Identifying the research and infrastructure needs for the global assessment of hazardous chemicals 10 years after establishing the Stockholm Convention

The Stockholm Convention (SC) on Persistent Organic Pollutants (POPs) is a global treaty under UNEP with the objective to protect human health and the environment from hazardous, long-lasting chemicals by restricting and ultimately eliminating their production, use, trade, and release. Ten years after the adoption of the Convention on 22 May 2001, an expert meeting organized by the Regional Centre of the Stockholm Convention for capacity building and transfer of technology in Central and Eastern Europe (RECETOX) was held in Brno, Czech Republic, on May 22-24, 2011, with the support of the Secretariat of the Stockholm Convention (SSC), the American Chemical Society and the European Association for Chemical and Molecular Sciences - Division of Chemistry and the Environment. The aim of the workshop was to assess progress, identify gaps, challenges and research needs associated with the global assessment of hazardous chemicals. In order to maximize the benefits of current scientific experience and enhance their transformation into policy actions, the expertise of 40 invited scientists from 16 countries of three UN regions was sought and supplemented by experience of the representatives of the SSC, UNEP, and government. Their expertise addresses the fields of environmental chemistry and modeling, monitoring of air, water and biota, assessment of human exposure, effects and risks, and data interpretation and management. Recognizing that significant but insufficient and uneven progress has been made towards the World Summit on Sustainable Development (WSSD) 2020 goal on sound management of chemicals through the Stockholm, Rotterdam and Basel Conventions, the Strategic Approach to International Chemicals Management (SAICM) and other existing programs, initiatives, and instruments as well as improved regulatory regimes at the national and regional levels, the workshop participants urge stakeholders to intensify efforts to make steps towards speedier progress across countries and regions to improve the sound management of toxic chemicals (including POPs). We identify the following priority areas:

I – Source control of POPs and other chemicals

Concerted and cost-effective source and exposure reduction requires knowledge and control of the key emission sources of hazardous chemicals on local to global scales that, in some cases, include surprisingly large but poorly documented stocks of 'primary' sources (new emissions to the environment) as well as 'secondary' sources (releases of previously emitted persistent chemicals and their further cycling in the environment). Recent evidence indicates that stockpiles, deposited wastes, and poorly controlled "recycling" of disposed products are an ongoing source of some POPs to the environment and they could become increasingly important for local and national exposure assessments. Many countries currently lack the capacity to document and control sources of POPs (see priority area VIII). It is important to ensure that compliance with controlling POPs banned under the SC is not achieved by relocating banned POPs from developed countries to countries lacking capacity.

II – Global scale transport, sources and sinks

POPs subject to control under the SC are characterized by their ability to disperse widely and exert effects far from their sources. Their potential to be transported on regional, continental and global (inter-continental) scales is affected by their formation/usage/ disposal patterns and their chemical and physical properties, and is linked to atmospheric

and oceanic circulation patterns and, to a lesser extent, transport by migrating animals. Understanding how POPs spread through the environment therefore requires linking source control (see priority area I) to knowledge on chemical and physical processes (see priority area III), chemical fate and transport models, and monitoring data. A helpful step forward in providing reliable monitoring data on core media (air, human milk and blood, and surface water) was establishment of the Global Monitoring Plan (GMP) under the SC in 2006 (see priority area VI), and development of the GMP Guidance Document giving advice on cost-effective sampling and sensitive analytical methods. However, experience shows that to ensure sustainable and coherent information flow in the near future, the global community needs to further link all existing instruments (see priority area VII).

III – Persistence of chemical compounds

Compound degradation, formation of metabolites and partial breakdown products all influence the persistence and hence the long-term concentrations of chemicals and yet there is a dearth of information about degradation rates and pathways. Improved understanding of these processes can be achieved by linking laboratory-scale experiments with mass balance models to assess degradation of chemicals whilst they undergo multimedia global transport. Knowledge on half-lives and degradation pathways will facilitate the estimation of source-receptor relationships and control strategies under a variety of global change scenarios.

IV – Tools for monitoring of chemical concentrations and fluxes

Advances in sampling and analysis developed since the signing of the SC should be utilized to increase the spatial and temporal resolution of POPs concentrations and flux measurements in core media (air and surface waters), since this will assist with assessing source and exposure contributions. A range of new and/or improved tools and techniques are needed to strengthen our ability to characterize primary and secondary emission sources of the chemicals of global concern and their fate in the environment including: (a) advanced and cost-effective sampling methods and sensors capable of providing in quasi-real time, well-calibrated concentrations of such compounds in ambient air, aquatic and terrestrial ecosystems, at different latitudes including polar regions; (b) flux-based techniques to improve the quantitative assessment of the relative importance of primary and secondary sources (see priority area I); and (c) screening methods for foodstuffs, bioavailability determinations and effect-based assessment.

V – Future trends and scenarios

While the production and use of many, but not all hazardous chemicals has been banned or restricted, ongoing commitments to future source and exposure reductions are constrained by uncertainties in: (a) the extent and hence impact of past and current control measures which include numerous exemptions; (b) the extent and impact of new control measures; (c) activities beyond the scope of the SC; and (d) changes in chemicals concentrations because of global climate change, change in land use, etc. Integrated measurement and modeling strategies are required to build the scientific platform to allow policy makers to assess and then undertake cost-effective strategies for reducing the risk for human health and the environment in the future.

VI – Global monitoring plan

The GMP, a key element to the Effectiveness Evaluation of the SC under Article 16, is meant to be an integral part of current efforts to improve the effective management of hazardous chemicals as well as our understanding of the Earth system (see priority area VII). While the GMP critically depends on reliable temporal trend data, the network reporting data for the GMP is currently an unsustainable, short-term 'proof of concept' project. It has been shown to be a workable model that can fulfill Article 16 requirements; however, it needs sustained long-term support to achieve its function. For long-term sustainability, this network should be also underpinned by key nationally funded programs. Good success has already been achieved with the incorporation of existing monitoring networks. It is envisaged that the established core international network of contributors be strengthened and further capacitated to enable the synergistic use of international joint research infrastructure together with partners from developing countries. Coordination of sampling activities, harmonization of QA/QC procedures and reporting formats are essential to this effort providing globally coherent trends monitoring.

VII - Global Earth observation system of systems (GEOSS)

To improve the flow of relevant data to the environmental and health communities, the GMP has to be linked to available synergic instruments, especially to the GEOSS. It has been incorporated in the area of health (HE-02), as one of 9 'Societal Benefit Areas' (disasters, health, energy, climate, water, weather, ecosystems, agriculture and biodiversity) identified in the revised (2012-2015) work plan in support to the 10-Year Implementation Plan of GEOSS. Among the priority actions to be undertaken in the next 3 years in frames of HE-2 is to (a) develop and implement a global monitoring plan for tracking changing levels of POPs in the natural environment and human beings, (b) evaluate the effectiveness of international efforts to reduce POP releases, and (c) interlink relevant existing information systems for monitoring air, water, ice caps and human health. While former priority actions are under development, the latter one is awaiting implementation as the information system hosting GMP data is non-existent. Development of such databases is needed to enhance visibility of the GMP and to facilitate improved interpretation, spatial visualization, and modeling of available monitoring data.

VIII - Capacity building

To ensure the effectiveness of the SC and related Conventions at local and global scales, institutional knowledge and the technical ability to participate fully and meaningfully in the Conventions are critical, and yet lacking in many countries. Fulfilling this need requires global collaboration between those whose capacity needs development and those who are able to assist with capacity building. Such a network should address specific and urgent problems of developing countries and countries with economies in transition in the area of chemical and waste management. This includes identification of old burdens as well as new source areas, management and destruction of chemicals including new POPs, development of environmental technologies to enable environmental safety and sustainable use of resources, and the recovery of POPs-contaminated ecosystems including marine, freshwaters, and agricultural land. Capacity requires building in a step-wise manner over the short and long-term by: (a) establishing top-quality joint infrastructure; (b) providing open access for experts within/outside the network; and (c) securing a long-term funding to support participants from developing countries.

IX – Limiting adverse effects from hazardous chemicals

Evidence is mounting of adverse effects of pollutants on human and ecological health. Such effects are particularly apparent in sensitive environments, such as the polar regions, despite their remoteness to sources of most pollutants. Studies have confirmed and supported the association between exposure to environmental pollutants and depressed immunity in Arctic and other exposed populations, increasing vulnerability to infectious diseases as well as reproduction toxicity. Whereas the SC has achieved success with a chemical-by-chemical approach in the past, new approaches to minimize harm from hazardous chemicals are needed in addition to chemical screening and risk management. Chemical alternatives assessment, supported by green chemistry and preventative engineering approaches, should be promoted as means towards ensuring the sustainable management of chemicals as the SC moves into the future.

X – Effective science to serve policy needs

Providing coherent frameworks for globally coordinated approaches to management of hazardous chemicals (including POPs) requires the urgent attention of all stakeholders and institutions. Recalling the Rio Declaration on Environment and Development, Agenda 21 and the Plan of Implementation of the WSSD (Johannesburg Plan of Implementation) as well as the commitment to implement the above mentioned declarations including the time-bound goals and targets, the authors believe that new research strategies should be proposed to address societal needs and produce policy-relevant knowledge, facilitating interaction between science and policy. Coordinating across all priority areas identified in this declaration will produce key benefits.

The text has been published as Viewpoint article in Environmental Science & Technology (doi:10.1021/es202751f).

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