Summary and context of the interlaboratory assessment

Heidelore Fiedler

Örebro University
School of Science and Technology, MTM Research Centre
SE-701 82 Örebro, Sweden
e-mail: Heidelore.fiedler@oru.se

Introduction and context

- Stockholm Convention on POPs requires and the Conference of the Parties established a 'Global Monitoring Plan' (GMP) as part of article 16 on ‘effectiveness evaluation‘;
- To be effective, monitoring data should “confirm a 50% decline in the levels of POPs within a 10 year period”

  →POPs laboratories must be capable – at any time – to analyse samples for POPs within a margin of ±25%;

  →Harmonized data generation and assessment

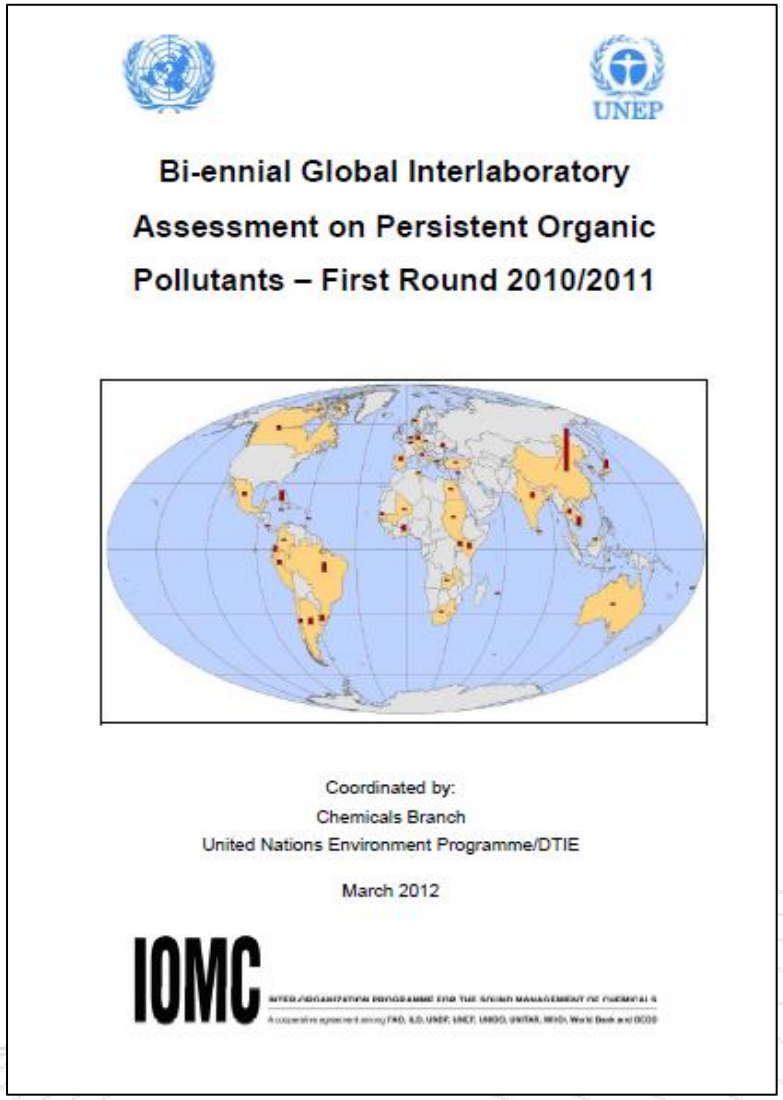
- Guidance document recommends to participate in interlaboratory assessments on regular basis and to include all POPs and matrices.

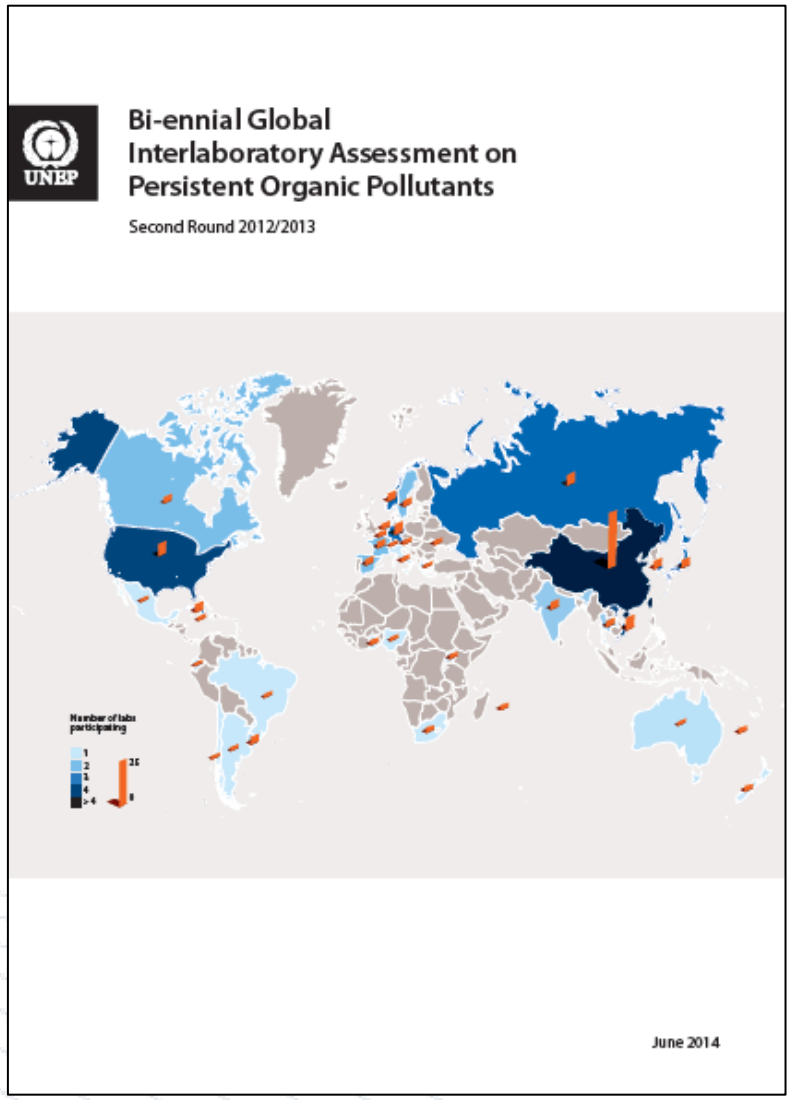
Cooperation partners

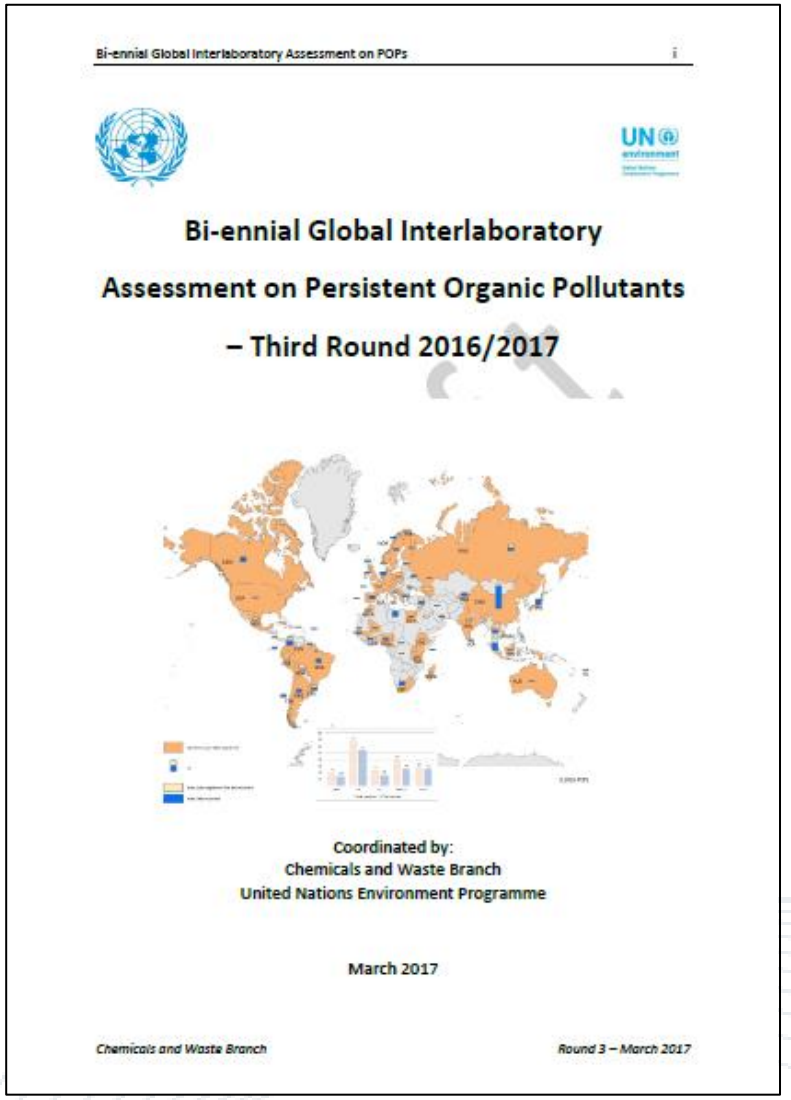
UNEP-MTM Contract:

- 2 rounds of interlaboratory assessments (2016/2017 and 2018/2019
- 2 reports

Three rounds of POPs interlaboratory assessment







Multiple participation pattern

Lab code	Round 1	Round 2	Round 3	Submitted results Round 1	Submitted results Round 2	Submitted results Round 3
1	1	1	1	1	1	1
2	2	2	2	1	1	1
3	3	3	3	1	1	1
4	4	4	4	1	1	1
5	5	5	5	1	1	1
6	6	6		1	1	na
7	7	**108**	7	1	1	1
				1	0	na
				0	1	0
				1	0	1
				0	1	na
				na	na	1
				na	na	1
				na	na	0
				na	na	0

High interest and commitment for all interlab assessments
Goal: Maintain commitment in future rounds

Spotted commitment
Question: continue or discontinue POPs analysis? Usefulness of capacity building?

Newly registered laboratories
Goal: participate and deliver in future rounds – or give up?

Registration form for 3rd round (2016-2017)

Key dates

- Registration from early March 2016 until 30 April 2016 (extended until 31 May 2016)
- Distribution of test samples: from end of June 2015 (IVM VU) and from 15 July 2016 (MTM)
- Reporting of results (MsExcel templates): Not later than 9 Sep 2016 extended until early October 2016
- Registation via e-mail (IL2016-POP@oru.se) or the WebPage IL2016-POP.com

REGISTRATION FORM FOR TEST SAMPLES

My laboratory is interested in analyzing the following matrices and POPs and provide the analytical results according to the reporting scheme and timetable (latest submission of results on 9 September 2016). Please tick the boxes:

Standard solution								
OCP ☐	PCB_6 ☐	PCDD/PCDF ☐	dl-PCB ☐	PBDE ☐	HxBB ☐	Toxaphene ☐	HBCD ☐	PFAS ☐
Sediment								
OCP ☐	PCB_6 ☐	PCDD/PCDF ☐	dl-PCB ☐	PBDE ☐	HxBB ☐	Toxaphene ☐	HBCD ☐	PFAS ☐
Fish								
OCP ☐	PCB_6 ☐	PCDD/PCDF ☐	dl-PCB ☐	PBDE ☐	HxBB ☐	Toxaphene ☐	HBCD ☐	PFAS ☐
Human milk								
OCP ☐	PCB_6 ☐	PCDD/PCDF ☐	dl-PCB ☐	PBDE ☐	HxBB ☐	Toxaphene ☐	HBCD ☐	PFAS ☐
Air extract								
OCP ☐	PCB_6 ☐	PCDD/PCDF ☐	dl-PCB ☐	PBDE ☐	HxBB ☐	Toxaphene ☐	HBCD ☐	PFAS ☐
Human blood								
PFOS ☐	PFAS ☐							
Water								
PFOS ☐								

Analytes

- OCPs: Organochlorine pesticides: All pesticides listed in annexes of the Stockholm Convention until 2013, except toxaphene
- PCB_6: Six indicator PCB (28, 52, 101, 138, 153, 180)
- PCDD/PCDF: 17 congeners of 2,3,7,8-substituted polychlorinated dibenzo-*p*-dioxins and dibenzofurans
- dl-PCB: 12 congeners of polychlorinated biphenyls that have assigned a TEF by WHO (77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, 189)
- PBDE: 8 congeners of polybrominated diphenyl ethers (17, 28, 47, 99, 100, 153, 154, 183) and PBB-153
- HxBB: Congener PBB-153
- HBCD: 3 stereoisomers of hexabromocyclododecane (α-, β-, γ-)
- Toxaphene: 3 Parlar congeners (26, 50, 62)
- PFAS: Linear and branched PFOS (L-PFOS, P6MHpS), FOSA, precursor FOSAs (MeFOSA, EtFOSA) and FOSEs (MeFOSE, EtFOSE) as well as PFAS acids and sulphonates (PFBA, PFPeA, PFHxA, PFHpA, PFNA, PFDA, L-PFBS, L-PFHxS)

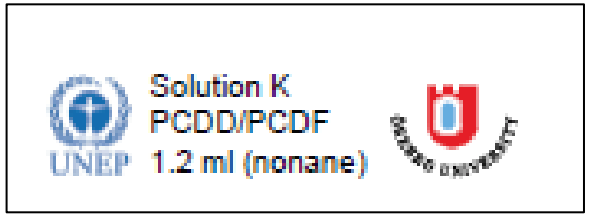
Test solutions of analytical standards

- ***PCDD/PCDF Solution K*** consists of a mixture of 17 2,3,7,8-substituted PCDD/PCDF congeners in nonane (10 ng/g-400 ng/g)
- ***dl-PCB Solution L*** consists of a mixture of twelve dl-PCB in nonane (20 ng/g-500 ng/g)
- ***PBDE Solution M*** *c*onsists of a mixture of eight polybrominated diphenyl ethers (PBDE) in nonane (50 ng/g-500 ng/g) (also contains PBB-153)
- ***PFAS Solution N*** consists of a mixture of per- and polyfluoroalkyl substances (PFOS, PFCAs, PFASs, FOSAs, FOSEs) in methanol (10 ng/g-500 ng/g)
- ***HBCD Solution O*** consists of a mixture of the α-, β-, and γ-isomers in toluene (100 ng/g-1000 ng/g)
- ***OCP Solution P*** consists of a mixture of organochlorine pesticides (OCPs) in iso-octane (1 ng/g-500 ng/g)
- ***PCB (6) Solution Q*** consists of a mixture of the indicator PCB in iso-octane (1 ng/g-10 ng/g)
- ***Toxaphene Solution R*** consists of a mixture of Parlar 26, 50 and 62 in iso-octane (1 ng/g- 100 ng/g)
- ***HxBB Solution S*** consists of a solution of PBB 153 in iso-octane (conc. range 1 ng/g-10 ng/g).

Naturally contaminated test samples

- *Sediment Sample:* dried sediment originating from the Elbe river. Results for **all POPs;**
- *Fish Sample:* a crab originating from the Netherlands. Results for **all POPs;**
- *Human Milk Sample:* pooled human milk sample from a milk bank in Sweden. Results for **all POPs;**
- *Human Plasma Sample:* pooled human blood plasma of individuals in Sweden. Results for **per- and polyfluoroalkyl substances including PFOS and FOSA.**
- *Air Extract for Organochlorine and Organobromine POPs Analyses - Air (TOL):* an extract from PUFs and glassfiber filters in active samplers taken in Barcelona, Spain, in toluene (fortified). Results for **lipophilic POPs**.
- *Air Extract for PFOS and Precursor Analyses – Air (MeOH): ibid* in methanol (fortified). Results for **L- and br-PFOS, FOSA, N-ethyl- and N-methyl –FOSAs and -FOSEs.**
- *Water Sample:* combined surface water sample from different locations in The Netherlands. Results for **PFOS (L- and branched)** only.

Test sample (preparation) and shipment



Instructions for reporting (and assessment)

- Reporting results (in an MsExcel file):
  - Limit of detection (LOD) reported as a "<" with the value of the LOD for this compound;
  - Always enter a number and not "ND";
  - For compound/congener not analysed enter "NA"
- For POPs that consist of more than one compound/congener, the sum of these congeners has to be reported. Reporting is for
  - **Lower-bound (LB)** values are defined by summation where results below LOD are calculated as **zero;**
  - **Upper-bound (UB)** values are calculated by including the value of the LOD;
  - UB and LB values will be assigned z-scores when all congeners/compounds are analysed.

Reported results

- Laboratories were provided with MsExcel file to report their results according to POP and test sample;
- In addition, reporting sheets were created to inform about analytical techniques;
- All individual data files were compiled into one database (by VU Amsterdam);
- This database was sent to the laboratories to check their information – and correct when editorial issues did arise;
- Preliminary assessment done: 116 laboratories were informed that ”errors” were noted;
- Most of them reported corrected results back;
- These data were put into statistical evaluation (→ Ike van der Veen presentation).

Commonly made errors (1)

Indicator PCB	
PCB 28	9.7
PCB 52	5
PCB 101	2.5
PCB 138	4.5
PCB 153	8.4
PCB 180	12
Sum Indicator PCB LB (ND=0)	42.1
Sum Indicator PCB UB (ND=LOD)	42.1
Sum Indicator PCB Lower Bound (ND=0)	**65**
Sum Indicator PCB Upper Bound (ND=LOD)	**65**

HCHs		
a-HCH	13425.98772	28.52
b -HCH	298.9200007	17.72
g-HCH	1086.814388	39.32
sum HCHs LB (ND=0)	**14811.72211**	**85.56**
sum HCHs UB (ND=LOD)	**14811.72211**	**85.56**
Sum HCHs Lower Bound (ND=0)		NA
Sum HCHs Upper Bound (ND=LOD)	14811.72211	85.56

a-HBCD	2.12003
b-HBCD	<0.061
g-HBCD	<0.060

Sum HBCD Lower Bound (ND=0)	**2.24**
Sum HBCD Upper Bound (ND=LOD)	**2.42**

- Errors with summation
- LB and UB not understood (definition)
- LB and UB handled erraneously

Lab reported

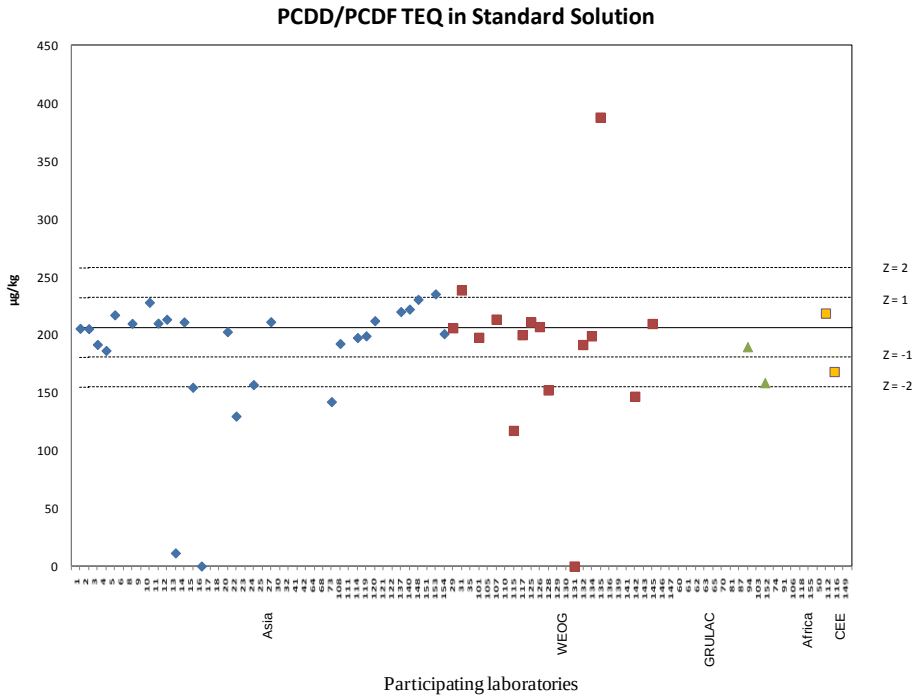
PCDD		
2,3,7,8-TeCDD	2.2554	2.29
1,2,3,7,8-PnCDD	1.6073	5.13
1,2,3,4,7,8-HxCDD	1.6667	4.56
1,2,3,6,7,8-HxCDD	3.4344	7.52
1,2,3,7,8,9-HxCDD	3.1544	<6.01
1,2,3,4,6,7,8-HpCDD	52.5983	64.018
OCDD	415.7885	534.69
PCDF		
2,3,7,8-TeCDF	13.219	16.52
1,2,3,7,8-PnCDF	13.5284	20.35
2,3,4,7,8-PnCDF	5.9476	11.32
1,2,3,4,7,8-HxCDF	30.947	30.61
1,2,3,6,7,8-HxCDF	21.7666	24.44
1,2,3,7,8,9-HxCDF	11.234	13.32
2,3,4,6,7,8-HxCDF	14.2227	6.78
1,2,3,4,6,7,8-HpCDF	112.4594	103.54
1,2,3,4,7,8,9-HpCDF	41.6747	38.98
OCDF	382.0156	422.81
WHO2005-TEQ($_{PCDD/PCDF}$) LB	**18.32**	**24.15**
WHO2005-TEQ(PCDD/PCDF) UB	**18.32**	**24.15**
WHO2005-TEQ (PCDD/PCDF) Lower	20.11	0.0242
WHO2005-TEQ (PCDD/PCDF) Upper	20.11	0.0262

dl-POPs:

- TEF scheme mathematically not understood
- Wrong TEF scheme

dl-PCB		
PCB 77	<1	158
PCB 81	<10	37
PCB 126	<10	57.8
PCB 169	<10	46.3
PCB 105	27000	2750
PCB 114	<10	89.6
PCB 118	<10	6320
PCB 123	<10	148
PCB 156	<10	513
PCB 157	<10	173
PCB 167	<10	232
PCB 189	<10	43.7
WHO2005-TEQ($_{PCB}$) (LB)	**0.81**	**7.50**
WHO2005-TEQ($_{PCB}$) UB	**2.12**	**7.50**
WHO2005-TEQ (dl-PCB) Lower Boun	27000	6.1
WHO2005-TEQ (dl-PCB) Upper Bour	27101	6.1

Assessment according to ISO 17043



$$\text{z-score} = \frac{\text{Mean from Laboratory} - \text{Assigned Value}}{\text{Total Error}}$$

z = 12.5%

Results of concentrations per analyte and matrix presented;

⇒ More than 10,000 z-scores generated

z-scores can be interpreted as follows:

$\|z\| < 2$	Satisfactory performance	S
$2 < \|z\| < 3$	Questionable performance	Q
$\|z\| > 3$	Unsatisfactory performance	U

Particpation degree per matrix and POP group

POP group	Test solutions	Sediment	Fish	Human milk	Human plasma	Air extract	Water
OCP	128	**136**	**106**	**115**	**26**	89	**44**
PCB	126						
PCDD/PCDF	66						
dl-PCB	73						
PBDE	70						
HxBB	37						
Toxaphene	36						
HBCD	34						
PFAS	41					19	
Total	**611**					**108**	

In total, **1146** test samples have been prepared

3rd round of interlaboratory assessments

Region	Labs registered	Labs samples received	Labs not reporting results	Labs results submitted	% Labs with results
Africa	19	18	5	14	74%
Asia	67	61	14	53	78%
CEE	23	22	7	16	70%
GRULAC	39	34	14	25	64%
WEOG	27	27	2	25	93%
Grand Total	**175**	**162**	**42**	**133**	**75%**

Registration vs. results delivery per region

Country	ISO-3	Results rec
Cameroon	CMR	-1
Egypt	EGY	1
Ethiopia	ETH	-1
Ghana	GHA	2
Kenya	KEN	1
Madagascar	MDG	-1
Morocco	MAR	1
Mali	MLI	1
Nigeria	NGA	-1
Nigeria	NGA	2
Senegal	SEN	1
Tanzania	TZA	-1
Uganda	UGA	1
South Africa	ZAF	4

No lab: DR Congo, Togo

Not present: Mauritius, Tunisia, Zambia,

Country	ISO-3	Results rec
China	CHN	-3
China	CHN	25
Fiji	FJI	1
Indonesia	IDN	1
India	IND	-2
India	IND	1
Japan	JPN	5
Kyrgyz Rep.	KGZ	3
Kuwait	KWT	1
Lebanon	LBN	-1
Lebanon	LBN	1
Sri Lanka	LKA	1
Syria	SYR	-3
Syria	SYR	3
Thailand	THA	3
Vietnam	VNM	-5
Vietnam	VNM	8

Country	ISO-3	Results rec
Albania	ALB	-2
Croatia	HRV	6
Czech Rep	CZE	1
Estonia	EST	1
Georgia	GEO	-2
Moldova, Rep of	MDA	1
Montenegro	MNE	1
Poland	POL	1
Russia	RUS	-3
Russia	RUS	3
Serbia	SRB	2

No lab: Lao PDR

Not present: Cambodia, Mongolia, Philippines

Countries displayed in bold participate in the UNEP/GEF GMP2 projects

Registration vs. results delivery per region

Country	ISO-3	**Results rec**
Antigua and Barbuda	ATG	1
Argentina	ARG	3
Bolivia	BOL	-4
Bolivia	BOL	1
Brazil	BRA	4
Chile	CHL	2
Chile	CHL	1
Colombia	COL	-3
Colombia	COL	5
Costa Rica	CRI	1
Cuba	CUB	-1
Ecuador	ECU	2
Jamaica	JAM	-1
Mexico	MEX	-2
Mexico	MEX	1
Peru	PER	1
Suriname	SUR	1
Uruguay	URY	-2
Uruguay	URY	3

Not present:
Barbados

Country	ISO-3	**Results rec**
Australia	AUS	1
Austria	AUT	1
Canada	CAN	6
Denmark	DNK	-1
Denmark	DNK	1
Finland	FIN	1
France	FRA	1
Germany	DEU	3
Italy	ITA	1
Netherlands	NLD	1
Norway	NOR	2
Portugal	PRT	1
Spain	ESP	3
Sweden	SWE	2
USA	USA	1
United Kingdom	GBR	-1

Countries displayed in bold participate in the UNEP/GEF GMP2 projects

Summary: registration vs. participation

	Unit	Africa	Asia	CEE	GRULAC	WEOG	Subtotal
Countries* registered	#	13	12	10	14	15	64
Countries* delivering results	#	9	12	8	12	13	54
Countries* not delivering results	#	5	0	2	2	2	11
Labs registered	#	19	67	23	39	27	175
Labs delivering results	#	14	53	16	25	25	133
Labs not delivering results	#	5	14	7	14	2	42
"Value" of samples	USD	61,800	207,800	50,500	87,300	89,300	496,700
"Value" of results delivered	USD	39,100	173,700	39,100	54,200	84,300	390,400
Sample value "lost"	USD	22,700	34,100	11,400	33,100	5,000	106,300
Loss per region/total	%	37%	16%	23%	38%	6%	21%

* Hongkong, SAR, included in China (CHN)

IL2016 POPs – Planned *vs*. Reported (1)

OCPs	# of Labs	# of results	% Labs	% results
Planned	133	9,397	100%	100%
Analyzed	74	2,178	56%	23%
Partially reported	63	359	47%	4%

PCB(6)	# of Labs	# of results	% Labs	% results
Planned	140	914	100%	100%
Analyzed	84	482	60%	53%
Partially reported	10	24	7%	3%

Toxaphenes	# of Labs	# of results	% Labs	% results
Planned	38	242	100%	100%
Analyzed	16	76	42%	31%
Partially reported	3	6	19%	2%

IL2016 POPs – Planned *vs*. Reported (2)

dl-POPs	# of Labs	# of results	% Labs	% results
Planned	95	1,082	100%	100%
Analyzed	64	638	67%	59%
Partially reported	4	12	4%	1%

PBDE	# of Labs	# of results	% Labs	% results
Planned	74	518	100%	100%
Analyzed	41	228	55%	44%
Partially reported	8	12	20%	2%

PFAS	# of Labs	# of results	% Labs	% results
Planned	59	648	100%	100%
Analyzed	29	227	49%	35%
Partially reported	26	65	44%	10%

IL2016 POPs – Planned *vs*. Reported (3)

HxBB	# of Labs	# of results	% Labs	% results
Planned	40	276	100%	100%
Analyzed	15	94	38%	34%
Partially reported		-		

HBCD	# of Labs	# of results	% Labs	% results
Planned	36	226	100%	100%
Analyzed	20	90	56%	40%
Partially reported		-		-

Example of results' table

Table 1: Summary results indicator PCB, test solution Q (ng/g)

Test Solution Q Analyte	n	Theore-tical conc.	AV	Median	Mean	Min	Max	Between lab CV (%)	Inclusion rate (%)
PCB 28	74	11.0	9.1	9.6	9.1	0.04	56	35	70
PCB 52	74	5.9	5.4	5.4	5.4	0.04	41	24	64
PCB 101	72	2.5	2.5	2.6	2.5	0.01	38	27	61
PCB 138	75	9.4	8.3	8.2	8.3	0.01	43	30	64
PCB 153	76	4.9	4.8	4.9	4.8	0.01	50	28	63
PCB 180	75	12.2	10.7	10.8	10.7	0.02	52	22	66
Sum Indicator PCB LB (ND = 0)	***72***	45.9	***41.5***	***41.8***	***41.5***	***0.00***	***281***	***25***	***66***
Sum Indicator PCB UB (ND = LOD)	***73***	45.9	***41.5***	***42.0***	***41.5***	***0.14***	***348***	***25***	***65***

Table 2: Summary of laboratory performance indicator PCB, test solution Q

Test Solution Q Analyte	% of the data received	% of z-scores |z|<2 Satisfactory	% of z-scores 3>|z|>2 Questionable	% of z-scores 6>|z|>3 Unsatisfactory	% of z-scores |z|>6 Extreme
PCB 28	44	51	16	21	9
PCB 52	43	59	12	14	12
PCB 101	45	56	9	12	15
PCB 138	44	56	9	22	10
PCB 153	45	56	9	15	17
PCB 180	44	65	10	12	10
Sum Indicator PCB LB (ND = 0)	***42***	***59***	***11***	***19***	***8***
Sum Indicator PCB UB (ND = LOD)	***42***	***60***	***11***	***18***	***11***

Summary of z-scores assigned

POP group	# S	Max of S	# U	Max of U	# Q	# C	# I
dl-POP	4,040	42	1,129	20	536	25	167
HBCD	96	14	23	3	6	2	0
HxBB	18	7	8	3	6	0	4
OCP	1,464	39	1,380	33	279	69	311
PBDE	691	32	173	13	78	14	30
PCB(6)	921	50	764	34	232	10	93
PFAS	461	22	89	8	64	8	8
Toxaphene	46	10	4	1	6	0	0
Grand Total	**7,737**	**50**	**3,570**	**34**	**1,207**	**128**	**613**
Total z-scores				**13,255**			

Region	# S	Z-scores assigned
Africa	198	1,054
Asia	3,659	5,884
CEE	622	1,401
GRULAC	625	1,338
WEOG	2,633	3,578
Grand Total	**7,737**	**13,255**

Summary of z-scores

z-score	#labs OCPs	% of labs	# z-scores	% of scores
S	73	91%	1464	11%
Q	58	73%	279	2%
U	76	95%	1380	10%
C	24	30%	69	1%
I	42	53%	311	2%
All	80		3503	26%

z-score	#labs PCB(6)	% of labs	# z-scores	% of scores
S	81	90%	921	7%
Q	63	70%	232	2%
U	83	92%	764	6%
C	7	8%	10	0%
I	18	20%	93	1%
All	90		2020	15%

z-score	#labs dl-POPs	% of labs	# z-scores	% of scores
S	65	98%	4040	30%
Q	58	88%	536	4%
U	60	91%	1129	9%
C	14	21%	25	0%
I	25	38%	167	1%
All	66		5897	44%

z-score	#labs PBDE	% of labs	# z-scores	% of scores
S	42	95%	691	5%
Q	31	70%	78	1%
U	31	70%	173	1%
C	10	23%	14	0%
I	9	20%	30	0%
All	44		986	7%

z-score	#labs HxBB	% of labs	# z-scores	% of scores
S	10	53%	18	0%
Q	5	26%	6	0%
U	6	32%	8	0%
C	0	0%	0	0%
I	3	16%	4	0%
All	19		36	0%

z-score	#labs Tox	% of labs	# z-scores	% of scores
S	11	79%	46	0%
Q	4	29%	6	0%
U	3	21%	4	0%
C	0	0%	0	0%
I	0	0%	0	0%
All	14		56	0%

z-score	#labs HBCD	% of labs	# z-scores	% of scores
S	17	100%	96	1%
Q	5	29%	6	0%
U	9	53%	23	0%
C	2	12%	2	0%
I	0	0%	0	0%
All	17		127	1%

z-score	#labs PFAS	% of labs	# z-scores	% of scores
S	28	97%	461	3%
Q	22	76%	64	0%
U	21	72%	89	1%
C	6	21%	8	0%
I	6	21%	8	0%
All	29		630	5%

Africa and Asia: Number of labs and performance

Country	Count of Labs	Sum of S	Sum of Q	Sum of U	Sum of C	Sum of I
CMR	1	0	0	0	0	0
EGY	1	56	30	105	0	0
ETH	1	0	0	0	0	0
GHA	2	4	2	77	3	73
KEN	1	22	3	54	0	7
MDG	1	0	0	0	0	0
MLI	1	9	2	36	0	0
MAR	1	4	0	21	0	0
NGA	3	12	5	160	0	10
SEN	1	18	7	21	3	4
TZA	1	0	0	0	0	0
UGA	1	6	0	74	3	35
ZAF	4	67	11	91	3	16
Africa	**19**	**198**	**60**	**639**	**12**	**145**

13 countries registered, each region

Country	Count of Labs	Sum of S	Sum of Q	Sum of U	Sum of C	Sum of I
CHN	26	2303	317	668	16	102
FJI	1	0	0	71	0	0
HKG	2	36	4	100	0	0
IDN	1	5	4	12	8	9
IND	3	8	0	7	0	4
JPN	5	**795**	**45**	**34**	6	6
KGZ	3	20	7	92	0	1
KWT	1	153	44	40	0	2
LBN	2	21	8	21	0	7
LKA	1	3	0	21	14	30
SYR	6	24	6	52	0	24
THA	3	30	6	37	1	0
VNM	13	261	85	282	4	28
Asia	**67**	**3659**	**526**	**1437**	**49**	**213**

CEE and GRULAC: number of labs and performance

10 countries registered in CEE; 14 countries registered in GRULAC

Country	Count of Labs	Sum of S	Sum of Q	Sum of U	Sum of C	Sum of I
ALB	2	0	0	0	0	0
CZE	1	129	13	2	0	1
EST	1	55	10	75	5	27
GEO	2	0	0	0	0	0
HRV	6	109	33	215	4	50
MDA	1	4	0	45	0	0
MNE	1	39	7	14	0	0
POL	1	76	8	78	0	2
RUS	6	162	25	87	0	9
SRB	2	48	21	31	2	15
CEE	**23**	**622**	**117**	**547**	**11**	**104**

Country	Count of Labs	Sum of S	Sum of Q	Sum of U	Sum of C	Sum of I
ARG	3	59	4	68	1	14
ATG	1	0	0	2	0	0
BOL	5	7	2	11	0	3
BRA	4	352	35	86	2	7
CHL	3	45	6	11	0	0
COL	8	23	3	89	2	29
CRI	1	14	13	8	3	14
CUB	1	0	0	0	0	0
ECU	2	67	13	56	4	32
JAM	1	0	0	0	0	0
MEX	3	21	6	73	2	2
PER	1	2	1	11	0	0
SUR	1	2	3	4	0	4
URY	5	33	21	65	1	2
GRULAC	**39**	**625**	**107**	**484**	**15**	**107**

WEOG: Number of labs and performance

16 countries in WEOG

Country	Count of Labs	Sum of S	Sum of Q	Sum of U	Sum of C	Sum of I
AUS	1	203	29	10	3	3
AUT	1	46	2	1	0	0
CAN	5	527	110	158	7	5
CDN	1	10	0	1	0	0
DEU	3	639	26	30	13	5
DNK	2	9	0	0	0	0
ESP	3	338	34	47	2	1
FIN	1	30	1	1	0	1
FRA	1	178	41	26	1	2
GBR	1	0	0	0	0	0
ITA	1	77	36	12	0	0
NLD	1	141	19	64	10	21
NOR	2	114	21	40	2	1
POR	1	10	18	4	2	3
SWE	2	281	56	67	1	2
USA	1	30	4	2	0	0
WEOG	**27**	**2633**	**397**	**463**	**41**	**44**

Decreasing number of satisfactory z-scores

Best labs (1)

Region	Lab#	S All	Q All	U All	C All	I All	B All	n Rep All	%S
Asia	L027	346	21	13	1	0	211	381	91%
WEOG	L117	290	11	19	8	5	259	333	87%
Asia	L190	241	29	42	3	13	264	328	73%
WEOG	L126	229	24	36	0	2	301	291	79%
Asia	L004	225	17	28	3	6	313	279	81%
WEOG	L124	225	12	11	5	0	339	253	89%
Asia	L011	215	11	41	0	0	325	267	81%
GRULAC	L072	210	19	43	2	5	313	279	75%
WEOG	L024	203	29	10	3	3	344	248	82%
WEOG	L034	203	18	18	2	0	351	241	84%
Asia	L030	194	19	14	5	6	354	238	82%
WEOG	L132	189	55	52	5	4	287	305	62%
WEOG	L101	185	7	11	2	1	386	206	90%
WEOG	L145	178	41	26	1	2	344	248	72%
Asia	L207	160	5	3	0	0	424	168	95%
Asia	L173	153	44	40	0	2	353	239	64%
Asia	L025	151	0	4	0	0	437	155	97%
Asia	L137	146	13	59	2	7	365	227	64%
WEOG	L105	141	19	64	10	21	337	255	55%
Asia	L013	140	40	74	3	28	307	285	49%
Asia	L005	138	20	36	2	8	388	204	68%
Asia	L153	133	22	38	0	0	399	193	69%
EEG	L037	129	13	2	0	1	447	145	89%
WEOG	L125	124	3	0	0	0	465	127	98%
Asia	L158	117	23	15	0	4	433	159	74%
WEOG	L128	103	19	35	2	1	432	160	64%
EEG	L113	102	9	56	0	9	416	176	58%

Region	Lab#	S abiotic	Q abiotic	U abiotic	C abiotic	I abiotic	B abiotic	n Rep abiot	%S
Asia	L027	129	8	4	0	0	84	141	91%
WEOG	L117	117	7	12	6	5	78	147	80%
GRULAC	L072	101	11	22	0	4	87	138	73%
WEOG	L132	95	21	24	2	1	82	143	66%
Asia	L190	95	9	23	0	0	98	127	75%
Asia	L004	86	8	7	0	0	124	101	85%
WEOG	L126	82	9	11	0	1	122	103	80%
Asia	L011	81	2	24	0	0	118	107	76%
WEOG	L024	80	5	5	1	0	134	91	88%
WEOG	L101	77	3	4	0	0	141	84	92%
Asia	L025	74	0	0	0	0	151	74	100%
Asia	L005	68	10	21	0	2	124	101	67%
Asia	L013	67	30	23	2	12	91	134	50%
Asia	L207	67	1	0	0	0	157	68	99%
WEOG	L125	62	1	0	0	0	162	63	98%
Asia	L173	59	26	16	0	2	122	103	57%
WEOG	L242	50	0	3	0	0	172	53	94%
Asia	L012	46	6	16	0	0	157	68	68%
WEOG	L034	45	8	8	0	0	164	61	74%
Asia	L008	44	10	30	0	0	141	84	52%
Asia	L073	44	6	34	0	0	141	84	52%
Asia	L234	44	2	0	0	0	179	46	96%
Asia	L007	42	6	8	0	0	169	56	75%
WEOG	L145	41	36	21	0	0	127	98	42%
WEOG	L139	41	2	1	0	0	181	44	93%
Asia	L022	40	17	18	0	0	150	75	53%
EEG	L037	40	9	1	0	0	175	50	80%

Decreasing number of satisfactory z-scores

Best labs (2)

Region	Lab#	S biotic	Q biotic	U biotic	C biotic	I biotic	B biotic	n rep biot	%S
WEOG	L124	124	4	5	5	0	96	138	90%
Asia	L027	122	8	7	1	0	96	138	88%
Asia	L030	110	10	9	5	6	94	140	79%
Asia	L137	100	12	16	2	7	97	137	73%
WEOG	L024	82	4	4	2	3	139	95	86%
WEOG	L145	82	5	5	1	2	139	95	86%
WEOG	L126	75	11	22	0	1	125	109	69%
Asia	L190	71	18	15	3	13	114	120	59%
WEOG	L034	68	3	7	2	0	154	80	85%
Asia	L004	67	8	20	3	6	130	104	64%
WEOG	L117	66	2	7	2	0	157	77	86%
WEOG	L101	65	4	7	2	1	155	79	82%
Asia	L207	58	4	3	0	0	169	65	89%
Asia	L153	55	14	25	0	0	140	94	59%
WEOG	L132	50	4	9	3	3	165	69	72%
Asia	L001	48	7	10	0	0	169	65	74%
GRULAC	L072	44	0	2	2	1	185	49	90%
EEG	L037	43	0	1	0	1	189	45	96%
Asia	L002	42	10	13	0	0	169	65	65%
Asia	L173	42	4	8	0	0	180	54	78%
Asia	L158	41	20	14	0	4	155	79	52%
Asia	L011	41	2	10	0	0	181	53	77%
WEOG	L105	40	3	19	7	14	151	83	48%
EEG	L175	39	2	6	0	2	185	49	80%
EEG	L113	37	2	26	0	5	164	70	53%
GRULAC	L152	28	1	5	0	0	200	34	82%
Africa	L053	27	9	36	0	0	162	72	38%

Country	Lab#	S TS	Q TS	U TS	C TS	I TS	B TS	n Rep TS	%S
WEOG	L117	107	2	0	0	0	24	109	98%
WEOG	L124	101	8	6	0	0	18	115	88%
Asia	L027	95	5	2	0	0	31	102	93%
Asia	L011	93	7	7	0	0	26	107	87%
WEOG	L034	90	7	3	0	0	33	100	90%
Asia	L025	77	0	4	0	0	52	81	95%
Asia	L190	75	2	4	0	0	52	81	93%
Asia	L013	72	10	15	0	0	36	97	74%
WEOG	L126	72	4	3	0	0	54	79	91%
Asia	L004	72	1	1	0	0	59	74	97%
WEOG	L105	69	12	7	0	0	45	88	78%
Asia	L030	67	4	1	0	0	61	72	93%
Asia	L005	66	4	11	0	1	51	82	80%
GRULAC	L072	65	8	19	0	0	41	92	71%
WEOG	L125	62	2	0	0	0	69	64	97%
Asia	L002	55	6	7	0	0	65	68	81%
WEOG	L145	55	0	0	0	0	78	55	100%
Asia	L001	53	7	8	0	0	65	68	78%
Asia	L173	52	14	16	0	0	51	82	63%
Asia	L153	52	3	0	0	0	78	55	95%
WEOG	L242	52	1	0	0	0	80	53	98%
Asia	L137	46	1	43	0	0	43	90	51%
Asia	L023	46	11	10	0	0	66	67	69%
Asia	L234	46	2	2	0	0	83	50	92%
EEG	L037	46	4	0	0	0	83	50	92%

Thank you