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**Subsidiary Body on Scientific,
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**Monitoring framework for the
Kunming-Montreal Global
Biodiversity Framework**

**Report of the expert meeting on developing a methodology for
headline indicator 7.2 under the monitoring framework of the
Kunming-Montreal Global Biodiversity Framework**

Note by the Secretariat

1. The Executive Secretary circulates herewith, for the information of participants in the twenty-sixth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice, a report prepared by the Food and Agriculture Organization of the United Nations (FAO) on the results of the expert meeting on developing a methodology for headline indicator 7.2 under the monitoring framework of the Kunming-Montreal Global Biodiversity Framework co-organized by the Secretariat of the Convention on Biological Diversity and FAO and held from 23 to 24 January 2024 at FAO Headquarters.
2. The present document was prepared to inform the Ad Hoc Technical Expert Group on Indicators for the Kunming-Montreal Global Biodiversity Framework of the results of the expert meeting and supports the consideration of the pre-session document CBD/SBSTTA/26/2 Monitoring framework for the Kunming-Montreal Global Biodiversity Framework.
3. This document is being issued in the form and language in which it was received by the Secretariat.

* CBD/SBSTTA/26/1.

Report of the Expert meeting on developing a methodology for Headline indicator 7.2 under the monitoring framework of the Kunming-Montreal Global Biodiversity Framework

Food and Agriculture Organization Headquarters, Rome (Italy), 23-24 January 2024

1 BACKGROUND TO THE EXPERT MEETING

The Kunming-Montreal Global Biodiversity Framework (GBF [decision 15/4])[1] was adopted during the 15th meeting of the Conference of Parties (COP15) to the Convention on Biodiversity (CBD). The GBF includes 4 goals with 23 targets for 2030. Among the 23 targets, Target 7 is of particular relevance to agriculture as it calls for a reduction in risks to biodiversity from agricultural inputs including pesticides (part 7b of the target).

Target 7: Reduce pollution risks and the negative impacts of pollution from all sources by 2030, to levels that are not harmful to biodiversity and ecosystem functions and services, considering cumulative effects, including: (b) by reducing the overall risk from pesticides and highly hazardous chemicals by at least half, including through integrated pest management, based on science, taking into account food security and livelihoods [1].

The GBF is accompanied by a detailed monitoring framework comprised of a set of agreed indicators for tracking progress towards the Goals and Targets of the Framework [decision 15/5][2]. An Ad Hoc Technical Expert Group (AHTEG) was established to advise on the operationalization of the monitoring framework. At its third meeting, the AHTEG noted that:

For the indicators on Target 7.2, on pesticide environment concentration, there is not an international entity which is developing an indicator on pesticides. A collaboration with FAO could provide a way to progress this indicator which could be explored by the Secretariat. Testing of this indicator would be needed in order to ensure that it captures the impact on biodiversity.[3]

In response to the AHTEG's recommendation, the CBD in collaboration with FAO convened an expert meeting on 23 and 24 January 2024 at FAO Headquarters in Rome (Italy) to define a suitable headline indicator 7.2 (pesticides) for Target 7 [4,5]. Twenty-experts attended the meeting (a list of attending experts and their affiliations is available in Annex I). The expert meeting had four main outcomes: (1) a feasible indicator of pesticide risks for biodiversity was selected; (2) the indicator's data requirements and the availability of data were assessed; (3) the requirements for operationalization of the indicator were assessed; and (4) a list of recommendations was made to further develop the headline and related indicators

2 SELECTION OF A FEASIBLE INDICATOR OF PESTICIDE RISKS TO BIODIVERSITY

To support negotiations for the K-M GBF, the 2^e développement program of Future Earth and the Secretariat of the Group on Earth Observations Biodiversity Observation Network (GEO BON) convened groups of experts to prepare scientific briefs on Targets 1, 2, 3, 7, 8 and 10, among other topics [6,7]. Monitoring and indicators for Target 7 were addressed in the brief and circulated at the fourth meeting of the Open-Ended Working Group on the Post-2020 GBF [6,7]. The brief was also circulated among the group of experts prior to the meeting in Rome and a short survey on pesticide indicators and available data was distributed to the experts.

The survey results indicated that: (a) Whereas experts preferred indicators that directly measure pesticide impacts on biodiversity and ecosystem functions; they agreed that input and risk indicators would be more feasible based on data availability. (b) A majority of experts indicated that comprehensive data that represents lower administrative units in their home countries are available for yields, registered pesticides and their associated toxicities; whereas exposure, contamination and impact data are mainly available for specific sites and at limited time scales. (c) A majority of experts indicated that data on pesticide trade, toxicity and usage are currently available for their countries, but may not be for other countries. (d) A majority of experts indicated that open-source information is available in their countries on currently registered pesticides and related toxicities, on national biodiversity (i.e.,

species richness), and water quality. It was further noted that science struggles to link pesticides with biodiversity; experimental toxicology studies are easier to reproduce and allow possibilities to determine causality, meanwhile, field monitoring and meta-analyses are challenged by complexity, uncertainty and relevance. As such indicators of risk are most feasible for field-scale inferences.

Brief information on a range of pesticide impact indicators was given during presentations by the experts. Many of the indicators were noted to be comprehensive but complex, often relying on data that is difficult to attain. It was noted that any globally applicable pesticide indicator must be science-based (in terms of the underlying data and responsiveness) but simple (because of data requirements and to support transparency). Furthermore, simpler models were recommended where data is lacking and to prevent accumulated errors based on multiple assumptions. On this basis, many of the more complex indicators were deemed more suitable for local or farm-level risk assessments, or for modeling risk reduction and the impacts of mitigation measures [8-10]; these could be included as complementary indicators for pesticide risks and impacts on biodiversity.

The experts concurred with the recommendations of the Science Brief [6,7] that the focus should be on those indicators that used widely available data such as sales data by active ingredient (AI), application rates by AI (based on the label/product database), and pesticide properties (including the results of toxicity tests). Among the more suitable indicators that are currently in operation at country levels were Pesticide Environmental Concentration (PEC) [1]; the Danish Pesticide Load Indicator (PLI) [13] and its adaptation for UK policy needs and environment [14-16], and Total Applied toxicity (TAT) [17]. Based on the formulas to calculate each of these indicators, risks to biodiversity can be reduced either by reducing mass (i.e., applications) or by reducing the toxicity of the Ais [18] or both.

The computation of PEC was explained with possible derived indicators including the Pesticide Hazard Load (PHL), Risk Point (RP) and Risk Score (RS). The PEC uses a range of available data including predicted active ingredient (AI) applications rates (using PEST-CHEMGRIDS [11] and CROPGRIDS [12]), soil conditions, and hydrometeorological conditions; with exposure limits based on reported toxicities for selected species [19]. When calculated using pesticide mass (the mass of AI accumulated in the environment) and the regulatory threshold limits for the AI in question, the PHL is equivalent to the indicator Total Applied Toxicity (TAT) [17]. The data requirements for PEC and some of the derived indicators may represent a challenge for many countries as the models rely on environmental, agricultural and geological data with relatively high spatial resolution, and personnel would require at least moderate training in geographic information systems and geospatial data analyzes to operationalize the indicator. As a complementary indicator, the PEC was highly recommended for further development and possible inclusion in future capacity building programs aimed at monitoring pollution risks.

PLI, TAT and derived indicators are based on pesticide use by active ingredient and pesticide properties, including the results of toxicity tests. For example, the UK PLI uses pesticide type and amount applied from UK pesticide usage surveys [PUS]. The PUS data is then combined with data from the Pesticide Properties DataBase (PPDB) [20] to derive load values for 20 metrics (i.e., Fate: persistence (soil DT₅₀), surface water motility (K_{foc}/K_{oc}), groundwater motility (GUS), bio-concentration factor (BCF); Ecotoxicity: algae acute (EC₅₀), aquatic plants acute (EC₅₀), *Daphnia* acute (EC₅₀), *Daphnia* chronic (NOEC), fish acute (LD₅₀), fish chronic (NOEL), birds acute (LD₅₀), birds chronic (NOEL), worms acute (LC₅₀), worms chronic (NOEC), bees contact (EC₅₀), bees oral (LD₅₀), mammals acute (LD₅₀), mammals chronic (NOAEL), parasitic wasps (LR₅₀), predatory mites (LR₅₀)).

The TAT is similar to the PLI in that it uses pesticide use data, but it limits the pesticide properties to only consider toxicities to species or species groups and limits the number of groups to about nine. The TAT can be used as a relatively simple metric to examine trends over time and detect differences in the impacts on taxa based on the types of Ais used in different countries (Figure 1). By using toxicity data from laboratory-based toxicology studies, risks can be determined across countries and regions to assess progress in achieving the global target for reducing risks to biodiversity.

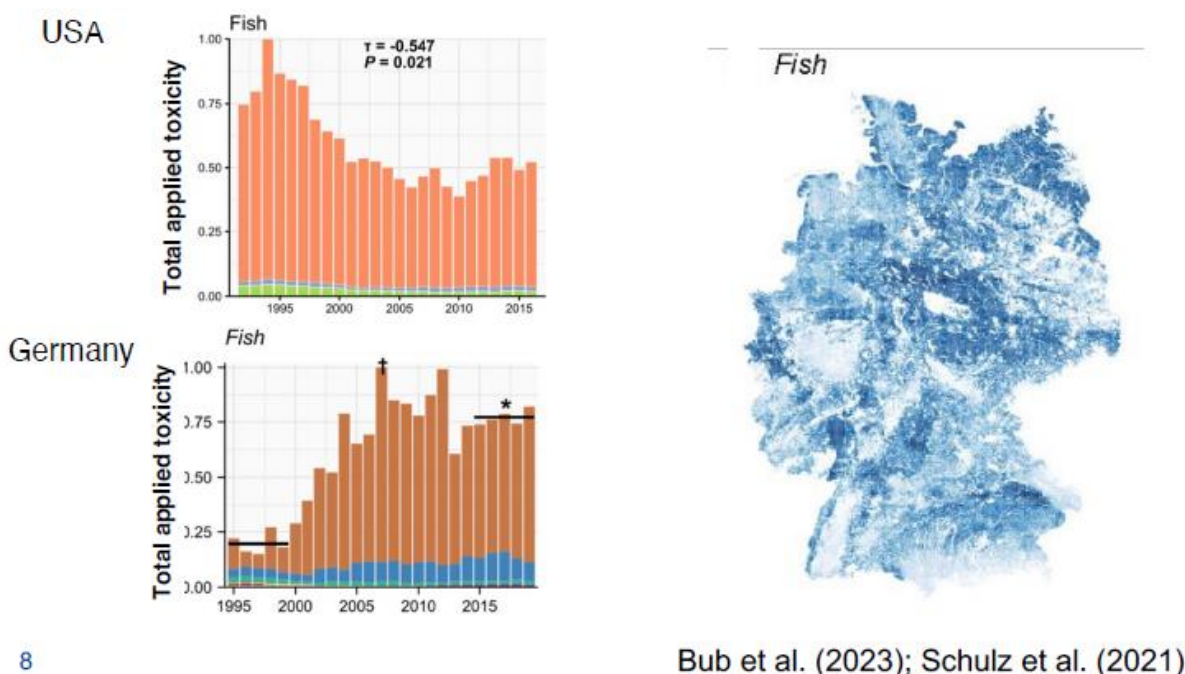


Figure 1: TAT estimates for fish in the USA and Germany from 1995 to 2019 [17,19]

Several experts indicated the challenges for PLI and TAT of adequately weighting toxicities based on exposures of different test species: for example, based on weighting and the test results used to estimate pesticide loads, indicators can give opposite trends over time for the same pesticide use data. Such contrasting trends in pesticide risk indicators were explored across a range of test species using the Julius Kühn Institute's pesticide trends database explorer [21]. A limited availability of data on application rates, usage and sales of pesticides was also highlighted among the current challenges for applying these indicators in risk assessments. Pesticide use data is often available only at a low spatial resolution or as aggregated usage.

The experts proposed that TAT be used to assess pesticide risks to biodiversity. To incorporate exposure, experts proposed developing multiple tiers of indicators based on TAT. Tier 1 is the original TAT as outlined by Schulz et al (2021)[17]. Tier 2 would combine TATs for individual species or species groups into a single indicator and normalize exposure by application area. **To function as a headline indicator, TATs for different species or species groups must be aggregated into a single number for each country (i.e., Aggregated TATs – ATATs); because ATATs need to be comparative across countries and years, the calculations require some normalization for pesticide applied areas (see equation 1).** Tier 3 would assess risks by including some differential measure of exposure (which has not yet been defined, but relates to species richness or endemism). **Methodologies for Tiers 2 and 3 need to be further defined and tested.** Tiers 4 and 5 would include disaggregated data on crop locations and biodiversity, respectively. These latter two are similar to the PEC and would likely be included as complementary indicators. Furthermore, more complex, higher tier indicators might account for long half-life times in soil and water, additional human exposure routes and/or additional information with regard to biodiversity characteristics.

$$ATAT_{s,sp,t} = \sum_{s=n}^s \left(\frac{m_{s,t,b}}{(RTL_{s,sp})} \right) / a \quad (\text{equation 1})$$

3 ASSESSMENT OF DATA REQUIREMENTS AND THE AVAILABILITY OF DATA

The experts indicated several sources of pesticide property data. Among the largest databases is the Pesticide Properties DataBase (PPDB); this database holds data for ca 2500 pesticide active substances and over 700 metabolites, with ca 320 parameters (e.g., toxicity, biodiversity risk assessments, etc.) stored for each substance [22]. The PPDB was developed by the University of Hertfordshire and is publicly available [20]. The database is used worldwide to support pesticide risk assessments, models and indicators, policy focused monitoring exercises, and general research.

Data on pesticide sales and usage is available for some countries. For example, the National Agricultural Statistics Service (NASS) Agricultural Chemical Use Program is the USDA's official source of statistics about on-farm chemical use and pest management practices. Since 1990, NASS has surveyed U.S. farmers to collect information on the chemicals they apply to agricultural commodities through fertilizers and pesticides. Surveys can be completed online [23]. However, it was noted that there are trade-offs between the costs of data collection and the type, quality and coverage of the data. As regards usage data, it was noted that the more openly accessible usage data is (particularly if based on farm surveys), the more unreliable it can become. It was further noted that for some Lower and Mid-Income Countries (LMICs), pesticide registration is mainly based on analogy and that chemical manufacturers are slow to share information. Therefore, many countries aggregate sales or usage data at national, state or provincial levels, or, if sales/usage data are unavailable, countries may only have access to pesticide trade data. Whereas data on pesticide trade is available in most cases, it is often not available in the required format or openly accessible. FAOSTAT is of limited use because its data on pesticides is aggregated. In some cases, information from data-rich environments can be used to infer for relatively data-poor environments as has been proposed by using PEST-CHEMGRIDS [11].

Experts noted the need for data validation, they indicated that some countries may have embargoes on data, and that data ownership needs to be addressed in the context of the indicator. Furthermore, experts discussed the need to resolve whether validation should be part of the testing and/or built into the methodology. Potential barriers to data validation and sharing may require institutionalized data collection (including provision of attendant budgets) and incentives for different agents and agencies to invest in data collection, validation and sharing. Some experts noted that integrating data from different ministries remains challenging in several countries, but using different data sets from different ministries also represents an opportunity for data validation.

The experts conducted a SWOT analysis on the proposed indicator (ATAT) and its underlying data, the results of which are presented in Table 1.

Table 1: SWOT analysis of headline indicator 7.2 – ATAT -as based on pesticide availability and a selected suite of toxicities that represents countries.

Strengths	Weaknesses	Opportunities	Threats
The indicator is relatively simple to calculate and understand	It is based only on the amount and properties of the pesticide applied and lacks information on risk mitigation, biodiversity exposure, lag time, etc.; the indicator will lose resolution where lead metrics are combined to generate a single indicator value; does not track pesticide use through the environment	The Global Framework on Chemicals requires similar indicators; a similar indicator could be used to assess human health risks thereby demanding that pesticide availability or use data be made available; PEST-CHEMGRIDS/CROPGRID S and similar models can support countries to estimate pesticide use where data is not available	There is currently no centralized repository of pesticide trade or use data that could facilitate use of the indicator in some data-poor countries; FAOSTAT data is currently aggregated by pesticide type; many countries are currently understaffed to report the indicator or provide supporting data for the indicator
The indicator is fit for purpose (i.e., it will allow	To implement changes and reduce pesticide	Models based on high-resolution crop and	It will be challenging to upscale use of currently

comparisons between countries and monitor trends over time)	impacts on biodiversity, data should be disaggregated by crop, region, climate, etc., within countries – particularly larger countries	pesticide use data are available to permit some measure of disaggregation that informs conservation and resource management in countries	applied and related indicators without capacity building programs – particularly for some LMICs
All component indicators are available for many countries (i.e., import/export data; PPDB)	Pesticide sales and use data are preferred but not available for many countries; Load metrics are influenced by worst-case substances that may differ between countries and over time; no basis as yet for selecting indicator metrics/species; the indicator doesn't take into account environmental fate	Toxicity parameters for active ingredients can be shared between countries for those countries that lack toxicity data	For some countries, data is not available or held-up at ministries; data is made available only gradually with time lags that can be greater than 5 years
Although the indicator is simple – the data it demands will be openly available for parallel studies of pesticide impacts	Open-source data is subject to politically motivated screening and reporting that may reduce accuracy	Regional strategies for pesticide management and to restrict illegal trade increasingly share pesticide trade data	Countries may be opposed to open availability of data on pesticide availability
Baseline values (2011-2020) can be generated using historical records of pesticide availability and current information in PPDB	Historical records of pesticide availability are only available in some countries	FAOSTAT has been collecting pesticide trade and use data since the 1960s; although this is aggregated by pesticide types, disaggregation can be achieved using crop data, yield data and household and farmer surveys in some cases	Highly hazardous pesticides used before 2020 but now de-registered may skew pesticide loads in some countries and result in disproportionate loads across countries
The indicator accounts for multiple organisms	A single suite of organisms is unlikely to represent all countries equally; Ecosystems are complex and fitting test species to account for impacts on ecosystems is challenging; does not account for species	Biodiversity inventories are available for most countries and can be used to calibrate exposure	Biodiversity inventories generally underrepresent certain taxa, including plants, arthropods, microbiota; relations between species richness and ecosystem function are poorly understood;

	idiosyncrasies – for example rarity, conservation status, etc.		
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4 ASSESSMENT OF OPERATIONALIZATION OF THE INDICATOR WITH SUGGESTED ACTIONS

A poll was conducted among the experts to assess operationalization of the indicator. According to the results, several experts felt that limited resources and the lack of a sufficiently enabling environment would slow progress on applying the indicator; for many members, operationalization would take more than a year and, in some cases, up to two years. The experts felt that further work is required for progress on the indicator.

As regards the indicator, whereas several component and complementary indicators have sufficient supporting data and are currently operational in some countries, the headline indicator requires further development and testing. This testing may include the generation for some countries of baseline (2011-2020) indicator values using historical data. Data validation and issues around data ownership and sharing can be included as part of the testing. Furthermore, testing and validation will need to address a range of countries with distinct geographical, sociopolitical, ecological and agricultural backgrounds. Several of the experts conduct research on pesticide impacts and indicators of pesticide related risks and continue to actively publish on these topics in scientific journals. These academic experts may be consulted to further progress the indicator for use in global risk assessments.

The capture of data on pesticide trade, sales and usage, particularly for LMICs needs to be addressed; and priority for structural development and capacity building given to the most biodiverse countries to operationalize the indicator. Current systems of data collection, reporting and sharing should be assessed for a wide range of countries based on reporting trends apparent from FAOSTAT and other databases, and surveys or stakeholder interviews conducted to assess the legal, structural and technical requirements to advance reporting. This exercise will further highlight countries, institutes and persons that should be prioritized for capacity building. Experts can work with FAO and FAOSTAT to further improve data collection and management on pesticide trade and use.

5 SUMMARY AND RECOMMENDATIONS

Use pesticide sales or usage data (one dataset for each country) for each AI and for all years beginning in 2011.

Pesticides used in all sectors (forestry, veterinary, public health) will be included because trade data includes all sectors – certain sectors may be disaggregated based on pesticides' registered uses in countries. All active ingredients will be included (i.e., not based on any subsets of pesticides) but only for pesticides considered for outdoor use; however, GMO crops will not be included as a pesticide type; and microbial biopesticides, biological control agents and nanopesticides will not be included as pesticide types. Where possible, toxic adjuvants, solvents or industrial contaminants should be included. Pesticide availability will consider import, export and local production; it will not attempt to include illegally traded products – because country data on illegal pesticides is often missing or difficult to verify.

Total Applied Toxicity (TAT) is a suitable indicator for reducing the effects of pesticides on key biota. It relies on widely available data and is simple to calculate while addressing underlying processes in pesticide impacts on biodiversity. The proposed indicator in its published form can be regarded as a component indicator; **but it requires some development and testing to derive a suitable headline indicator and to use this indicator to monitor progress on achieving the GBF targets for risk reduction.** For further development, the TAT should be normalized by application area (e.g., the area of crop land receiving pesticide applications), it requires a mechanism to aggregate toxicities for different species and species groups into a single value. Such a headline indicator could be called ATAT. **The expert group will submit the metadata for an indicator based on TAT, noting the need for its further development. The expert group further invites FAO to establish an inclusive working group on target 7b to advise on implementation and monitoring of the target.**

Data on pesticide properties are currently widely available on open-source platforms and are sufficiently detailed to permit calculation of TAT and several complementary indicators. Decisions have to be made about which load indicators (i.e., species of species groups) should be used to calculate TAT and which standard data sources can be

recommended for all countries. Pesticide toxicity should entail a single, global data set based on 9 groups of organisms (aquatic invertebrates, terrestrial invertebrates, pollinators, aquatic plants, terrestrial plants, fish, mammals (humans), birds, and soil organisms). Acute and, if available, chronic toxicity data should be used for the nine groups of organisms (based on lab studies using OECD guidelines) and applying respective regulatory threshold levels (=RTL). Chronic toxicity can be adjusted using persistence values for the substance (as is done in the Danish and UK PLI) to provide a more accurate picture of ecotoxicity. Means of RTLs for each compound and species group could be calculated – this would result in ca 15 acute and chronic RTL values for 400-600 pesticides. A suitable protocol for calculating RTLs should be provided.

Data on crop areas and agricultural and forestry production are available from relevant agriculture and trade ministries in most countries and historical data is available through FAOSTAT in sufficient detail to normalize the indicator. **Data on species richness, endemism and the spatial distribution of species or species groups is generally available** from national biodiversity databases or based on published records.

Data on pesticide sales and usage, although it exists for most countries, may not always be accessible or sufficiently disaggregated to support computation of TAT. Trade data are more widely available than sales or usage data and can be used to calibrate models that estimate usage based on crops, acreage, and recommended application rates. In the absence of available, disaggregated data on usage, and until countries have developed adequate reporting systems for pesticide use, PEST-CHEMGRIDS or other similar models can be used to estimate usage. **Where sales or use data is unavailable for countries, usage can be estimated based on crop composition (up to 100 main crops or at least crop groups), pesticide label information (application rates, etc.), and basing usage on data from similar countries.** Resources and training are required to support countries to inventory pesticide trade with sufficient detail that allows risk assessment and to monitor pesticide use by sector, crop and administrative units. To this end, the expert group **invites FAO to lead/establish a mechanism for the indicator methodology, testing, and supporting implementation of target 7b, including through capacity building and data collection and management**

RESOURCES

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ANNEX 1: Attending experts

Name	Organization
Alex Stuart	Pesticide Action Network, UK
Anita Fjelsted	Environment Agency, Ministry of Environment Denmark
Buyung Hadi	Sustainable Production, IFAD, Italy
Carol Theka	Environmental Officer, Environmental Affairs Department, Malawi
Felicien Amakpe	Ministère du Cadre de Vie et des Transports en Charge du Développement Durable, Benin
Fiona Tang	Department of Civil Engineering, Monash University, Australia
Frederico Maggi	School of Civil Engineering, University of Sydney, Australia
Gervais Nzoa	Social and Economic Council (ECOSOC), Yaounde, Cameroon
Giovana Galarza Silva	National Commission for Biological Diversity, Lima, Peru
Janice Villeneuve	National Water Management Program for Pesticides, Canada
Jinzhou Wang	Chinese Research Academy of Environmental Sciences (CRAES), China
John Tzilivakis	Agriculture and Environment Research Unit (AERU), University of Hertfordshire, UK
Jonah Davis Ormond	Registrar of Pesticides and Toxic Chemicals, Antigua and Barbuda
Lars Neumeister	Independent Consultant on Pesticides, Backnang, Germany
Peter Campbell	Syngenta, Jealott's Hill International Research Centre, UK
Ralf Schulz	iES Institute for Environmental Sciences, Germany
Raphael John Mwezi	Tanzania Plant Health and Pesticide Authority, Tanzania
Robert Hijmans	Department of Environmental Science and Policy, University of California, Davis, USA
Sikeade Oluwakemi Egbuwalo	Nigeria Federal Ministry of Environment, Nigeria
Tomoyuki Kawai	Agricultural Chemicals Office, Ministry of Agriculture, Forestry and Fisheries, Japan