scheme that involves cooperation between the public and the private sectors aimed at financing, designing, implementing and operating public sector infrastructure and services supporting the implementation of the Convention;

(xx) “Reuse”, which means the use by the public of environmental information held by public authorities for commercial or non-commercial purposes other than the initial purpose within the performance of public functions or the provision of public services in relation to the environment for which the information was collected. In technical terms, reuse can be supported by data management principles (see sections II and III below);

(yy) “Search engine advertising” (SEA), which means advertising through search engines;

(zz) “Search engine optimization” (SEO), which means the process of maximizing the number of users of a particular website by ensuring that the website appears high on the list of results returned by a search engine;

(aaa) “Semantic web”, which is a mesh of information linked up in such a way as to be easily processable by machines, on a global scale;

(bbb) “Social media optimization” (SMO), which means the use of social media networks to manage and maximize the number of users and the online presence;

(ccc) “Standard licence”, which means a set of predefined reuse conditions in a digital format, preferably compatible with standardized public licences available online;

(ddd) “Text mining”, which means the discovery by machine of new, previously unknown information, by automatically extracting information from different written resources;

(eee) “User feedback”, which refers to a data quality component that includes information about the data directly provided by users based on their experiences using the

[1] Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, art. 5 (9).

data. It may include comments, quality assessments, discovered issues, usage reports, etc. It complements the data quality information provided by its producer;

(fff) "Widget", which refers to a small piece of web programming code that makes environmental data and information appear on a blog, wiki, or web page. Information in a widget can feature updated information or allow the user do something like use a search box.

II. Data sharing and data management principles developed by the Group on Earth Observations

2. "Earth observations" include space-based or remotely sensed data, as well as ground-based or in situ data.

3. The following data sharing principles and data management principles have been developed by the Group on Earth Observations:[2]

(a) Data sharing principles:

(i) Data, metadata and products will be shared as open data by default, by making them available as part of the Global Earth Observation System of Systems Data Collection of Open Resources for Everyone (Data-CORE) without charge or restrictions on reuse, subject to the conditions of registration and attribution when the data are reused;

(ii) Where international instruments, national policies or legislation preclude the sharing of data as open data, data should be made available with minimal restrictions on use and at no more than the cost of reproduction and distribution;

(iii) All shared data, products and metadata will be made available with minimum time delay;

(b) Data management principles:

(i) Discoverability:

DMP-1. Data and all associated metadata will be discoverable through catalogues and search engines, and data access and use conditions, including licences, will be clearly indicated;

(ii) Accessibility:

DMP-2. Data will be accessible via online services, including, at a minimum, direct download but preferably user-customizable services for visualization and computation;

(iii) Usability:

DMP-3. Data will be structured using encodings that are widely accepted in the target user community and aligned with organizational needs and observing methods, with preference given to non-proprietary international standards;

DMP-4. Data will be comprehensively documented, including all elements necessary access, use, understand and process, preferably via formal structured metadata based on international or community-approved standards. To the extent possible, data will also be described in peer-reviewed publications referenced in the metadata record;

DMP-5. Data will include provenance metadata indicating the origin and processing history of raw observations and derived products, to ensure full traceability of the product chain;

[2] Referenced in the Group on Earth Observations Strategic Plan 2016–2025: Implementing the Global Earth Observation System of Systems (GEOSS) and reaffirmed through the Mexico City Declaration adopted by the Group on Earth Observation at its twelfth plenary session (Mexico City, 11 and 12 November 2015), available at, respectively, http://www.earthobservations.org/open_eo_data.php# and https://earthobservations.org/geo12.php .

DMP-6. Data will be subjected to quality control and the results of quality control shall be indicated in metadata; data made available in advance of quality control will be flagged in metadata as unchecked;

(iv) Preservation:

DMP-7. Data will be protected from loss and preserved for future use; preservation planning will be for the long term and include guidelines for loss prevention, retention schedules and disposal or transfer procedures;

DMP-8. Data and associated metadata held in data management systems will be periodically verified to ensure integrity, authenticity and readability;

(v) Curation:

DMP-9. Data will be managed to perform corrections and updates in accordance with reviews, and to enable reprocessing as appropriate; where applicable this shall follow established and agreed procedures;

DMP-10. Data will be assigned appropriate persistent, resolvable identifiers to enable documents to cite the data on which they are based and to enable data providers to receive acknowledgement of use of their data.

III. Shared Environmental Information System principles

4. A "shared environmental information system" (SEIS) is underpinned by a series of principles that ensure interoperable flow of information about environmental monitoring, data, indicators, assessments and knowledge.[3]

5. According to the principles of a shared environmental information system, information should be:

(a) Managed as close as possible to its source;

(b) Collected once and shared with others for many purposes;

(c) Readily available to easily fulfil reporting obligations;

(d) Easily accessible to all users;

(e) Accessible to enable comparisons at the appropriate geographical scale and the effective participation of the public in the development and implementation of policies relating to the environment;

(f) Fully available to the public and at the national level, and available in the relevant national language(s);

(g) Supported through common, free, open software standards.

6. A functional shared environmental information system should be structured around three pillars: content, infrastructure and cooperation. First, the system needs to identify the types of content (data) required, as well as potential sources. Second, an effective, web-enabled technical infrastructure is required that takes full advantage of the best available state-of-the-art digital technologies, including web services supported by machine-to-machine communication. Third, governance structure and cooperation among information providers and users are required to manage human resources, inputs and networking.

IV. Standards for a nationwide digital environmental information system

7. All data contained in the nationwide digital environmental information system should be accompanied by traceable and linked standardized metadata developed in accordance with

[3] See www.unece.org/environmental-policy/environmental-monitoring-and-assessment/areas-of-work/shared-environmental-information-system.html .

standards established by the International Organization for Standardization,[4] the World Meteorological Organization,[5] the World Wide Web Consortium,[6] the Open Geospatial Consortium[7] and other international forums, as mandated.

8. All metadata should be user- and machine-readable, accompanied by an open licence and made accessible, preferably as part of a Hyper Text Markup Language (HTML) web page and via application programming interfaces (APIs).

9. The following metadata standards for the digital environmental information system can be used:

(a) Dublin Core Metadata (DCMI) terms (DCTERMS);[8]

(b) Data Catalogue Vocabulary (DCAT),[9] including GeoDCAT-AP and StatDCAT-AP;

(c) Statistical Data and Metadata eXchange (SDMX);[10]

(d) DDI-Lifecycle standard;[11]

(e) [ISO 19115] EN ISO 19115-1:2014, Geographic information – Metadata – Part 1: Fundamentals;[12]

(f) [ISO 19139] ISO/TS 19139-1:2019, Geographic information – XML schema implementation – Part 1: Encoding rules.[13]

10. Data and metadata contained in the digital environmental information system can be shared and made interoperable using the following standards:

(a) OGC Web Map Service (WMS);[14]

(b) OGC Web Coverage Service (WCS);[15]

(c) OGC Catalogue Service for the Web (CSW);[16]

(d) OGC Water Markup Language (waterML);[17]

(e) OGC Web Feature Service (WFS);[18]

(f) OGC GEOPackage Encoding Standard;[19]

(g) [RFC 7946] GeoJSON Format;[20]

(h) OGC Earth Observation Dataset Metadata GeoJSON(-LD) Encoding Standard;[21]

(i) OGC OpenSearch Extension for Earth Observation;[22]

[4] See www.iso.org/standards-catalogue/browse-by-ics.html .
[5] See https://public.wmo.int/en/resources/standards-technical-regulations .
[6] See www.w3.org/standards/about.html .
[7] See www.ogc.org/docs/is .
[8] See https://dublincore.org/ .
[9] See www.w3.org/TR/vocab-dcat-2/#introduction .
[10] See https://sdmx.org/ .
[11] See https://ddialliance.org/explore-documentation .
[12] See www.iso.org/standard/53798.html .
[13] See www.iso.org/standard/67253.html .
[14] See www.ogc.org/standards/wms .
[15] See www.ogc.org/standards/wcs .
[16] See www.ogc.org/standards/cat .
[17] See www.ogc.org/standards/waterml .
[18] See www.ogc.org/standards/wfs .
[19] See www.ogc.org/standards/geopackage .
[20] See https://geojson.org/ .
[21] See www.ogc.org/standards/eo-geojson .
[22] See www.ogc.org/standards/opensearch-eo .

(j) OGC OpenSearch Geo and Time Extensions;[23]

(k) [ISO 13028] ISO/TR 13028:2010, Information and documentation – Implementation guidelines for digitization of records;[24]

(l) XML for parliamentary, legislative and judiciary documents (Akoma Ntoso).[25]

11. When complementing and not covered by section II above, the Findable, Accessible, Interoperable and Reusable (FAIR) principles for scientific data management and stewardship[26] should be followed to promote accessibility, reuse and interoperability of environmental research data. For promoting public participation in scientific research, the core data and metadata standards (PPSR-CORE)[27] could be used.

V. Single one-stop web access point (portal) for environmental information

12. Develop environmental portal serving as a single one-stop web access point for environmental data and information, in accordance with open data sharing principles and data management principles (see also sections II and III of the above-mentioned recommendations and sections II–IV above), to ensure user customization and accessibility, effective maintenance of integral parts of the digital environmental information system and support of harvesting information through standardized reporting at the local, subnational, national and international levels, as appropriate.

13. Link the environmental portal through the use of open application programming interface, Really Simple Syndication (RSS) feeds and other interoperability tools to the thematic portals, platforms and data hubs (local, subnational, national and international), as relevant, to make environmental data and information discoverable and directly accessible.

14. Enable the use, through the environmental portal, of new or emerging digital technologies, including cloud computing services, open data cubes, artificial intelligence, blockchain, linked data, text mining and semantic web tools (see also para. 35 of the above-mentioned recommendations).

15. Provide opportunities for the public to participate in the design, development and upgrade of the environmental portal, taking into account good practices to ensure that the needs of different users are met.

16. Develop the onboarding system for different types of users and take the necessary measures to make the portal accessible taking into account their needs (see also section V of the above-mentioned recommendations).

17. Ensure high visibility of the portal to the public through the use of search engine optimization, social media optimization and search engine advertising, as appropriate.

18. Ensure direct access through the environmental portal to disaggregated, real-time and other dynamic data, as appropriate, including to space-based, citizen science, crowdsourced and other data outlined in paragraph 23 (d) of the above-mentioned recommendations.

19. Provide information on the points of contact to support the public in seeking access to information under the Convention.

20. Ensure that each web page of the environmental portal containing information and links is updated regularly and contains the date of the last update and the information source.

21. The content of the environmental portal can include the following themes:

(a) Introduction;

[23] See www.ogc.org/standards/opensearchgeo .
[24] See www.iso.org/standard/52391.html .
[25] See www.akomantoso.org/ .
[26] See www.go-fair.org/fair-principles/ .
[27] See https://github.com/CitSciAssoc/DMWG-PPSR-Core .

(b) Reports on the state of the environment;

(c) Environment themes (overview of legislation, policy, programmes, plans, international commitments, monitoring, data/data sources, environmental indicators, assessments, map viewers, scenarios, good practices in accordance with section III of the above-mentioned recommendations):

(i) Air and atmosphere;

(ii) Climate;

(iii) Water;

(iv) Soil;

(v) Land;

(vi) Ocean and sea;

(vii) Subsoil and mineral resources;

(viii) Natural sites and landscape;

(ix) Forests;

(x) Biological diversity;

(xi) Genetically modified organisms;

(d) Factors (overview of legislation, policy, programmes, plans, international commitments, data/data sources):

(i) Pollutant release and transfer register;

(ii) Chemicals management;

(iii) Waste management;

(iv) Energy efficiency and consumption;

(v) Noise and odour;

(vi) Radiation;

(vii) Use of natural resources;

(viii) Product passports and other product-related information;

(e) Decision-making in environmental matters:

(i) Public consultations;

(ii) Strategic environmental assessment;

(iii) Environmental impact assessment and State ecological expertise;

(iv) Licensing and permitting;

(f) Activities, measures and good practices:

(i) Economic-environmental accounting;

(ii) Eco-labelling scheme;

(iii) Eco-audit scheme;

(iv) Producer responsibilities;

(v) Green procurement;

(vi) Public-private partnerships and environmental agreements;

(vii) Funded environmental projects;

(viii) Good practices on better environmental management, sustainable consumption and production, best available techniques, green procurement, green and circular economy and sustainable development;

(g) Environmental compliance and enforcement;

(h) Environment-related hazards and their zones, risks and emergencies:

(i) Dashboard and maps;

(ii) Situation reports and scenarios;

(iii) Mitigation and remediation measures taken by public authorities;

(iv) Prevention, mitigation and remediation measures for the public concerned, in particular for groups and communities in vulnerable situations;

(v) Citizen science and crowdsourcing data;

(vi) Media resources;

(vii) Training and e-learning;

(i) Public records;

(j) Data explorer;

(k) Research and education;

(l) Publications and downloads;

(m) Public engagement:

(i) Official notice board;

(ii) Aarhus Convention, its implementation and compliance;

(iii) Access to information;

(iv) Citizen science and crowdsourcing;

(v) Participation in decision-making in environmental matters;

(vi) Access to justice;

(vii) Accessibility menu and accessibility statement for access by persons with disabilities, and capacity-building for onboarding process tailored to different user needs;

(n) Media news and resources;

(o) Points of contact and user support and feedback services;

(p) Specifications for reuse of data and information;

(q) Terms and conditions of use.