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Para América Latina y el Caribe
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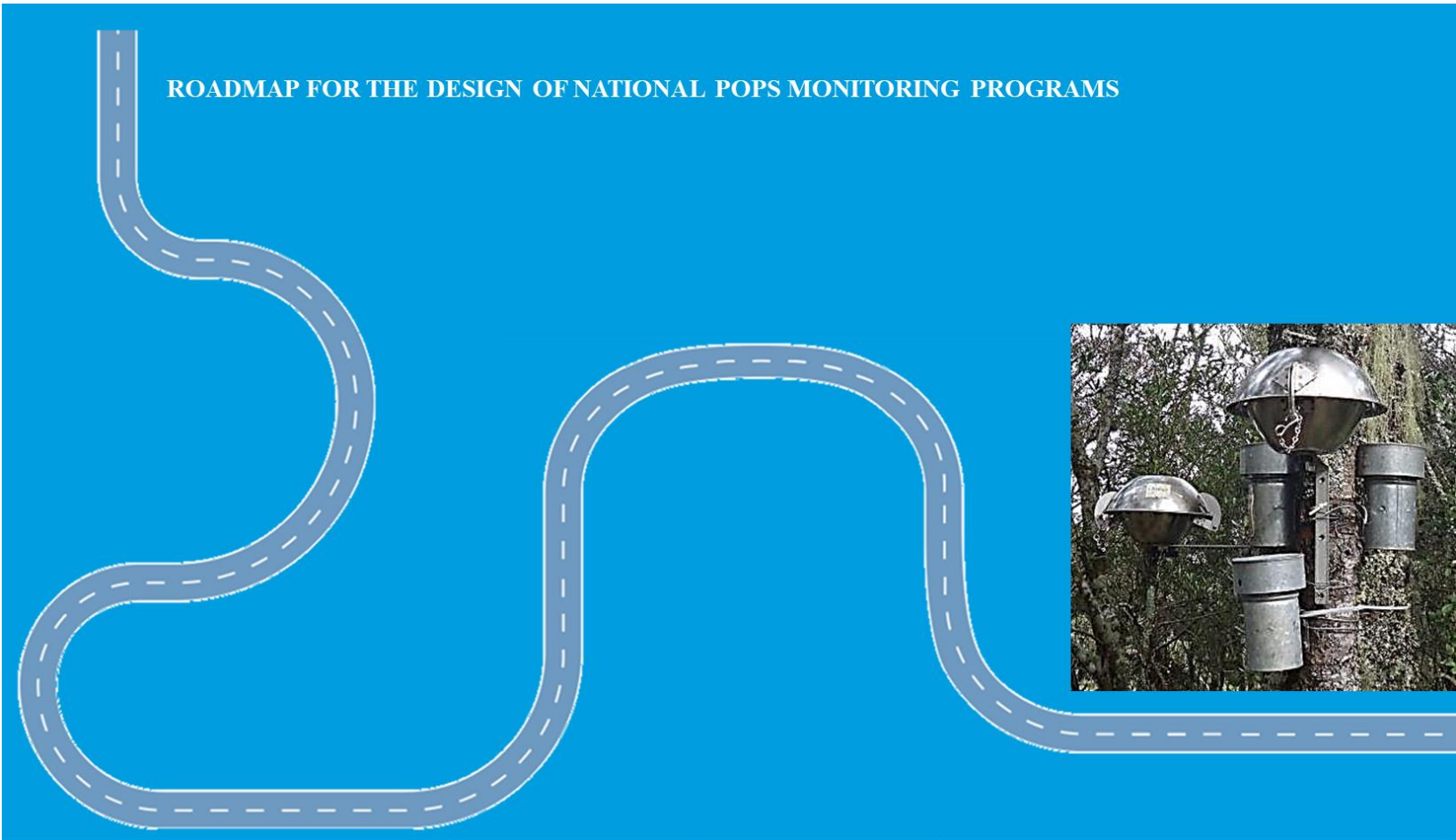
APPENDIX 7:

Basel Convention Coordinating Centre, Stockholm Convention Regional Centre, for Latin America and the Caribbean (BCCC-SCRC)

ROADMAP FOR THE DESIGN OF NATIONAL POPS MONITORING PROGRAMS

June 2023



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ACKNOWLEDGEMENTS

This publication was developed in the framework of the projects entitled "Integrated SC toolkit to improve the transmission of information under Articles 07 and 15" (GEF ID 9884) and Global Environment Facility (GEF) funded project "Continuing Regional Support for POPs Global Monitoring Plan under the Stockholm Convention" in the Africa, Asia, Pacific and Latin-American and Caribbean Regions (GEF ID 4886, 4894, 4881, 6978) and in close collaboration with the Basel Convention Coordinating Centre, Stockholm Convention Regional Centre, for Latin America and the Caribbean (hereinafter BCCC-SCRC).

The support of UNEP, Chemicals and Health Branch, and the BCCC-SCRC Latin America and the Caribbean, is gratefully acknowledged. The worldwide implementation of the Global Monitoring Plan is made possible thanks to the substantial contributions by the Global Environment Facility (GEF) to support POPs monitoring activities in regions implemented by UNEP.

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UNEP, Chemicals and Health Branch, Geneva, Switzerland. 50 pp.

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Abbreviations

AMAP	Arctic Monitoring and Assessment Programme
ASTM	American Society for Testing and Materials
BCCC-SCRC	Basel Convention Coordinating Centre, Stockholm Convention Regional Centre, for Latin America and the Caribbean
COP	Conference of the Parties
DQO	data quality objectives
EMEP	Cooperative programme for monitoring and evaluation of long-range transmission of air pollutants in Europe
GAPS	Global Atmospheric Passive Sampling
GEF	Global Environment Facility
GMP	Global Monitoring Plan
GMP DWH	Global Monitoring Plan Data Warehouse
GRULAC	Latin America and the Caribbean Group (CRULAC, for its acronym in Spanish)
LAC	Latin America and the Caribbean
NFP	national focal point
NIP	National Implementation Plan
POPs	Persistent Organic Pollutants
PUF	Polyurethane Foam
QA	quality assurance
QAP	quality assurance plan
QAS	quality assurance system
QC	quality control
ROG	Regional Organization Group
SOP	standard operating procedures
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNITAR	United Nations Institute for Training and Research
US EPA	U.S. Environmental Protection Agency
WHO	World Health Organization
XAD	Styrene/divinylbenzene-co-polymer resin

INTRODUCTION

Many authors establish that environmental monitoring refers to **systematic sampling of air, water, soil, and biota in order to observe and study the environment, as well as to derive knowledge from this process**. UNECE definition established that: Environmental monitoring is a tool to assess environmental conditions and trends, support policy development and its implementation, and develop information for reporting to national policymakers, international forums, and the public (https://unece.org/environmental-monitoring).

In simple terms, environmental monitoring is conducted to obtain information on ecosystem status or trends. As such, the monitoring falls into several broad, though not necessarily mutually exclusive categories:

- Successive monitoring. To determine status or trends.
- Prediction monitoring. To determine if expected effects have occurred.
- Impact monitoring. To determine project impacts whether anticipated or not, and
- Mitigation success monitoring. To determine if objectives for management are being achieved, if measures were applied and with what effect, among others.

That is the case of the Global Monitoring Plan (GMP) under the Stockholm Convention, that was developed in response to the need of the Conference of the Parties of comparable global monitoring data on the presence of Persistent Organic Pollutants (POPs), to evaluate the effectiveness of the convention. In accordance with its mandate, it identifies trends in POPs levels over time and provide information on their regional and global environmental transport.

The US EPA states that "trends monitoring is characterized by locating a minimal number of monitoring sites across as large an area as possible while still meeting the monitoring objectives and can be used to determine the extent and nature of air pollution and to determine the variations in the measured levels of the atmospheric contaminants in respect to geographical, socio-economic, climatological, and other factors. (EPA; 2017). The data are useful for planning epidemiological investigations and for providing background for more intensive regional and community studies of air pollution on a national scale.

Also, because the GMP obtains global monitoring data primarily from existing monitoring programs and by conducting monitoring activities to fill information gaps in regions such as Africa, Asia, GRULAC and the Pacific Islands, the participating countries have benefited not only from the information generated by these projects but also from the training opportunities and technical and financial assistance received.

In each case, the data collected underlies the decision for some action. Either the data is used as feedback to improve the project it was collected at or to improve the planning or implementation of another project, such as National POPs monitoring. GMP data have uncovered not only success stories about the effectiveness of the Convention but also local issues that countries will need to address and follow up on to protect the health of their people and fulfill their commitments under the Convention.

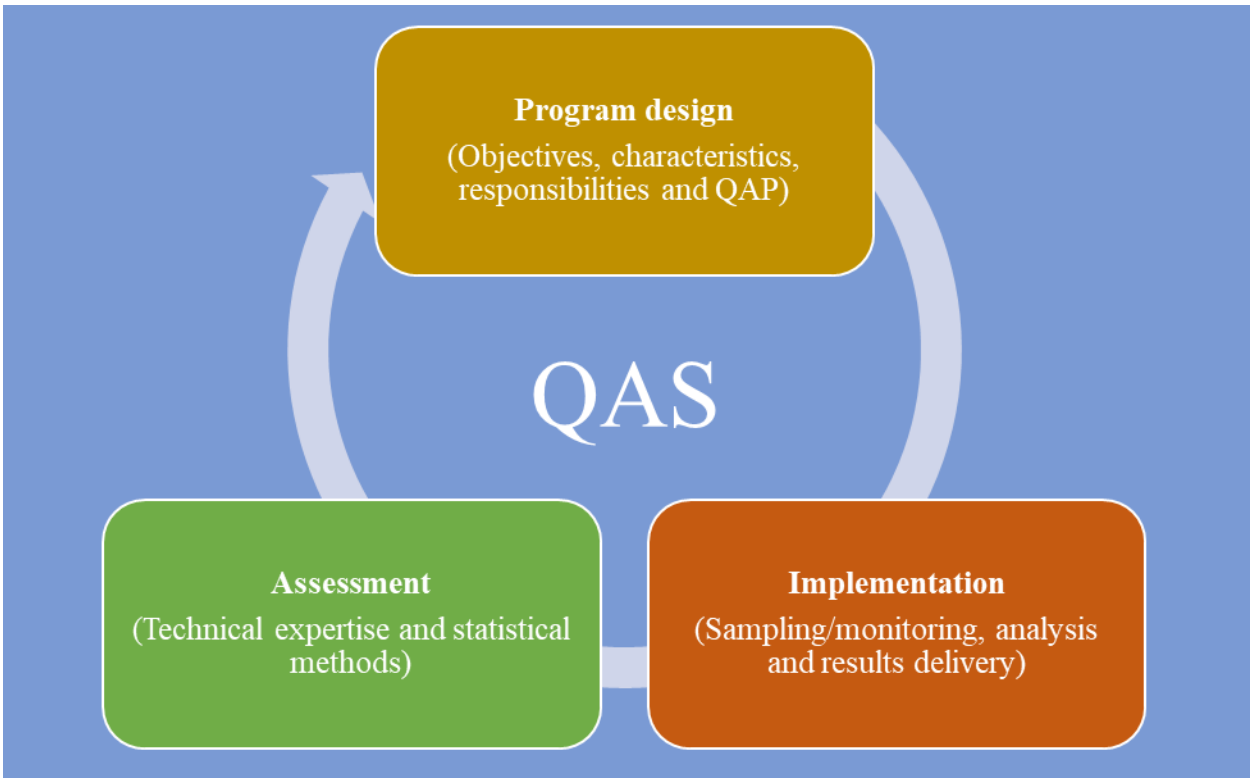
1. PHASES OF A MONITORING PROGRAM

A monitoring program consists of three main phases: program design/planning, where the objectives are established, including data quality objectives, and monitoring characteristics, such as the parameters to be monitored, type of sampling and frequency, among others, and those responsible, people and institutions; implementation, which is where the data are acquired, used or produced and includes sampling or monitoring, sample analysis, and delivery of results; and program evaluation, where technical expertise and statistical methods are used to determine whether or not the data meet the user's needs and whether the program design needs to be improved.

As a best practice, it is also recommended that this program be immersed in a quality assurance system (QAS) to ensure that each stage of the program meets the quality needs required to achieve the established objectives.

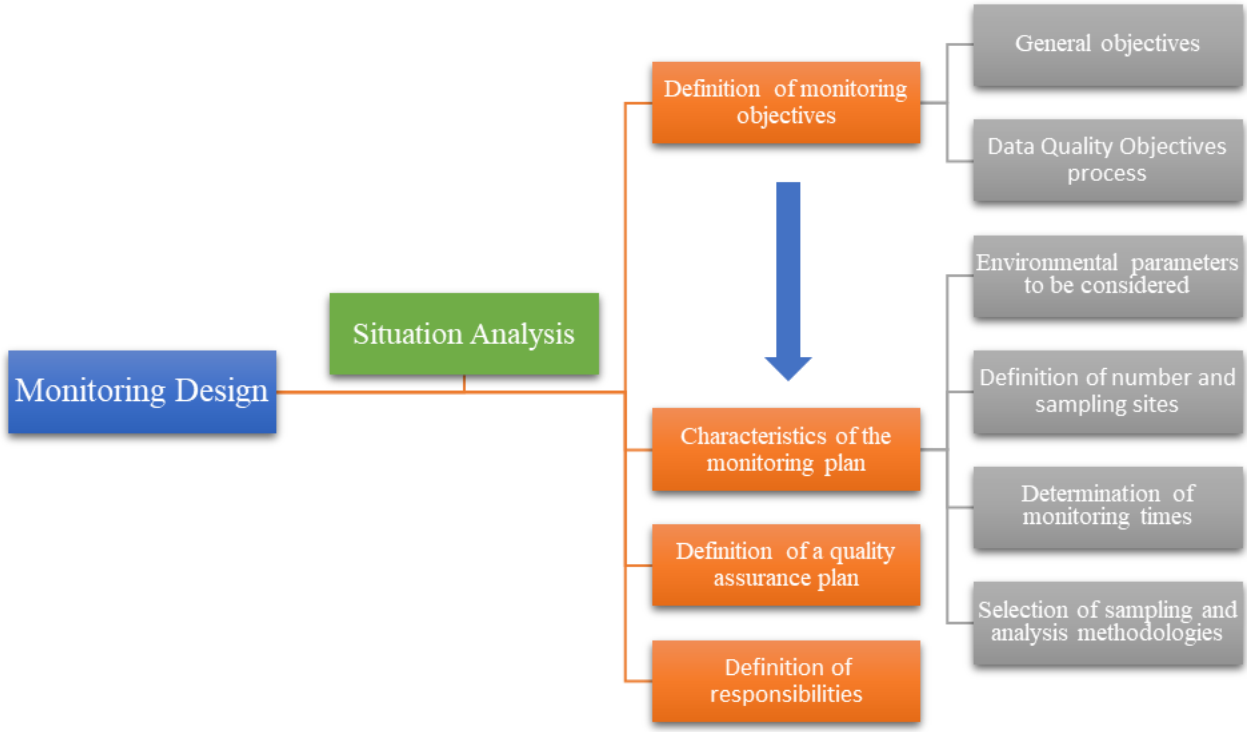
Therefore, it is also suggested that from the beginning of the design or planning of the program, the design of a quality assurance plan (QAP) should also be considered (see figure 1).

Figure 1. Monitoring program phases



The design of the monitoring program, which should include the overall objectives of the program and the quality of the data that will be needed to achieve the objectives, references to the specific strategies that help achieve the objective, and details of the specific tasks within those strategies, is the subject of this document, and comprises the following activities (see Figure 2), which are described below.

Figure 2. Monitoring design components



2. SITUATION ANALYSIS. DIAGNOSIS, COUNTRY CONTEXT, CAPACITIES, AND GAPS.

A key element in the process of the design of a monitoring program for persistent organic pollutants (POPs) is the development of a diagnosis of the current situation of these compounds in the country, and country's capacity and its needs. This will help to identify problems, establish goals, and use funds more efficiently, since the budget for these activities is generally limited, and the implementation and operation of monitoring sites and analysis of these substances is expensive. A list of topics to be addressed in developing a country profile is provided in Annex 1.

To do so, it is necessary, based on the description of the main social and economic characteristics of the country, to understand the context in which POPs may be generated, traded, used, and disposed of.

As part of this diagnosis, it is very important to have an inventory of POPs, both in terms of products and wastes as well as releases and emissions. In this regard, it is important to have available the reports generated by the country in relation to the National Implementation Plan, National Reports to the Stockholm Convention, and other studies related to the subject, such as effectiveness evaluation, laboratory reports and research studies carried out by academia, among others.

If the country does not have a National Implementation Plan (NIP), it will be necessary as a first step to develop such a management instrument before considering the design of a POPs environmental monitoring program.

In the first instance, the assessment should consider the POPs listed in the Stockholm Convention, and for the purposes of the monitoring program, this list may be adjusted according to the main POPs detected or of concern in the country.

The diagnosis includes the following activities:

2.1 Collection and Evaluation of Monitoring Information

In this step, a compilation and analysis of the studies conducted by the academic sector and governmental institutions on POPs monitoring or sampling in the country will be carried out.

Information will be obtained from

- Periodic publications
- Meeting proceedings
- Undergraduate and graduate theses
- Technical reports
- Personal communication with specialists
- GMP projects
- Global networks
- National Implementation Plans and National Report presented to the Stockholm Convention

The documents expected to be collected from this activity to outline the country profile are:

- Files (in printed material or online), with POPs monitoring and evaluation information.
- Databases by type of publication, matrix and region.
- POPs distribution maps (national, state, municipal and local).
- Spreadsheets with the maximum values reported for each substance.

The information collected will undergo a process of review and evaluation for its integration and validation.

Information will also be compiled on imports, exports and production of POPs, their regulatory framework, and the country's socioeconomic characteristics, among others.

Relevant information will also be contained in product, waste, and emissions inventories, as well as health statistics.

This information will be used to outline the country's POPs profile, which will be presented in a clear and understandable way, to communicate the situation assessment results to the relevant authorities for their consideration.

2.2 IDENTIFICATION OF EXISTING CAPACITIES AND AREAS OF APPLICATION

To understand the country's capacity to address POPs monitoring, it is recommended to investigate whether there are legal and administrative infrastructure for the sound management of POPs, capacities for monitoring of POPs, like governmental agencies, universities, or institutions, and private laboratories, among others, and professionals involved in POPs studies in the country, which POPs they study and how they operate their studies. Because it will be very important to consider these capabilities in the design of the program.

Research will be carried out by sending surveys to the different agencies that carry out studies, or monitoring programs on the POPs topic. The intention is to create a database with each institution, capacities, and the responsible researcher or professional and the topic or specialty he/she deals with, establishing an information network among all those involved (see Annex 1).

Governmental agencies, universities, institutions, private laboratories, and professionals with the capacity to carry out analyses of certain POPs could contribute to filling capacity gaps. Similarly, personnel trained to install monitoring stations and operate them could also participate in the national program.

Another important task that will require expertise would be the analysis and management of POP monitoring data.

2.3 ASSESSMENT OF EXISTING CAPACITY BUILDING PLANS

An indispensable factor in any program is capacity building. The identification of the existing capacities of the country will reveal the needs for achieving different objectives. The national capacities of each country could contribute to support a local monitoring program, however, in order to comply with all the commitments established under the Convention, specialized laboratories will be required to analyze new POPs and even POPs in products. Depending on the objectives to be met, a country could choose to establish agreements with such specialized laboratories or establish/equip and operate a laboratory that could perform such analyses.

It is therefore recommended that an assessment be made of the possible monitoring objectives that the country can meet in a cost-effective manner, establishing scenarios of capacity building needs based on a diagnosis resulting from surveys of experts and a review of specialization programs.

This aspect is undoubtedly key to the success of the program, since as technicians and specialists strengthen their abilities, skills and knowledge in measuring, monitoring, modeling, analyzing, and evaluating POPs concentrations, fate, transport, risk and effects, the country will be able to respond more efficiently to national and international commitments. Likewise, through constant training and updating, there will be a group of experts specialized in this subject, who will become promoters and/or trainers of other specialists at national level, thus laying the foundations for the design and implementation of programs of this type at the local, municipal or state level.

3. DEFINITION OF MONITORING OBJECTIVES

3.1 GENERAL OBJECTIVES

The first step in the design of a monitoring/sampling program is to define all the objectives to be achieved and to derive from them the data requirements needed to achieve them. The objectives of a monitoring program generally derive from a particular problem, e.g., how to evaluate the effectiveness of the Stockholm Convention or in the case of a country how to support its implementation and are focused on solving the information needs required to address it.

There are many general objectives that can be achieved when a monitoring network is established, e.g., -, to support informed national decision making, to protect human and environmental heath, also concentration changes or trends can be assessed, as in the case of the POPs Global Monitoring Plan (GMP), effectiveness of mitigation strategies, human exposure and health risks, impact on ecosystems or on a particular ecosystem, environmental transport, and data can also be used for models' evaluation and calibration, among others.

Sometimes there is no information available on the POPs situation in a given country, nor have the problems arising from them been identified. In these cases, the first thing that is required is to know the POPs status and its behavior, for which it is suggested that a pilot monitoring program be established to provide information using a systematic planning.

Systematic planning is a process based on the "scientific method" in which you identify the problem to be investigated or the decision to be made, and then define the project's objectives, the type, quantity and quality of information needed, the technical and quality control activities, and the level of supervision that will ensure project criteria are satisfied. (EPA, 2002a and 2006).

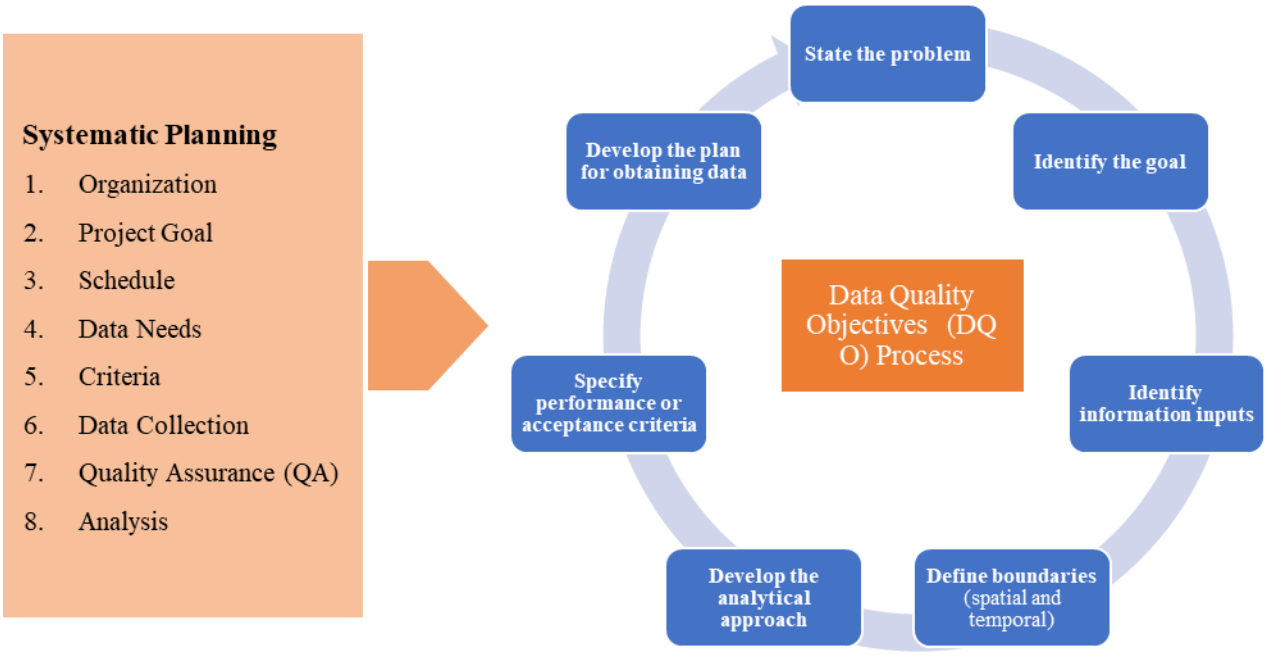
Once information on POPs in the country is available, multi-objective networks can be considered or objectives can be prioritized according to the country's needs and capabilities. It is worth mentioning that each objective will require the definition of the parameters necessary to achieve it. That is, the design will be different if, e.g., it is required to understand the behavior of air toxics in the atmosphere or if, it is required to know the impact of specific sources or to evaluate contaminated soils to select candidate sites for remediation.

In environmental monitoring, it is extremely important to know the specifics of the data needed to achieve the proposed objective. Therefore, a planned methodology, such as the aforementioned systematic planning including qualitative and quantitative objectives and data quality objectives (DQO), should be established prior to data collection.

3.2 DATA QUALITY OBJECTIVES PROCESS

U.S. EPA also establish that the design of a monitoring program should include the overall objectives of the program and the quality of the data that will be needed to achieve these objectives, references to the specific strategies that help achieve the objective, and details of the specific tasks within those strategies. "The Data Quality Objectives (DQO) Process is the most used application of systematic planning in the general environmental community. EPA recommends this process when data are to be used to make some type of decision (e.g., compliance or non-compliance with a standard) or estimation (e.g., ascertain the mean concentration level of a contaminant)" (EPA, 2006), see figure 3.

Figure 3. Elements of Systematic Planning



The DQO Process is a series of logical steps that guides managers or staff to a plan for the resource-effective acquisition of environmental data. The DQO Process is used to establish performance and acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of the study. Use of the DQO Process leads to efficient and effective expenditure of resources; consensus on the type, quality, and quantity of data needed to meet the project goal; and the full documentation of actions taken during the development of the project (EPA, 2006).

The DQO process is described extensively by the U.S. EPA in its *Guidance on Systematic Planning using the Data Quality Objectives Process (QA/G-4)*. In summary, the process includes the following steps (EPA, 2006 and 2017):

1) **State the problem**: Define the problem that necessitates the study or monitoring; identify the planning team, examine the budget and the schedule.
2) **Identify the goal:** State how environmental data will be used in meeting objectives and solving the problem, identify study questions, define alternative outcomes.
3) **Identify information inputs:** Identify data and information needed to answer study questions.
4) **Define boundaries:** Specify the target population and characteristics of interest, define spatial and temporal limits, scale of inference.
5) **Develop the analytical approach:** Define the parameter of interest, specify the type of inference, and develop the logic for drawing conclusions from findings.
6) **Specify performance or acceptance criteria**:
   a) **Decision making (hypothesis testing):** Specify probability limits for false rejection and false acceptance decision errors.
   b) **Estimation approaches:** Develop performance criteria for new data being collected or acceptable criteria for existing data being considered for use.
7) **Develop the plan for obtaining data:** Select the resource-effective sampling and analysis plan that meets the performance criteria.

Step 6 of the DQO process is designed to generate performance or acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study. "*Performance criteria* represent the full set of specifications that are needed to design a data or information collection effort such that, when implemented, generate *newly-collected* data that are of sufficient quality and quantity to address the project's goals. *Acceptance criteria* are specifications intended to evaluate the adequacy of data as being acceptable to support the project's intended use" (EPA,2006).

Step 7 develops the design or plan to collect data. Specifies all the characteristics of the monitoring plan or network, the type, number, location, and physical quantity of samples and data, as well as the QA and QC activities that will ensure that sampling design and measurement errors are managed sufficiently to meet the performance or acceptance criteria specified in the DQOs. The outputs of the DQO Process are used to develop a QA Project Plan and for performing Data Quality Assessment.

From these DQOs will be derived all the characteristics of the program, such as the contaminants to be sampled, sampling methods, frequency, type of analysis and data delivery with interpretation.

These DQO are established to ensure that the decisions to be made regarding the achievement of the objective are within a specified degree of certainty, and data quality assessment determines whether the data are fit for use according to a specific objective and is only meaningful when it is related to the use for which the data were generated. Therefore, it is essential to know in what context the data will be used in order to establish relevant criteria that determines the appropriateness of using the data. For more information on activities and outputs of each step of the DQO Process, see Annex 2.

In the case of the POPs Global Monitoring Plan the general objective can be described as to:

"Provide a harmonized organizational framework for the collection of comparable monitoring data on the presence of the POPs listed in Annexes A, B and C of the Convention in order to identify trends in levels over time as well as to provide information on their regional and global environmental transport" (UNEP, 2021).

To achieve the POPs Global Monitoring Plan objective, qualitative and quantitative objectives for trend analysis are set out in the GMP Guidance, but each country must decide its objectives and data quality needs, e.g., required accuracy, precision, and completeness, among others.

Chapter 3 of the GMP Guidance describe qualitative and quantitative objectives for temporal trends as follows:

"A qualitative objective for temporal studies could be stated as follows:

> To detect a decrease within a time period of 10 years with a statistical power of 80% at a significance level of 5%.

A quantitative objective for temporal studies could be stated as follows:

> To detect a 50 % decrease within a time period of 10 years with a statistical power of 80 % at a significance level of 5 %. (A 50 % decrease within a time period of 10 years corresponds to an annual decrease of about 7 %)" (UNEP, 2021).

"Data quality objectives (DQO) are also criteria that clarify the study objectives, define appropriate types of data acquisition, and specify tolerable levels of potential decision errors" (EPA, 2006).

Sources of error are present in all environmental programs. Overall uncertainty is used as a generic term to describe the sum of all sources of error: population uncertainty (spatial and temporal) and measurement uncertainty (data collection). Population uncertainties are related to the uncertainty in, e.g., air concentrations related to spatial and temporal variability. These uncertainties can be controlled through the selection of appropriate boundary conditions (the monitoring area and sampling period/frequency of sampling) to which the decision will be apply and developing an appropriate statistical sampling design.

Measurement uncertainties are the errors associated with the collection of environmental data, including errors associated with sample preparation, transport, and the field and laboratory measurement phases. Important data quality indicators in determining total measurement uncertainty are:

- **Precision:** refers to the closeness of the ratio of values obtained from identical measurements to a quantity. a measure of agreement among repeated measurements of the same property under identical, or substantially similar, conditions. This is the random component of error. Precision is estimated by various statistical techniques typically using some derivation of the standard deviation.
- **Bias:** the systematic or persistent distortion of a measurement process which causes error in one direction. Bias will be determined by estimating the positive and negative deviation from the true value.
- **Detection Limit:** The lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability.
- **Accuracy:** refers to how close the measured value is to the true value. Is a measure of the overall agreement of a measurement to a known value and includes a combination of random error (precision) and systematic error (bias) components of both sampling and analytical operations.
- **Completeness:** describes the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions. It can be measured as the percentage of valid samples or data obtained if 100% of them had been captured. For data management purposes, it is recommended that completeness be at least 75%.
- **Comparability:** is a measure of the confidence with which one data set or method can be compared to another, considering the units of measurement and applicability to standard statistical techniques. Is one of the characteristics used to describe data quality. The comparability of different data sets determines how they can be used collectively to support the decision-making process. Comparability is also used to measure the usefulness of data when using less risky analytical quality techniques. There are numerous factors that influence the comparability of data. The main ones are due to sample collection and handling, others to the analytical methods used (EPA, 2017 and INE Handbooks 2 and 5, 2010).
- **Representativeness:** refers to the degree to which the data most faithfully represent the characteristics of a population, the variation of a parameter at the sampling point, the condition of a process, or an environmental condition.
- **Traceability:** is the property of the result of a measurement or the value of a standard where it can be related to specified references, usually national or international standards, through a continuous chain of comparisons, all with specified uncertainties (INE, 2010).

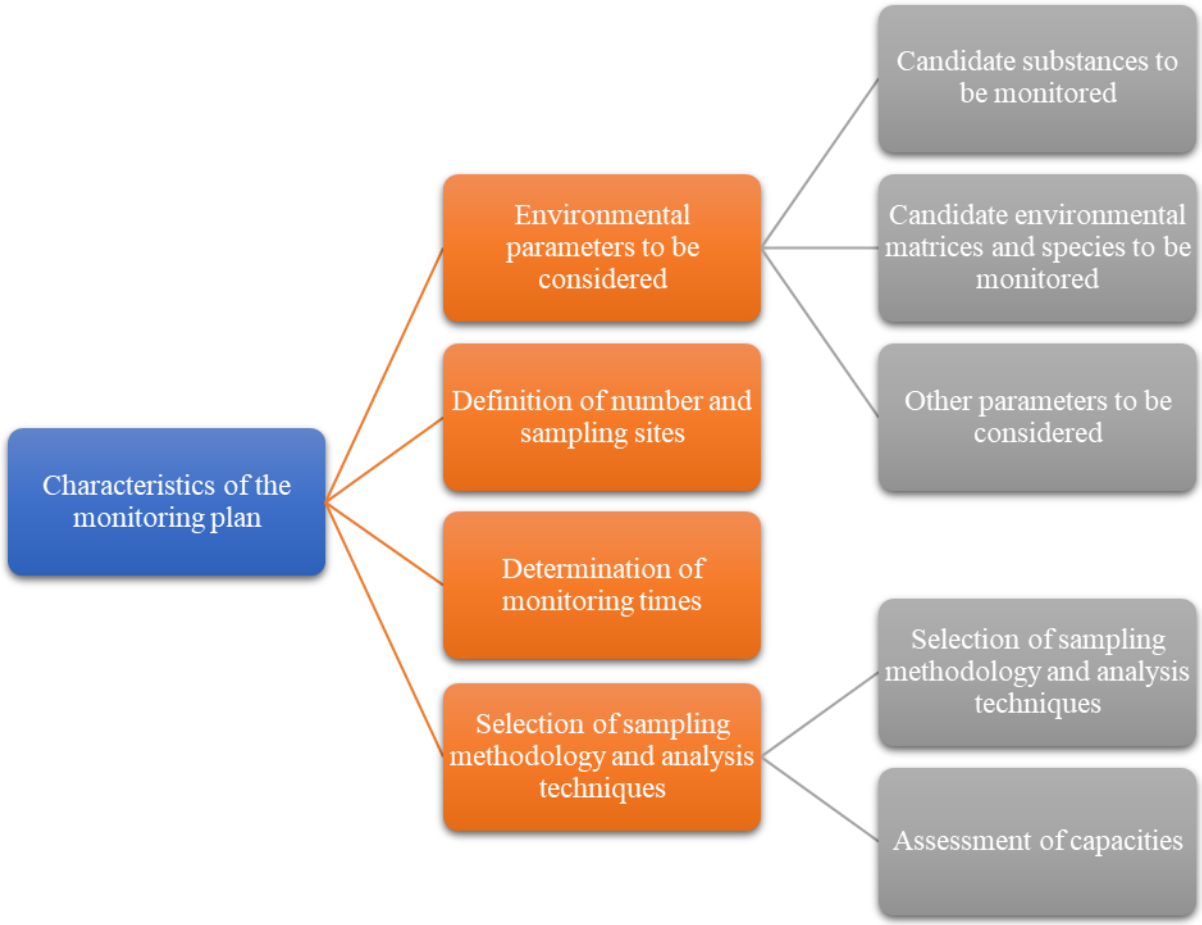
Overall uncertainty estimation is an important component of the DQO process that must be understood when it is being developed.

As stated in the GMP Guidance 2021, "carefully describing and defining objectives are the most crucial steps in planning and organizing monitoring activities". It includes, as was mentioned above, the choice of sampling matrices and rigorous definitions of sampling units, such as number of samples per sampling occasion, length of the time series and sampling frequency, among others, which in turn will require the definition of qualitative and quantitative objectives through clear statistical assumptions, and a description of what they represent in time and space for a proper interpretation of the results.

4. CHARACTERISTICS OF THE MONITORING PLAN OR NETWORK

Once the problem has been identified, the objectives understood, and the most appropriate temporal and spatial scales specified to achieve the stated monitoring objectives, it is then necessary to design the monitoring network as outlined in step 7 of the DQO process. To do so, the characteristics (see figure 4) described below will have to be defined.

Figure 4. Characteristics of the monitoring plan



4.1 ENVIRONMENTAL PARAMETERS TO BE CONSIDERED

It includes the definition of the substances to be measured/monitored (what to sample), the environmental matrices (where to sample) and other parameters to record when conducting sampling, such as meteorological and topographical, that will need to be determined to meet the established objectives.

4.1.1. Candidate substances to be monitored

Persistent organic pollutants (POPs), generally artificially synthesized, are organic, carbon-based chemical substances and are mostly halogenated compounds (F, Cl, Br,). Their main characteristics are:

- **Persistence:** they are resistant to photolytic, biological and chemical degradation, so they remain in the environment.
- **They travel long distances**: they evaporate or adhere to particles, semi-volatile, which allows them to travel long distances before being deposited.
- **They show bioaccumulation and biomagnification:** they accumulate at high levels of the trophic chain, mainly in fatty tissue.
- **Highly toxic:** At low concentrations they affect the health of humans, biota, and the environment.

Many POPs are deposited from the atmosphere to the Earth's surface, but then have the capacity to re-emit to the atmosphere under environmental conditions that favor this process (heat and humidity). This cycle of deposition and re-emission results in a process known as "global fractionation" which favors the transport of these chemicals to the cold polar regions.

In addition, melting of ice and snow, thawing of permafrost and warmer temperatures can increase the release of chemicals that have accumulated in soils, glaciers, and surface ocean waters. Loss of sea ice facilitates the exchange of pollutants between the atmosphere and the oceans.

Also, changes in wind patterns, ocean currents, precipitation and runoff will affect contaminant pathways and connections between source and receptor regions.

Regarding the POPs' bioaccumulation and toxicity properties, they can bioaccumulate in food webs and, because of their persistence and tendency to associate with lipids, many biomagnify in food chains. High levels of POPs in species of the food chain (especially in marine food webs) result in exposure to these chemicals for certain animals and people who consume these species as part of their subsistence diet. This, together with the toxic properties of many POPs, makes human and wildlife health a concern (AMAP, 2016a).

POPs to be monitored by a country will depend on the objectives set by the country, and on the results of the diagnosis, which should contain which POPs are imported, produced, used, and disposed, and the possible problems to be addressed.

The GMP Guidance 2021 in its Chapter 2. Substances to be monitored, recommends to measure "the concentration of the POPs listed in Annexes A, B, or C of the Convention in relevant matrices". As of 2023, the Convention lists 34 POPs, which include the following substances or groups of substances", see table 1:

Table 1. POPs listed in the Stockholm Convention

	Chemical Substance	Acronym	Conference of the Parties and year	Category	Annex
1	Aldrin		Legacy' POPs	P	A
2	Alpha-hexachlorocyclohexane	α-HCH	COP-4, 2009	P	A
3	Beta-hexachlorocyclohexane	ß-HCH	COP-4, 2009	P	A
4	Chlordane		Legacy' POPs	P	A
5	Chlordecone		COP-4, 2009	P	A
6	Decabromodiphenyl ether	Deca-BDE	COP-8, 2017	I	A
7	Dechlorane Plus & isomers		COP 11, 2023	I	A
8	Dicofol		COP-9, 2019	P	A
9	Dichlorodiphenyltrichloroethane	DDT	Legacy' POPs	P	B
10	Dieldrin		Legacy' POPs	P	A
11	Endosulfan		COP-5, 2011	P	A
12	Endrin		Legacy' POPs	P	A
13	Gamma-hexachlorocyclohexane	ɣ-HCH	COP-4, 2009	P	A
14	Heptachlor		Legacy' POPs	P	B
15	Hexabromobiphenyl	HBB	COP-4, 2009	P	A
16	Hexabromocyclododecane	HBCD	COP-6, 2013	I	A
17	Hexabromodiphenyl ether and heptabromodiphenyl ether	PBDE	COP-4, 2009	I	A
18	Hexachlorobenzene	HCB	Legacy' POPs	I, P, UP	A y C
19	Hexachlorobutadiene	HCBD	COP-7, 2015 and COP-8, 2017	I, UP	A y C
20	Methoxychlor		COP 11, 2023	P	A
21	Mirex		Legacy' POPs	P	A
22	Pentachlorobenzene	PeCB	COP-9, 2019	I, P, UP	A y C
23	Pentachlorophenol, its salts and esters	PCP	COP-7, 2015	P	A
24	Perfluorooctane sulfonic acid	PFOS	COP-4, 2009	I, P	B
25	Perfluorooctanoic acid, its salts and related compounds	PFOA	COP-9, 2019	I	A
26	Perfluorohexane sulfonic acid, its salts and related compounds	PFHxS	COP-10, 2021	I	A
27	Polychlorinated biphenyls	PCB	Legacy' POPs	I, UP	A y C
28	Polychlorinated dibenzo-para-dioxins	PCDD	Legacy' POPs	UP	C
29	Polychlorinated dibenzofurans	PCDF	Legacy' POPs	UP	C
30	Polychlorinated naphthalenes	PCN	COP-7, 2015	I, UP	A y C
31	Short-chain chlorinated paraffins	SCCPs	COP-8, 2017	I	A
32	Tetrabromodiphenyl ether and pentabromodiphenyl ether	PBDE	COP-4, 2009	I	A
33	Toxaphene		Legacy' POPs	P	A
34	UV-328		COP 11, 2023	I	A

P = Pesticide
Annex A = Elimination

I = Industrial
Annex B = Restriction

UP = Unintentional Production
Annex C = Unintentional Production

More information and a detailed risk profile for these substances can be found on the Stockholm Convention web site at: (http://chm.pops.int/TheConvention/ThePOPs/TheNewPOPs/tabid/2511/Default.aspx#LiveContent%5BPFHxS%5D).

The GMP Guidance 2021 also recommends "collecting data for all 30 POPs, parent compounds, precursors and transformation compounds shown in Table 2.2, Chapter 2" of the Guidance, as it may not be necessary or even possible to analyze all individual congeners of mixtures of POPs listed in table 1. But the country may select or prioritize the substances to be measured according to the results of the diagnostic, its priorities, or concerns.

4.1.2 Candidate environmental matrices and species to be monitored

Environmental matrices include abiotic matrices such as water, air, soil and/or sediments and biotic matrices such as fish, birds, or indicator organisms (depending on the site and substance), and human biomonitoring (infants and adults of reproductive age), among others.

Air monitoring can be used to measure transport and transboundary pollution of almost all POPs except fluorinated compounds. In air, primary and secondary emissions can be measured, and it is a media that allows comparisons on a global scale. In other words, air matrix studies can be conducted at various spatial scales, from the micro to the global scale. Typically, atmospheric monitoring programs evaluate trends in specific chemicals to assess the effect of regulatory measures.

Water is recommended by the GMP 2021 Guidance as the primary medium for fluorinated POPs, based on the evidence that water is the main transport medium for these chemicals in the environment. Primary releases can also be measured in this matrix, allows comparisons on a global scale, and handles also studies from micro to global scales.

Biotic matrices include plants, animals and other organisms inherent to locations with specific characteristics. The monitoring of biotic matrices is often related to local problems and health issues. Therefore, the spatial scale of studies ranges from micro to regional.

The matrices identified by the Conference of the Parties to the Stockholm Convention at its second meeting as core for the first evaluation were ambient air; human mother's milk, and human blood. At the sixth meeting of the Conference of the Parties, water was added as a core matrix for the monitoring of Perfluorooctane Sulfonic Acid, its salts and Perfluorooctane Sulfonyl Fluoride. It was also recommended for Perfluorohexane Sulfonic Acid, its salts and related compounds.

For future evaluations, the Conference of the Parties has also decided to supplement the core data with data from other media such as biota, soil, and sediments. The chapter 4 of the GMP guidance 2021 includes consideration of supplemental media for future evaluations and specific considerations e.g. for sampling (UNEP, 2021).

The GMP 2021 Guidelines also state that "environmental and human monitoring under GMP should be conducted on a regional scale, while achieving global coverage. Therefore, the highest analytical performance requirements are needed to identify small changes in concentrations" (UNEP, 2021). Countries participating in GMP projects have received financial support for monitoring in the Convention's target matrices.

4.1.3. Other parameters to be considered

Other parameters that should be considered when implementing a monitoring program are meteorological and topographical, in order to better locate the monitoring stations and to understand and interpret the data.

Due to the spatial and temporal variability of pollutants and their transport, the effects of buildings, terrain, and heat sources or sinks on air pathways can produce local anomalies of excess pollutant concentrations. Meteorology must be taken into account when determining not only the geographic location of an air monitoring site, but also factors such as the height, direction and extent of sampling probes. Meteorological factors that can greatly influence the dispersion of contaminants are wind speed and direction, temperature, and relative humidity, among others (Martínez and Romieu, 1997).

Topography can affect both the transport and diffusion of air pollutants. Minor topographic features may exert small influences; major ones, such as deep river valleys or mountain ranges, may affect large areas. Prior to final site selection, it is recommended that the topography of the area be reviewed to ensure that the monitoring objective at that site will not be adversely affected (EPA, 2017).

4.2 DEFINITION OF NUMBER AND SAMPLING SITES

Sampling is selecting a subset of cases or individuals from a population. A statistical sample is obtained with the intention of inferring the properties of the whole population, so the sample must be representative.

Definition of number and sampling sites refers to the determination of the number of sites or species that need to be monitored or sampled to meet the established objectives. Therefore, description of the objectives and the definition of the qualitative and quantitative objectives and the appropriate temporal and spatial scales is a prerequisite for the estimation of the number of sites, the type of sites and their spatial location.

For each matrix and POP there are different sampling or monitoring procedures, which you will need to select and considered, e.g., for “the ambient air sampling network the GMP 2021 Guidance, interprets ‘representative’ as a sufficient number of sampling sites to draw general conclusions about POP trends and not be representative of the heterogeneity of that region." Therefore, to address POPs trends, the GMP recommends for each region as a minimum:

- One or more active high-volume air sampling stations which can provide episodic or cumulative sampling (for 1 to 2 days every week or continuously over periods of 1 to 2 weeks) and
- A network of 10 to 15 passive sampling stations, which provide continuous, cumulative passive (diffusive) sampling for integration periods ranging from a few months to 1 year. Passive samplers enhanced spatial resolution and information on POPs sources, transport, and trends over time (UNEP, 2021).

The GMP 2021 Guidance, also indicated that "larger sample sets provide more precise and reliable estimates of mean concentrations and variance. However, the contributions from additional samples depend to a very high degree on the sampling strategy".

To estimate the number of samples needed for quantitative objectives, information on expected variance must be available (see Chapter 3 of the GMP 2021 Guidance). The number of samples needed is even higher in case of non-parametric statistics. For the statistical analysis of the levels of POPs, the 2007 GMP Guidance recommends taking many samples frequently from one location rather than to take a few samples from many different locations. Based on experience from the first two POPs monitoring collection campaigns, the GMP 2021 Guidance also recommends a sample set size between 7 and 10 years for identification of a trend.

But the number and type of sites has very important implications for quality assurance activities. The more sites there are, the more oversight or audits will be required to ensure that the same methodology, like standardized protocols are followed at each site, geo-referencing and photographic registers are available, to locate with precision each site, and that a procedure for cataloging them is included. In addition, good practices will have to be ensured to guarantee the future location of the sites from one campaign to the next, the completeness of measurements, the use of field and/or trip and laboratory blanks, and the use of duplicates, among others. This is to reduce sources of error in the measurements and to ensure comparability of a set of data from one site with those from another site.

Regarding **air matrix** monitoring site locations, U.S. EPA Quality Assurance Handbook for Air Pollution Measurement Systems Volume II Ambient Air Quality Monitoring Program (EPA, 2017) recommends, as a first task, when evaluating a potential air site location to determine the scale for which a candidate location may qualify by considering the following:

- location and emissions strengths of nearby sources, especially major source
- prevailing wind direction in the area
- nearby uniformity of land use; and
- nearby population density.

To select locations according to these criteria, it is necessary to have detailed information on the location of emission sources, geographical variability of ambient pollutant concentrations, meteorological conditions, and population density. The variability of sources and their intensities of emissions, terrains, meteorological conditions and demographic features require that each site be studied individually, based upon the best available evidence and on the experience of the decision team" (EPA; 2017).

The GMP 2021 Guidance recommends that "positioning and installation of air samplers should follow standard operating procedures and the description of all selected sites should be provided. It also provides general criteria for the installation:

- **Regional representativity:** A location free of local influences of POPs and other pollution sources such that air sampled is representative of a much larger region around the site.
- **Minimal meso-scale meteorological circulation influences:** Free of strong systematic diurnal variations in local circulation imposed by topography (e.g., upslope/ down slope mountain winds; coastal land breeze/lake breeze circulation).

- **Long term stability:** In many aspects including infrastructure, institutional commitment, land development in the surrounding area.
- **Ancillary measurements:** For the super-sites, other atmospheric composition measurements and meteorological wind speed, temperature and humidity and a measure of boundary layer stability. For the passive sites, meteorological wind speed, temperature, and humidity.
- **Appropriate infrastructure and utilities:** Electrical power, accessibility, buildings, platforms, towers, and roads, with care to avoid sources of potential contamination.
- **Passive sampling sites** should also take advantage of the freedom to deploy samplers well away from infrastructure (buildings, roads) and human activity which could be potential sources of POPs contamination**.**

In addition to site location information, these sites should be classified in a standardized manner. In the GMP 2021 Guidance, Chapter 4, the following classification is provided (see table 2):

Table 2. Sites Classification (GMP, 2021)

Site type	Potential Source type (more than one type is possible)
urban	industrial
sub-urban	traffic
rural	residential
remote	agricultural
high altitude	waste sector
polar	none, *i.e.* continental background site
marine/coastal	

Note: population density can be used as an approximate guide for site classification as follows:
urban = >200 000 inhabitants within a 10 km radius.
sub-urban = between 20 000 and 200 000 inhabitants within a 10 km radius
rural = between 2000 and 20 000 inhabitants within 10 km radius
remote = relatively uninhabited (<2000 inhabitants within a 10 km radius)

For the **water matrix**, rivers are preferentially recommended by GMP Guideline 2021 but data from other sites are also welcome. Recommendations for sampling location and sitting requirement are also included as for air sampling. Such requirements for water sampling locations are:

- Ease of access by limnological or oceanographic vessels with capacity to deploy water sampling equipment or from land based sites such as bridges,
- Presence of an existing routine sampling program with water chemistry data,
- Availability physical measurements (temperature, pH, conductivity), flow,
- Meteorological observations,
- Personnel who could be trained in the sampling techniques,
- Availability of suitable laboratory facilities to prepare sampling media and subsequently extract and analyze the samples.

Although the GMP 2021 Guidance recommends a regional scale, other types of sites, such as source-oriented sites (urban, industrial, or agricultural), are useful as "context sites" for comparison purposes. Therefore, for abiotic matrices such as air and water, two types of sites are recommended: reference and source-oriented sites.

Reference sites: These are sites not directly impacted by human activities. The aim is to identify sites whose physical characteristics have not been impacted by human activity, in order to install monitoring sites whose data serve as a national and global reference, such as pristine sites.

Source-oriented sites: Selection of sites with agricultural, industrial, or urban activity that the diagnosis has identified e.g., places where POPs pesticides were applied, used or produced, and that are of national interest.

For **biotic samples** the GMP is using human milk and human maternal blood as the two equal core matrices for comparable biological monitoring. The aforementioned 2007 Guidance recommends the WHO protocol (WHO Food Safety), which gives guidance on the number of samples/sampling locations and selection of donors.

It also contains information on questionnaires, transport, storage, sample preparation and analysis, and annexes with questionnaires, summary information for a sample, an informed consent template, guidance for mothers, and an estimated timeline and budget. The WHO Research Ethics Review Committee has endorsed the project, but each country will also have to follow its own procedures" (UNEP, 2007). WHO guidelines (WHO, 2007) and amended UNEP guidelines (UNEP, 2017) require samples from 50 individuals.

Sampling protocols have been developed for abiotic and biotic matrices by institutions or organizations such as ASTM (American Society for Testing and Materials), EC (European Commission), US-EPA (Environmental Protection Agency), Environment Canada, Ministry of the Environment, Japan, GEMS (Global Environment Monitoring System), and WHO (World Health Organization), among others, Chapter 4 of the GMP 2021 Guidance includes many references of these procedures.

4.3 DETERMINATION OF MONITORING TIMES

This section will define the duration of the monitoring program, the sampling frequency, and the determination of sampling times, according to the type of program to be implemented.

As was mentioned in the previous section, description of the objectives and the definition of the qualitative and quantitative objectives is also a prerequisite for the estimation of the duration of the monitoring program, sampling frequency, and the determination of sampling times.

The duration of the monitoring program is the evaluation period during which measurements are taken to compile the database needed to meet program objectives. Most of the monitoring networks operate year round. In the case of GMP monitoring projects, the duration of each project was two years. But there are permanent programs that are renewed every year, seasonal and research programs that can last only a couple of weeks.

The sampling frequency indicates the number of samples to be taken in a period of time, at each sampling site, which can be every day, every two days, every six days, or deployed for a full year as in the case of passive sampling of POPs with XAD resins. It is very important to consider that in the case of abiotic matrices such as air and water, POPs concentrations may vary due to meteorological conditions, climatic or seasonal changes, among others. Therefore, it is recommended to consider a frequency that covers a complete year in order to carry out regional and global comparisons.

Therefore, the GMP 2021 Guidance recommends for the air matrix four passive samplings with PUFs with three months of deployment for each PUF, covering a full calendar year or with XAD samplers with annual deployment (see Chapter 4. Sampling and sampling preparation methodology). And for water matrix, sampling is recommended at each selected site 4 times a year (same site and with the same method) (UNEP; 2021).

The determination of sampling times refers to the sampling time of an individual reading and corresponds to the time period in which the concentration determination is carried out (Martínez and Romieu, 1997). This sampling time can be determined depending on the expected contaminant concentrations and the sampling equipment to be used and can be hours as in the case of active sampling, months as in the case of passive sampling with PUF or up to one year as in the case of passive sampling with XAD resins.

4.4 SELECTION OF SAMPLING METHODOLOGY AND ANALYSIS TECHNIQUES

The Sampling can be carried out using different methodologies depending on the type of substance or chemical and matrix to be sampled, the sampled material, and the subsequent analysis of the sample. In its simplest form, a sample methodology may consist of filling a clean bottle with river water and subjecting it to conventional chemical analysis. At the more complex end, sample data can be produced by automatic methods such as complex electronic detection devices that take sub-samples over fixed or varying periods of time.

Sampling methods include simple passive sampling, active sampling like semi-continuous and continuous monitoring, and biomonitoring, among other sampling methods. The sample taken must be subjected to a subsequent analysis where its concentration and characterization will be detected.

4.4.1 Selection of sampling methodologies

The selection of sampling methodology, equipment and analytical techniques should be in accordance with the objectives set, the data quality needs to achieve them and budget. Important factors to consider are the accuracy of equipment and of analytical techniques, and the local technical and financial capabilities.

For example, the measurement of atmospheric pollutants can be achieved through various methods that are grouped according to their measurement principles:

- Bioindicator sampling
- Passive sampling
- Active sampling
- Automatic method
- Optical remote sensing method

but each method requires different equipment, training personal and budget. Chapter 4 Sampling and sampling preparation methodology of the 2021 GMP Guidance recommends for air matrix, active and passive sampling using High volume sampling and PUF or SIP disk samplers respectively.

In the analysis of the samples also will be necessary that accredited or expert laboratories analyze the samples to ensure the quality of the data. Different procedures are applied for different types of sampling and contaminants, which in some cases require state-of-the-art laboratory equipment that is not available to all laboratories. The laboratory equipment, as well as the reagents and standards used, and the capacity of the personnel will be important to consider when selecting the laboratory to analyze the samples.

As GMP 2021 Guidance states that environmental and human monitoring under the GMP should be conducted on a regional scale, while achieving global coverage, the highest analytical performance requirements are therefore needed to identify small changes in concentrations.

The delivery of the data by the laboratory to the technicians, agencies or institutions that will perform the management (processing/handling) of the data is another component that must be defined. In the case of the Global Monitoring Plan, the data resulting from the analyses carried out by the accredited or expert laboratories are delivered to UNEP and to the countries involved in the projects, and these in turn are incorporated into the Global Monitoring Plan Data Warehouse by the ROG members (GMP DWH).

GMP 2007 and 2021 Guidances (UNEP, 2007 and 2021) describe in detail sampling design, sample preparation and analysis, QA/QC in core media for legacy POPs, and its chapter 5, covers most aspects of the analytical methods, including other media. Chapter 4 of the GMP Guidance 2021, covers water sampling and recommends documents with methods and guidances for several matrices like the ones from AMAP 2015, 2016b, 2017, EMEP 2001, and OSPAR 2013, among others.

In addition, several guidelines, tools like video tutorials, and Standard Operating Procedures (SOPs) have been developed during the implementation of the UNEP/GEF GMP projects. They provide information on the methods for sample preparation, extraction, purification and analysis; and are available on the UNEP website[1]. Also, GAPS Network has protocols for PUF disk and XAD samplers and other training videos (see Annex 3 for a list and links of SOPs and protocols).

Another important tool for quality control, which has been offered by GMP, is the interlaboratory assessment, which evaluates and communicates laboratory performance and serves as a single blind test for laboratories on POPs analysis. To date, four rounds of interlaboratory assessments have been conducted almost every two years (2010/2011, 2012/2013, 2016/2017, 2018/2019) and have been free of charge for developing countries (in the current GMP provision). A total of 289 laboratories participated in the four rounds covering all UN regions, but not all registered laboratories delivered results (https://www.unep.org/explore-topics/chemicals-waste/what-we-do/persistent-organic-pollutants/pops-interlaboratory).

Another resource is the databank consisting of information on laboratories analyzing POPs worldwide which is accessible through the UNEP website on Global Monitoring of POPs.

[1] https://www.unep.org/explore-topics/chemicals-waste/what-we-do/persistent-organic-pollutants/capacity-building-gmp2 and https://www.unep.org/resources/toolkits-manuals-and-guides/global-monitoring-plan-video-tutorial-pops-active-air.

4.4.2 Assessment of country's needs

Having defined all the characteristics of the monitoring plan, the country's needs for the implementation of the monitoring plan will be revealed.

These needs may range from the strengthening of a relevant regulatory framework, including institutions that have the authority to implement the plan, laboratories with the equipment, precision, and consumables, for example, standards necessary to analyze the samples with the required quality, to the training of the technical staff that will be in charge of implementing the monitoring program in all its stages. These include sampling, analysis, data handling, results assurance, audits, and communication of results, among others.

5. QUALITY ASSURANCE PLAN TO ENHANCE CREDIBILITY AND RELIABILITY OF MONITORING RESULTS

Quality assurance in an environmental monitoring program is all those actions that have to be carried out and documented to ensure the quality of the data produced. The Quality Assurance Plan is a detailed document that outlines how the monitoring program will ensure and verify that data meet specific data quality objectives (DQO) throughout the data lifecycle.

The success of a monitoring program depends on the quality of the data collected and used in decision making, and this can depend significantly on the Quality Assurance Plan and its effective implementation. It is for this reason that systematic planning, such as the Data Quality Objectives (DQO) Process developed by EPA, is required from its design, and that all stakeholders, i.e., data users, data producers, and decision makers, among others, be involved in the program planning process to ensure that their needs are adequately defined and addressed.

The QA Plan will document the results of the systematic planning in the project design; address all aspects of data generation and acquisition to ensure that appropriate methods, such as use of standard operating procedures (SOPs), for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are employed and documented, during implementation; and evaluate activities to assess the effectiveness of project implementation and associated QA/QC activities, and determines whether or not the data conforms to the specified criteria, thus satisfying the project's objectives, under the assessment phase.

The U.S. Environmental Protection Agency (EPA) has developed the Quality Assurance Project Plan (QA Project Plan) as a tool for project managers and planners to document the type and quality of data needed for environmental decisions and to describe the methods for collecting and assessing those data. This Plan integrates all technical and quality aspects of a project, including planning, implementation, and assessment. It documents how quality assurance (QA) and quality control (QC) activities are applied to an environmental data operation to assure that the results obtained are of the type and quality needed and expected (EPA, 2001).

Crosswalks between EPA quality assurance documents, such as the DQO process and the QA Project Plan, are available for consultation in the Appendix A of the EPA Requirements for Quality Assurance Project Plans (EPA, 2001).

As was mentioned, the QA Project Plan documents the results of a project's technical planning process, providing in one place a clear, concise, and complete plan for the environmental data operation and its quality objectives and identifying key project personnel" (EPA, 2002a).

Main steps to develop a QA Project Plan are the following (EPA, 2002a):

1) Find out what needs to be done, based on what is known about the site or situation.
2) Assemble a project team with the necessary expertise.
3) Plan what can be done, or what will be done to obtain data of known quality that are good enough to support the decisions to be made or the study questions to be answered.
4) Write the QA Project Plan.
5) Submit the QA Project Plan for peer review, input, and approval, revising it as needed.
6) Distribute the approved QA Project Plan to all pertinent individuals involved with the project.
7) Begin work while implementing the plan, but remember to:
   a) document any changes in the QA Project Plan,
   b) get re-approval before initiating the change, and then
   c) distribute the updated version.

The twenty-four QA Project Plan elements are summarized in table 3, from planning, through implementation, to assessment. These elements have been arranged for convenience into four general groups. The four groups of elements and their intent are summarized as follows:

A. **Project Management**- These elements cover the basic area of project management, including the project history, project objectives, and roles and responsibilities of the participants. These elements document that the project has a defined goal and that the participants understand the goal and the approach to be used.

B. **Measurement/Data Acquisition**- These elements cover all aspects of measurement systems design and implementation, ensuring that appropriate methods for sampling, analysis, data handling, and QC are employed and are properly documented.

C. **Assessment/Oversight**- These elements address the activities for assessing the effectiveness of the implementation of the project and associated QA and QC activities. The purpose of assessment is to ensure that the QAPP is implemented as prescribed.

D. **Data Validation and Usability**- These elements cover the QA activities that occur after the data collection phase of the project is completed. Implementation of these elements ensures that the data conform to the specified criteria, thus achieving the project objectives (EPA; 2000).

Table 3. List of a QA project Plan Elements (EPA; 2002a)

Grupo A. Project Management	Grupo B. Data Generation Desing and Acquisition	Grupo C. Assessment and Oversight
A1 Title and Approval Sheet	B1 Sampling Process Design (Experimental Design)	C1 Assessments and Response Actions
A2 Tables of Contents	B2 Sampling Methods	C2 Reports to Management
A3 Distribution List	B3 Sampling Handling and Custody	
A4 Project/Task Organization	B4 Sampling Methods	Group D. Data Validation and Usability
A5 Problem Definition and Background	B5 Quality Control	D1 Data Review, Verification and Validation
A6 Project/Task Description	B6 Instrument/Equipment Testing, Inspection, and Maintenance	D2 Verification and Validation Methods
A7 Quality Objectives and Criteria	B7 Instrument/Equipment Calibration and Frequency	D3 Reconciliation with User Requirements
A8 Special Training/Certifications	B8 Inspection/Acceptance of Supplies and Consumables	
A9 Documentation and Record	B9 Non-direct Measurements	
	B10 Data Management	

These basic elements will define and describe the following (EPA, 2002a):

- who will use the data;
- what the project's goals/objectives/questions or issues are;
- what decision(s) will be made from the information obtained;
- how, when, and where project information will be acquired or generated;
- what possible problems may arise and what actions can be taken to mitigate them;
- what type, quantity, and quality of data are specified;
- how "good" those data have to be to support the decision to be made; and
- how the data will be analyzed, assessed, and reported.

For more information consult the US EPA Quality Assurance Manuals for environmental programs on their web site https://www.epa.gov/quality/agency-wide-quality-program-documents.

US EPA states also that "to provide quality products and services, an organization must control its technical, administrative, and human factors that affect quality. A quality system is the means by which an organization ensures the quality of the products or services it provides and includes a variety of management, technical, and administrative elements such as:

- policies and objectives,
- procedures and practices,
- organizational authority,
- responsibilities, and
- accountability.

It provides the framework for planning, implementing, assessing, and improving work performed by an organization and for performing quality assurance (QA) and quality control (QC) activities" (EPA, 2002b).

U.S. EPA has also developed quality management tools (see table 4) to help implement the Quality System, which are summarized in the box below. For more information, see Overview of the EPA Quality System for Environmental Data and Technology (EPA, 2002b).

Table 4. Quality Management Tools

Program/Organization Tools	Project Tools
Quality Management Plans	The Data Quality Objectives (DQO) Process
Quality System Audits	Standard Operating Procedures (SOP)
QA Annual Reports and Work Plan	Standard Operating Procedures (SOP)
QA Training Program	Technical Assessments
	Data Validation and Verification
	Data Quality Assessment

The GMP 2021 Guidance also have recommendation and considerations for quality assurance activities, like those included mainly in Chapter 4, sections 4.1.4, 4.3.4, Chapter 5, section 5.5 and Annex 1. This Guidance states that a quality assurance/quality control (QA/QC) program is key to ensuring the credibility of the data and it can be used to establish long-term trends.

As was mentioned, some of the best practices promoted by GMP to ensure the quality of the monitoring program in the implementation phase are the use of standard operating procedures (SOPs), data validation and verification, selection of a qualified laboratory through laboratory accreditation, interlaboratory assessments, and experience in regular POPs analysis.

6. DEFINING RESPONSIBILITIES

Environmental data monitoring projects involve the coordinated efforts of many agencies, institutions, and individuals, including managers, engineers, scientists, statisticians and others. From the project design phase, all stakeholders, including government agencies, academic institutions, industry representatives, NGOs, and local communities, should be engaged in the program.

The involvement of experts and stakeholders throughout the process will help ensure the success and effectiveness of the program in addressing the challenges of supervision.

The QA Plan must integrate the contributions and requirements of everyone involved into a clear, concise statement of what needs to be accomplished, how it shall be done, and by whom. It must provide understandable instructions to those who must implement the QA Plan, including:

- Management: Legal and administrative (institutions and authorities)
- Coordination for program implementation
    - the field sampling team
    - the analytical laboratory
- the data reviewers
- Evaluation and audits
- Efficient use of data
- Public dissemination

It is very important to ensure that the institutions responsible for the implementation of the monitoring program and its evaluation remain in place throughout the life of the program. In some countries, government institutions and their objectives change with changes of government, and

this puts medium and long-term monitoring programs at risk. Of equal importance will be the training of personnel and securing jobs that perform such activities inherent to program implementation and evaluation.

A Quality Management Plan, or equivalent Quality Manual, is recommended by EPA, it documents how an organization structures its quality system, defines, and assigns QA and QC responsibilities, and describes the processes and procedures used to plan, implement, and assess the effectiveness of the quality system. The Quality Management Plan may be viewed as the "umbrella" document under which individual projects are conducted. EPA requirements for Quality Management Plans are defined in EPA Requirements for Quality Management Plans (QA/R-2) (EPA 2001).

Quality Management Plan is then supported by project-specific QA Project Plans. In some cases, a QA Project Plan and a Quality Management Plan may be combined into a single document that contains both organizational and project-specific elements.

7. EFFECTIVE NETWORKING AND COORDINATION FOR SUSTAINABLE MONITORING

There are many important actors linked to different clusters who could play different but vital and complementary roles in enhancing the delivery of outcomes and sustainability of a national POPs monitoring programme. They can be clustered in global, regional and national groups. Strategic coordination with and engagement of different clusters are important elements in overall planning and cost-efficient delivery of the monitoring outcomes.

This section provides clarity on strategic networking with multi-actors, both national as well as international and for clear understanding of responsibilities and accountabilities towards successful delivery of the objectives of monitoring POPs.

7.1 GLOBAL AND REGIONAL ACTORS

The Stockholm convention provides the global and regional mechanisms relevant to the POPs listed under the Convention, including monitoring the levels of POPs for its purposes and the framework related to technical as well as financial matters. These mechanisms could contribute to address different aspects and challenges of national monitoring.

The table below summarizes the mechanisms available under the Convention relevant to monitoring POPs and what those mechanisms could offer to assist in establishing and implementing a national monitoring program. A brief overview of each of those mechanisms, including links to access additional information needed to explore further on the topics are followed.

Entity	Key functions relevant to POPs monitoring	Possible actions to consider
Conference of the Parties Governing body of the Convention Composed of governments of countries accepted, ratified or acceded	Review and adopt decisions on Priorities for the Convention financial mechanisms (e.g. GEF) Tachnical assistance (TA) programme to assist developing countires on critical needs Global Monitroing Plan for POPs (GMP) National Implementation Plan (NIPs) The effectiveness evaluation Priorities for the Convention regional centers	Deliberate and seeks support to consider the critical national needs for monitoring POPs at national level in making decisions under related programmes
Convention Secretariat Assist /facilitate assistance to parties upon request Coordinate with other international bodies	Coordinate the implementation of the programmes related to POPs monitoring including technical assistance for developing countries	Requests for assistance under the TA programme Reports the status of POPs and the need under the NIP and national reporting
Official Contact Point (OCP) National authority for the performance of administrative functions	All formal communications under the Convention	Communication on capacity needs with the Secretariat and deliberations at the COPs
Regional Organization Group (ROG) Facilitate the regional implementation of the global monitoring plan. Prepare the regional monitoring reports for the effectiveness evaluation process of the Convention	Establish and implement a regional strategy for gathering information on POPs monitoring Capacity building and strategic partnerships to address the data gaps.	Guidance on designing and priorities in national POPs monitoring Access to expertise Support for capacity building needs
Regional Centers Provide technical assistance Promote the transfer of technology	Coordination and networking at regional level Technical assistance	Networking with regional experts Regional collaborations for technology transfer and capacity sharing Support access to information and data Coordinate training worships on regional needs and priorities

Conference of the Parties

As the highest policy making body on POPs the Conference of the Parities (COPs), among other things, deliberate on monitoring POPs at global level, set priorities, review challenges and decides on strategies and actions, including the modalities to provide assistance to developing countries meet national needs to achieve the Convention goals and objectives.

The Stockholm Convention by its Article 12 provides mandates for timely and appropriate technical assistance to developing countries required for effective implementation of the Convention. A framework is established for technical assistance under the Convention with sources of technical assistance, eligibility, the policy and strategy to follow, and the needs and priorities.

Further, technical guidelines as well as mechanisms for technical and financial assistance for Global Monitoring Plan for POPs (GMP) are deliberated and adopted by the COPs, as needed, to facilitate consideration of the results of monitoring POPs in the evaluation of effectiveness of the Convention.

Parties to the Stockholm Convention are required to prepare a plan explaining how they are going to implement the obligations under the Convention and make efforts to put such a plan into operation Among others, the status as well as activities related to monitoring are provided under the national implementation plan.

As parties to the Convention, the COPs is the global platform where countries to engage and inform the national needs including those relevant to the key topics above, decide on priorities, seek global support, where needed, on monitoring of POPs for national decision making and contributing to the global monitoring of POPs under the Convention.

Convention Secretariat

The Secretariat, among other functions, assist or facilitate assistance upon request from developing country Parties and Parties with economies in transition.

At regular intervals technical assistance needs of developing country Parties and Parties with economy in transition and the technical assistance available from developed country Parties and others for the implementation of the Stockholm Convention are collected and summarized by the Secretariat. The technical assistance plan for 2022-2025 available in the Convention Website can be accessed here.

The Secretariat has appointed regional focal points within the secretariat to serve as a liaison between the parties and the Secretariat, primarily on matters relating to technical assistance, and thus ensure that a prompt and tailored response is provided that addresses the needs of parties. The contact details of the Regional focal points can be accessed here.

Official Contact Point

Pursuant to decision by the Conference of the Parties, countries nominate Official Contact Points (OCP) under the Convention. The OCP is the national authority designated to be responsible for the performance of administrative functions and all formal communications under the Convention.

Additionally, under the Convention, countries shall designate a national focal point (NFP) for the exchange of the information relevant to the reduction or elimination of the production, use and release of PoPs; and alternatives to PoPs, including information relating to their risks as well as their economic and social costs.

Parties, through these focal points, exchange information either directly or through the Secretariat. The Secretariat serves as a clearing-house mechanism for information on POPs, including information provided by Parties. The contact details of OCPs and NFPs can be found here.

Regional Organization Groups - POPs Global Monitoring Plan (GMP)

The Global Monitoring Plan for POPs (GMP) established under the Convention facilitates consideration of scientific information relevant to POPs for the evaluation of effectiveness of the Convention. The plan provides a harmonized organizational framework for the collection of comparable monitoring data on the presence of POPs globally, to monitor changes in the concentrations over time, and regional and global environmental transport.

To facilitate the regional implementation of the global monitoring plan, regional organization groups have been established for each of the five United Nations Regions.

The objectives of the regional organization groups are to establish and implement a regional strategy for information gathering, including capacity building and develop strategic partnerships to address the data gaps, and to prepare the regional monitoring reports for the effectiveness evaluation process of the Convention.

Coordination and collaboration with this group help harmonizing the national programme with the GMP, access the expertise in planning and implementation as well as to explore opportunities for capacity building. Further information on Regional Organization groups can be accessed here.

Regional Centers

The Convention has established a network of 16 regional and sub-regional centres to provide technical assistance and to promote the transfer of technology to developing countries to further support the implementation of their obligations under the Convention. These institutions operate as autonomous bodies under the authority of the Conference of the Parties. It is not anticipated that regional centers possess expertise in all aspects relevant to the operation of the Convention. The Centres, however, can play an important role in planning and implementation of a nation POPs monitoring programme towards

- Identifying expertise and capacities available at regional level for sampling, laboratory analyses and data interpretation, preferably through the maintenance of a regional databases and rosters of experts.
- Coordination of training and technical assistance needs
- Promote the transfer of technology

Information on regional centers provided in the Stockholm Convention website can be accessed here.

7.2 POPs MONITORING NETWORKS AND PROJECTS

There are many different independent actors engaged in monitoring POPs at global level. While some monitoring initiatives contribute to policy review and actions at global and regional level, the others focus on enhancing the scientific knowledge of POPs. Some of these are multi-regional programs (e.g. GAPS, MONET, UNEP-GEF, AMAP) contribute to the Stockholm Convention GMP. A comprehensive assessment of regional and national capacities for monitoring and research of POPs in air and water was conducted by the UNEP under the Global Environment Fund supported POPs monitoring projects (UNEP/GEF GMP projects). The assessment concludes with, among other things, useful information to strategically engage with wider community of support for monitoring POPs. The full report is available here.

7.3 NATIONAL ACTORS AND STAKEHOLDERS

Coordination with expertise and resources relevant to monitoring across all stakeholder groups is important at planning and designing stage. While some actors are actively linked to POPs management and measuring the levels, others could form synergy in the delivery of outcomes through their strategic engagement or passive contribution to achieve the overall goals.

As the situation differ from in different countries, a situation analysis is the important first step to identify the essential partners as well as possible contributors. Understanding of potential roles that can be played by different entities would help initial mapping. (See annex 1, titled *Compilation of information for a situational analysis to inform the establishment of a sustainable national POPs monitoring programme* for details)

The approach and purpose of coordination with global, regional and national actors vary depending on the different phases of the monitoring programme:

- Initial panning, designing and establishing
- Programme implementation
- Results and data sharing.

The clarity and consensus of the roles, responsibilities and accountabilities of each actor under each stages mentioned above are vital.

While the responsible agency undertake the work required to deliver the task, the accountable agency is ultimately, answerable for the completion of the task, timely and completely. In some cases, multiple actors may share the responsibility.

7.4 APPROACH

Overall lead

It is important that the proper mandate and authority for the implementation of the Stockholm Convention at national level are vested at the overall lead. It facilitates proper and effective

coordination with a diversity of clusters and actors nationally as well as internationally. The foundation of establishing a sustainable POPs monitoring programme consists three pillars:

a) necessary legal and/or administrative mandate;
b) capacities and systems, including financial mechanisms are in place to implement a regular sampling, generation of high quality and comparable data and;
c) efficient use of the results of the monitoring programme to inform policy review and the stakeholders for action.

It is noteworthy of having established national policies and standards for sound lifecycle management of POPs including releases and monitoring the levels. To facilitate national authorities establishing legal and regulatory frameworks and implementing them, the following guidance documents are available under the Convention.[2]

- Guidance for strengthening regulatory framework and voluntary agreements for regular monitoring of products or articles that may contain new POPs;
- Developing National Legal Frameworks to Implement the Stockholm Convention;
- Guide for the Implementation of the Stockholm Convention.

In the absence of such a system, the government agency responsible for the implementation Convention obligation shall preferably undertake the overall lead.

Alternatively, a competent technical agency or institute, having the required experience, expertise or resources such as the Government Analyst, a University or the Stockholm Convention regional center stationed locally, could also play the lead role with the delegation of authority by the national agency responsible for sound management of POPs and in close coordination and collaboration with it.

Consultation with key stakeholders in programme designing phase

The purpose of networking in the programme designing phase mainly focuses on assessing the expertise and resources available or accessible for monitoring POPs as well as mapping of the agencies that have the necessary mandates and/or administrative powers related to sampling, analysis and assessment of results to review policies, implement actions and addressing financial needs. Coordination and consultation with entities/institutions involved in sampling and analysis of POPs or other chemicals of national concerns such as pesticides, would be useful to explore synergies.

The main outcomes of coordination at this phase should include;

a) Defining the scope, objectives, activities and deliverables of national monitoring of POPs
b) Opportunities that exist for collaboration and consensus of the roles they could undertake in the implementation activities identified
c) Strategies for sustainable long-term funding mechanisms
d) Timeline and roadmap of implementation
e) Responsibilities and accountabilities of activities and deliverables
f) Establishing an inter-agency coordinating committee.

[2] http://chm.pops.int/Implementation/NationalImplementationPlans/Guidance/tabid/7730/Default.aspx

When establishing an inter-agency coordinating committee, it is important to first review existing committees with similar functions and/or mandate to explore opportunities to integrate functional responsibilities of the implementation national POPs monitoring programme for enhance sustainability and cost-efficiency.

Coordination during the implementation phase

Effective and timely delivery of the work plan is the main outcome of coordination during the implementation phase. Both technical as well as logistical aspects are critical to be coordinated for the expected outcomes. Opportunities for sharing of responsibilities of coordination and communication among different actors, as appropriate, is important ensure timely implementation of activities.

Coordination during results and data sharing

Proper coordination of sharing results is critically important to achieve the objectives of the POPs monitoring programme and for the sustainability. Key target audience in sharing results includes, national policy makers, relevant national agencies and prgrammes, academic community, industry sector and the general public. It may involve additional actors not engaged in the previous phases such as, experts on data quality, handling, management and interpretation and, specialist in communication.

At regional level, the Stockholm Convention Regional Organization Group and the Regional Centers are important actors to be involved in sharing the results as well as challenges encountered to explore the opportunities for capacity strengthening where needed.

CONCLUSIONS AND RECOMMENDATIONS

The importance of environmental monitoring lies in the fact that it is the basis of environmental management since it provides objective data on the effects of an economic activity in a defined geographical area and thus allows the implementation of measures to mitigate these effects and evaluate the effectiveness of the measures.

This roadmap provides countries with the steps to follow to design programs that meet national information needs to implement public policies to protect health of the population and ecosystems. It is based on the strategic planning designed by the EPA and invites countries to use these tools or any other tool that allows them to produce reliable data to support public policy actions.

The components of the roadmap are summarized below:

1. Situation analysis. The aim is to prepare a profile or diagnosis of the country with respect to the current situation of POPs in the country, as well as the country's capacity and needs to mitigate or eliminate these compounds. It is advisable to carry out this diagnosis in order

to understand the country's situation with respect to POPs management, to be able to define its problems and thus its need for information.

2. Definition of Monitoring Objectives. It is recommended to first describe and define the problem that needs the monitoring data and then identify the goal of the study. The DQO process is a useful EPA tool for defining the objectives and characteristics of the monitoring network.

3. Characteristics of the Monitoring Plan. The characteristics of the monitoring network include the definition of candidate substances, the matrices/media to be monitored and the number of sampling sites, the determination of monitoring times, and the selection of sampling methodologies and analysis techniques. It is recommended that stratigraphic planning be followed to define these characteristics in order to have reliable data.

4. Definition of a Quality Assurance Plan. Quality assurance in an environmental monitoring program is all those actions that have to be carried out and documented to ensure the quality of the data produced. This plan should integrate actions to ensure data quality in the three phases of a monitoring program, planning, implementation and evaluation, so it is recommended that it be implemented from the planning stage of the project to document the entire process.

5. Definition of Responsible Parties. Creating a stakeholder engagement plan to involve relevant parties in the program development process will be very important for project success. The identification of key stakeholders, including government agencies, academic institutions, industry representatives, NGOs and local communities is advised to be carried out early in program planning to involve them in the design of the program and then in its implementation and evaluation.

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ANNEX 1. COMPILATION OF INFORMATION FOR A SITUATIONAL ANALYSIS TO INFORM THE ESTABLISHMENT OF A SUSTAINABLE NATIONAL POPS MONITORING PROGRAM

Introduction

Proper and comprehensive analysis of the current status with respect POPs in the country both from releases of and exposure to them as well as regulatory control infrastructure of the country towards identifying national priorities, gaps in knowledge and capacities and opportunities for synergy are vital for the establishment of a long-term sustainable monitoring programme on POPs. The foundation for such exercise is to compile the information that informs the situation accurately.

Most of the information required should be captured in the National Implementation Plan (NIP) established under the Stockholm Convention. As the knowledge on POPs and their status are constantly evolving, it may be useful to ensure the information available under the NIPs are current and accurate. Some specific areas of information related to establishing a robust POPs monitoring programme at national level that contributes to addressing the national priorities and its' long-term sustainability may require accessing additional sources, as well.

The guidance below captures the information required to inform the establishment of a sustainable POPs monitoring programme at national level or integration of POPs monitoring activities within the existing national monitoring programmes.

The NIP guidance documents developed under the Stockholm Convention[3] provide the scope and further details of the national information portfolio of POPs. Additional resources on preparing a national profile to assess infrastructure and capacity needs for chemicals management can be assessed through the UNITAR Guidance Document (UNITAR 2012)[4].

The complete profile of information on POPs for a comprehensive situation analysis is broad, extensive and diverse. It ranges from policy, legal, and technical aspects to administrative, logistical, economic and social dimensions.

Availability of and accessibility to information for a complete and comprehensive compilation may be challenging, particularly in developing countries. Lack of certain types of information listed below are preferred but should not hinder the efforts to establish a national POPs monitoring programme, provided that proper consideration of such weaknesses or gaps are recognized during the analysis of information for defining the monitoring scope and objectives. The supplementary information should serve in identifying possible sources for synergy and opportunities for enhanced sustainability.

The primary focus on compiling information should be to map the expertise, resources and monitoring infrastructure available in the country for the development of a plan/strategy towards generation of quality and comparable data to facilitate addressing the national priorities while contributing to the global objectives, as appropriate.

The topics to cover in compiling the information are presented below.

[3] Guidance on developing and updating National Implementation Plans (NIPs) http://chm.pops.int/Implementation/NationalImplementationPlans/Guidance/tabid/7730/Default.aspx
[4] http://cwm.unitar.org/publications/publications/inp.aspx

NATIONAL PROFILE OF POPS

Information on the existence of POPs within the context of the national relevance is one of the key pillars in identifying the priority POPs and potential exposure/release route that leads to defining the scope and priorities of the national POPs monitoring programme or integration of POPs monitoring activities within the existing national monitoring programmes.

1. Inventory of POPs produced, imported, used, in articles, and in stockpiles
   - 1.1. Types and quantities of production of POPs and/or articles containing POPs
   - 1.2. Information on the use of POPs including quantities, and if available distribution and future trends
     - 1.2.1. POPs registered for use under the specific exemptions of the Convention
     - 1.2.2. POPs registered for use for acceptable purposes under Annex B of the Convention
   - 1.3. Information related to generation of POPs in Annex C and measures in place to mitigate their releases
   - 1.4. If available, uses of product treated/contaminated with POPs (e.g.: PCB contaminated electrical transformer oil)
   - 1.5. If available, import of used articles, equipment or other goods contaminated/treated with POPs for final disposal, or recycle/reuse.
     - 1.5.1. Types of articles and quantities
     - 1.5.2. Purposes of import (e.g.: disposal, recycle, reuse to determine potential releases and exposure sites)
   - 1.6. Inventory of storage sites of POPs or POPs contaminated products
     - 1.6.1. Locations
     - 1.6.2. Quantities and type of POPs
     - 1.6.3. Condition of storage
   - 1.7. Inventory of POPs wastes and contaminated sites
     - 1.7.1. Locations, types, quantities and current operational status of disposal sites of POPs contaminated wastes
     - 1.7.2. Legacy POPs/chemicals disposal sites and, if available, types and quantities
     - 1.7.3. Sites of maintenance/operations of POPs containing and/or contaminated products and equipment (e.g.: Electrical transformers etc.)

2. Data on human and environmental levels of POPs[5]
   - 2.1. National data
     - 2.1.1. Levels in human tissues
     - 2.1.2. Levels in environmental matrices
     - 2.1.3. Time trends, if any, on human and environment levels
     - 2.1.4. Important data gaps, if any (spatial, temporal and type of POPs)
   - 2.2. Information presented in Regional Monitoring Reports of the Global Monitoring plan on POPs under the Stockholm Convention relevant to the national contexts

[5] Stockholm Convention data warehouse may contain data collected and reported under the Convention. See http://chm.pops.int/Implementation/GlobalMonitoringPlan/GMPdatawarehouse/tabid/181/Default.aspx

CAPACITIES AND INFRASTRUCTURE FOR MONITORING

3. Information on the key actors related to POPs monitoring
   - 3.1. National agencies that have the mandated to monitor POPs in various media or in the absence of such arrangement, other chemical contaminants in general (e.g.: pesticides, water quality)
   - 3.2. Government analysts' role in measuring the levels of POPs in different matrices or, if not, for other chemical contaminants in general
   - 3.3. Any role of the national standards agency in regulating chemicals in general, or POPs in particular
   - 3.4. Waste management sector, both public and private, monitoring levels in conformity with national standards/regulations or those provide the services on demand by clients
   - 3.5. Universities and other academic institutions involved in POPs related research and monitoring
     - 3.5.1. Roster of experts on POPs monitoring, including their field of study/research, affiliations with local and international monitoring networks, related project or studies currently involved in
     - 3.5.2. Information on ongoing academic studies, programmes and projects, including international collaborations
     - 3.5.3. Research laboratories with analytical capacities and technical expertise to generate high quality reliable data on the levels of POPs, including the types of POPs and matrices
     - 3.5.4. Existing networks and infrastructure currently available and activities implemented in the past for sampling human and environmental matrices for monitoring POPs
   - 3.6. Special projects and external networks engaged in national POPs related research and monitoring
   - 3.7. Other national and regional initiatives/projects that are not linked to POPs but can contribute to synergies for sampling, monitoring and review of national policies on POPs management

4. Information on existing coordination mechanisms for monitoring POPs
   - 4.1. Inter-ministerial and/or interagency committees for
     - 4.1.1. National decision making on matters related to POPs
     - 4.1.2. Coordinating the implementation of POPs related policies, programmes and projects
   - 4.2. In the absence of above, other existing national coordination mechanisms on chemicals that can accommodate POPs monitoring (eg. Environmentally sound disposal of wastes, environmental monitoring)

5. Information management, use and dissemination
   - 5.1. National level
     - 5.1.1. For policy review and NIPs related activities
     - 5.1.2. Reporting under the Convention
     - 5.1.3. Information/data repositories on POPs or in the absence of such, those of hazardous chemicals
   - 5.2. Research and academic sector
     - 5.2.1. If available, information on databases of research articles and technical publications related to monitoring POPs

5.2.2. Periodic research/academic conferences on chemicals and POPs related topics

5.3. If available, information on social and non-governmental information platforms related to POPs or, in the absence, on hazardous chemicals, in general

6. Technical infrastructure
   6.1. Sampling
      6.1.1. Technical capacities at national level on designing and implementing sampling programmes
      6.1.2. Academic research networks and projects that can collaborate in sampling activities
      6.1.3. Private sector initiatives and engagements in sampling of human and environmental media for monitoring chemical contaminants
   6.2. Analysis
      6.2.1. National laboratory capacities for the analysis of POPs in different human and environmental media
      6.2.2. External POPs monitoring networks and projects with access to analytical services
      6.2.3. Other monitoring programmes or external networks with opportunities for collaboration in measuring the levels
      6.2.4. Laboratory analytical facilities for measuring the levels in human and environmental media available at academic research community
      6.2.5. Private sector laboratories that has capacity to offer the analytical services for POPs in different matrices
      6.2.6. Quality assurance and quality control systems in place for the analysis of POPs

7. Resources available and needed for establishing sustainable monitoring of POPs
   7.1. Regular budget allocations for monitoring POPs at national level
   7.2. Business plans, if available, of analytical service agencies that can accommodate sustainable monitoring of POPs
   7.3. Availability and long-term prospects of funding for academic research projects
   7.4. Opportunities for resources from regional networks and international donor community
      7.4.1. Types of funding support (e.g. human resources development, strengthening laboratory analytical capacities)
      7.4.2. Regional networks for sharing knowledge, analytical and technical resources (e.g. analyses of different matrices and POPs)

LEGAL AND ADMINISTRATIVE INFRASTRUCTURE FOR MONITORING POPS

8. Information on national policies, laws and regulations specific to POPs and/or those governing the lifecycle of POPs and their levels in human and environmental media,
   8.1. Production, import, export, transport, storage, use and disposal
   8.2. Monitoring and research aspects addressed in the NIP
   8.3. If available, environmental standards related to POPs
   8.4. Environmental permits systems and their monitoring requirements

9. National authority(s) responsible for national monitoring programmes, laboratory accreditations, quality control, research and development.

10. Administrative infrastructures related to sound management of chemicals and/or those specific to POPs that regulates the lifecycle of POPs including their releases and exposure
    10.1. The national authority(s) responsible for the establishment and review of national policies and laws related to POPs
    10.2. National agencies responsible for implementing or enforcing regulatory actions related to the life-cycle management POPs, including wastes and their releases to the environment and exposure to them
        10.2.1. Control/clearance of imports and exports of POPs, products containing POPs, POPs contaminated wastes
        10.2.2. Regulation of transport, storage, use and disposal
        10.2.3. National environmental standers for disposal and the levels in the environment on POPs or, in the absence, related to other hazardous chemicals
        10.2.4. Monitoring the levels in biotic and abiotic matrices of POPs or, in the absence of such arrangement, of hazardous chemicals, in general.

CONCLUSIONS AND RECOMMENDATIONS

Compilation of information listed above should inform sound, facts based assessment of the situation, including several aspects, vital for the establishment of sustainable and cost efficient POPs monitoring programme.

A. Existing capacities

One of the main purposes of a situational analysis is to identify and assess the capacities in place for the establishment of a sustainable and cost effective monitoring programme. It includes, available expertise for designing a scientifically sound POPs monitoring plan for the generation of scientifically sound results, policy/legal framework for monitoring POPs, human, physical and financial resources required for effective and sustainable implementation. It should also inform the availability of the infrastructure, needed for uninterrupted periodic sampling of matrices and laboratories capable of generating quality and comparable data.

B. National priorities

Sustainability of a long-term monitoring of POPs heavily depends, among others, on the assessment of national priorities and effective integration of them in the monitoring plan. The priorities consist, the POPs to be focused on monitoring and in which respective matrices, sampling sites/locations and the frequency. The national profile of POPs, in particular, the evidence on the availability, historical use patterns, potential contaminated sites or releases of POPs and existing data on the levels of POPs should inform the basis for the priorities. National policies related to the lifecycle management of POPs forms the scope and rationale for monitoring.

C. Synergy

Assessment of gaps and challenges in POPs monitoring and identification of potential partners, both internal and external, facilitate strategic engagement with them to address the challenges as well as provide synergies for enhanced delivery of outcomes. Compilation

of information on POPs monitoring networks active in the region, academic and research institutions engage in POPs related topics and monitoring, and exploring opportunities for assistance and guidance of the Regional Coordinating Group established under the Convention would be helpful.

D. National Roadmap

Proper collection of information and objective assessment of them informs defining the scope and objectives of the monitoring plan for the delivery of national priorities and the road map to address the critical gaps through strategic and effective multi-stakeholder collaboration, supported by sound financial mechanisms.

ANNEX 2. DQO PROCESS

The DQO process consists of seven logical steps that guide managers or staff toward a resource-efficient environmental data acquisition plan (EPA QA/G-4. Systematic Planning using the Data Quality Objectives Process).

Step 1. State the Problem

Define the problem that necessitates the study or monitoring; identify the planning team, examine budget, and schedule.

Activities:

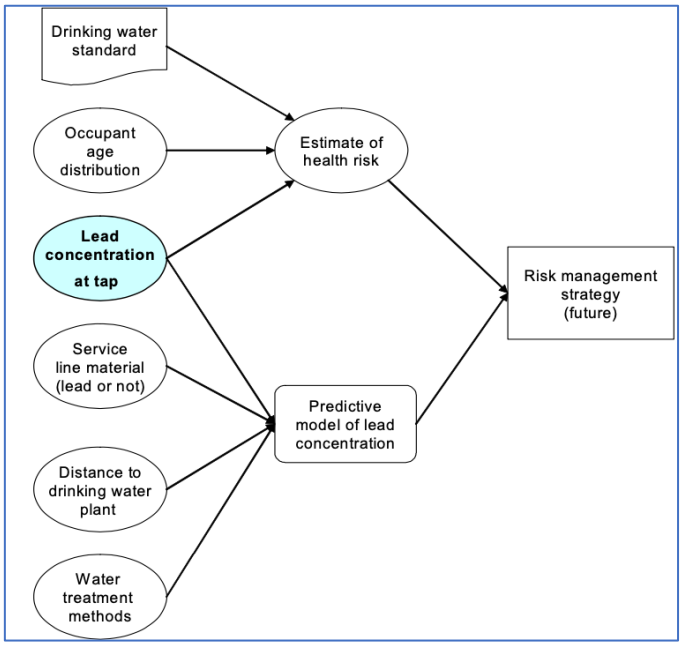
- describe the problem, develop a conceptual model of the environmental hazard to be investigated, and identify the general type of data needed
- establish the planning team and identify the team's decision makers
- discuss alternative approaches to investigation and solving the problem
- identify available resources, constraints, and deadlines associated with planning, data collection, and data assessment.

Outputs:

- a concise description of the problem
- a conceptual model of the environmental problem to be investigated with a preliminary determination of the type of data needed and how it will be used
- a list of the planning team members and identification of decision makers or principal data users within the planning team; and,
- a summary of available resources and relevant deadlines for the study, including budget, availability of personnel, and schedule.

Components of the conceptual model of the environmental problem:

- Known or expected locations of contaminants,
- Potential sources of contaminants,
- Media that are contaminated or may become contaminated, and
- Exposure scenarios (location of human health or ecological receptors).



Step 2. Identify the Goal of the Study

State how environmental data will be used in meeting objectives and solving the problem, identify study questions, define alternative outcomes.

Activities

- identify the principal study question and define alternative actions that may be taken based upon the range of possible outcomes that result from answering the principal study question;
- use the principal study question and alternative actions to make either a decision statement or estimation statement (whichever is relevant to the particular problem); and
- organize multiple decisions into an order of sequence or priority, and organize multiple estimation problems according to their influence on each other and their contribution to the overall study goals.

Outputs

- A well-defined principal study question,
- A listing of alternative outcomes or actions as a result of addressing the principal study questions,
    - For decision problems, a list of decision statements that address the study question, and
    - For estimation problems, a list of estimation statements that address the study question.

Examples of typical principal study questions

Decision problems

- Does the concentration of contaminants in ground water exceed acceptable levels?
- Does the pollutant concentration exceed the NAAQ Standard?
- Does a contaminant pose a human health or ecological risk?
- Is the contaminant concentration significantly above background levels?

Estimation problems

- What is the average rate of ground water flow in the aquifer?
- What is the distribution of pollutant air concentrations over space and time?
- What are the sizes of endangered species populations within the habitat of concern?
- How many children in urban environments are exposed to unhealthy levels of airborne
- pollutants?
- How do the background contaminant concentrations vary over space and time?

Step 3. Identify Information Inputs

Identify data and information needed to answer study questions.

Activities

- the types and potential sources of information needed;
- information basis for specifying performance or acceptance criteria; and
- the availability of appropriate sampling and analyses methods.

Outputs

- lists of environmental characteristics that will resolve the decision or estimate and potential sources for the desired information inputs;
- information on the number of variables that will need to be collected;
- the type of information needed to meet performance or acceptance criteria; and
- information on the performance of appropriate sampling and analysis methods.

Step 4. Define the Boundaries of the Study

Specify the target population and characteristics of interest, define spatial and temporal limits, scale of inference.

Activities

- define the target population,
- determine the spatial and temporal boundaries, (geographic area, and period of time the data should represent)
- identify practical constraints, and
- define the scale of inference (i.e., decision unit or scale of estimation).

Outputs

- Definition of the target population with detailed descriptions of geographic limits (spatial boundaries),
- detailed descriptions of what constitutes a sampling unit
- time frame appropriate for collecting data and making the decision or estimate, together with those practical constraints that may interfere with data collection, and
- the appropriate scale for decision making or estimation.

Step 5. Develop the Analytic Approach

Define the parameter of interest, specify the type of inference, and develop the logic for drawing conclusions from findings.

Activities

- specify the population parameter (e.g., mean, median or percentile) considered to be important to make inferences about the target population;

- for decision problems, choose an Action Level (using information identified in Step 3) that sets the boundary between one outcome of the decision process and an alternative, and verify that there exist sampling and analysis methods that have detection limits below the Action Level;
- for decision problems, construct the theoretical "If...then...else..." decision rule by combining the true value of the selected population parameter; the Action Level; the scale of decision making (Step 4), and the alternative actions (Step 2);
- for estimation problems, develop the specification of the estimator by combining the true value of the selected population parameter with the scale of estimation and other boundaries (Step 4).

Outputs

- identification of the population parameters most relevant for making inferences and conclusions on the target population;
- for decision problems, the "if..., then...else..." theoretical decision rule based upon a chosen Action Level; and
- for estimation problems, the specification of the estimator to be used.

Step 6. Specify Performance or Acceptance Criteria

Decision making (hypothesis testing): Specify probability limits for false rejection and false acceptance decision errors.

Estimation approaches: Develop performance criteria for new data being collected or acceptable criteria for existing data being considered for use.

Step 7. Develop the Plan for Obtaining Data

Select the resource-effective sampling and analysis plan that meets the performance criteria.

Activities

- Gathering information that you will need in developing an acceptable and efficient sampling and analysis design;
- Identifying constraints that will impact the sampling and analysis design;
- Providing details on the sampling and analysis methods you will use to generate the data;
- Identifying one or more candidate designs from which to select;
- Determining an "optimal" amount of information to collect for the potential design using statistical and cost considerations;
- Preparing a resource-effective information collection plan that will meet your needs and requirements.

Outputs

- Full documentation of the final sampling and analysis design, along with a discussion of the key assumptions underlying this design,

- Details on how the design should be implemented together with contingency plans for unexpected events, and
- The Quality Assurance and Quality Control procedures that would be performed to detect and correct problems and so ensure defensible results.

ANNEX 3. SOPS AND PROTOCOLS FOR POPS SAMPLING AND ANALYSIS

Air
Passive sampling of Ambient Air Methodology and Procedure (EN/SP)
Procedure for Air Monitoring using Active Air Samplers (HVS) (EN/FR/SP)
Video tutorial of active air sampling and on passive air sampling

Human milk
Guidelines for Organization, Sampling and Analysis of Human Milk on Persistent Organic Pollutants (EN/FR/SP)
Video tutorial of human milk survey (EN/FR/SP)

Water
Protocol for the Sampling of Water as a Core Matrix in the UNEP/GEF GMP2 Projects for the Analysis of PFOS

Matrices of National Interests
Protocol for the Sampling and Pre-treatment of National Samples within the UNEP/GEF Projects to Support the Global Monitoring Plan of POPs 2016-2019

Protocol 1: Analysis of Perfluorooctane Sulfonic Acid (PFOS) in Water and Perfluorooctane Sulfonamide (FOSA) in Mothers' Milk, Human Serum and Air, and the Analysis of Some Perfluorooctane Sulfonamides (FOSAS) and Perfluorooctane Sulfonamido Ethanols (FOSES) in Air (EN/FR/SP)

Protocol 2: Analysis of Polychlorinated Biphenyls (PCB) and Organochlorine Pesticides (OCP) in Human Milk, Air and Human Serum (EN/FR/SP)

Protocol 3: Analysis of Polybrominated Diphenyl Ethers (PBDE) in Human Milk, Air and Human Serum (EN/FR/SP)

Protocol 4: Analysis of Per- and polyfluoroalkyl substances (PFAS) in Water for the Global Monitoring Plan of the Stockholm Convention (EN/FR/SP)

Protocol 5: Analyse des polychlorodibenzo-paradioxines, des polychlorodibenzofurannes (PCDD/PCDF) et des polychlorobiphényles (PCB) de type dioxine (dl-PCB) dans l'air ambiant et les tissus humains (FR/SP)

GAPS Network protocols for PUF disk and XAD samplers and other training videos could we found in the following links:

- Instructions on PUF disk sample changes for Arctic passive network:
- https://www.youtube.com/watch?v=8A22nvu7kbQ
- XAD tube sampler setup:
- https://www.youtube.com/watch?v=9vvrvpRD96k
- Temperature logger installation:
- https://www.youtube.com/watch?v=nkzbCzRPMyc&feature=youtu.be
- PUF passive sampling video (in Arabic):
- https://www.youtube.com/watch?v=NznXwa-xk-0